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# Effect of Foliar Nutrition on Productivity of Hybrid Pearl Millet

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## Abstract

A field experiment was conducted at MJRP College of Agriculture and Research Jaipur during kharif season 2023 on loamy sand soil, which consisted ten treatments of foliar nutrition ($T_1$: control, $T_2$: RDF, $T_3$: RDF + water spray, $T_4$: RDF + urea 2% spray at FI, $T_5$: RDF + DAP 2% spray at FI, $T_6$: RDF + MoP 2% spray at FI, $T_7$: 19:19:19 (NPK) 2% spray at FI, $T_8$: RDF + B chelate 0.5% spray at FI, $T_9$: RDF + Zn chelate 0.5% spray at FI, $T_{10}$: RDF + Fe chelate 0.5% spray at FI and were tested in randomized block design with three replications. Recommended dose of fertilizer for hybrid pearl millet was 60 kg N and 40 kg $P_2O_5$/ha. Results indicated that application of $T_5$: RDF + DAP 2% spray at FI, $T_6$: RDF + MOP 2% spray at FI, $T_4$: RDF + urea 2% spray at FI, $T_{10}$: RDF + Fe chelate 0.5% spray at FI, $T_9$: RDF + Zn chelate 0.5% spray at FI and $T_8$: RDF + B chelate 0.5% spray at FI remaining at par with each other and significantly increased plant height, dry matter accumulation. While, chlorophyll content was recorded in treatment $T_4$ (RDF + urea 2% spray at FI).

***Key words*: Flower initiation, Recommended dose of fertilizer, Diammonium phosphate, Muriate of potash, Nitrogen phosphorus potassium**

Pearl millet [*Pennisetum glaucum* (L.) R. Br.] is one of the most important staple food crops of majority of poor and small land holders in Asia and Africa continent. It is considered as the Principal Food grain and fodder crop among millets. India accounts for half of global millet production in the country. It is the most drought tolerant cereal grown in arid and semi-arid regions of the world and can be grown in areas where rainfall is less sufficient (200 to 600 mm year) for the cultivation of maize and sorghum. It is a fifth most important cereal crop in the world after rice, wheat, maize and sorghum. The nutrient of pearl millet grain is very well comparable with other cereals and millets. Nutritional value of pearl millet is better than wheat, rice, maize and sorghum. It is good source of energy, carbohydrate 67%, fat (5%), ash, dietary fibre (11.49 g/100 g), protein (11.6%), antioxidant such as coumaric acids with better digestibility. Pearl millet has higher contents of nutrients such as iron, zinc, calcium, magnesium, copper, manganese, phosphorus, folic acid and riboflavin. Cultivation of pearl millet is mainly confined to semi-arid and arid region of India. In India, pearl millet occupies an area of 7.4 million ha with an average production of 9.13 million tonnes and productivity of 1237 kg/ha [1]. Pearl millet is generally grown in light or shallow depth of soil which has less moisture condition hence fertilizer application through soil is not much effective as compare with foliar application or spraying. Foliar spraying of nutrient gives better growth and yield. Pearl millet absorb nutrient through cuticle, which has fast result. The trends in area, production and productivity of pearl millet suggest that area has increased marginally 2% during last 2 years and productivity has gone up by 19% [2]. Normally pearl millet is grown under rainfed conditions and can fit into any of the cropping systems due to its shorter duration. Because of its high nutritive value, its demand has been increased in the recent years.

Nitrogen is deficient in most of the Indian soils particularly the light textured ones which is one of the basic plant nutrients. It is involved in the formation of proteins, nucleic acids, growth hormones and vitamins and is an integral part of chlorophyll. An adequate supply of nitrogen is associated with vigorous vegetative growth and dark green colour. Phosphorus is known to stimulate extensive root system, thereby, enabling the plant to extract moisture and mineral nutrients optimally. Phosphorus plays a vital role in increasing crop yield because it improves crop quality. It also plays a key role in formation of energy rich phosphate bonds like adenosine triphosphate (ATP), phospholipids and major part of nucleus of the cells where, it is involved in organization of cell and transfer hereditary characteristics. Iron is an essential micro nutrient for all living organisms and it plays critical role in metabolic processes such as DNA synthesis, respiration photosynthesis. In plants, iron is involved in the synthesis of chlorophyll and it is essential for the maintenance of chloroplast structure and function. Zinc is one of the eight essential micronutrients. It is needed by plants in smaller amounts, but yet crucial to plant development. In plant, Zinc is a key constituent of many enzymes and proteins. It plays an important role in a wide range of processes, such as growth hormone production and internode elongation. In India, Zn is one of the multi-nutrient deficiencies causing poor crop yields. Zinc deficiency in Indian soils is expected to increase from 42% in 1970 to 63% by 2025 due to continuous depletion of soil fertility [3].

Foliar spraying of N, P and K fertilizers was more effective and had positive effect in improving yield of the crop

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[4]. Indian soils are deficient in zinc which causes disturbance in photosynthesis and nitrogen metabolism of plants. Iron is an important constituent of cytochromes, ferredoxin, catalase, peroxidase, ferrochrome and also for chlorophyll synthesis in plants. Foliar supplementation of zinc and iron had improved the grain quality, yield and higher economic production [5]. Boron is now a days becoming a deficient micronutrient boron in plants. It is the most widespread micronutrient deficiency around the world and causes large losses in crop production and crop quality. Boron deficiency affects vegetative and reproductive growth of plants, resulting in inhibition of cell expansion, death of the meristem, and reduced fertility. Plants contain boron both in a water-soluble and insoluble form.

It has been found that maximum values of dry matter accumulation, leaf area index and chlorophyll content with recommended dose of NPK (120 kg N, 60 kg $P_2O_5$ and 60 kg $K_2O$ /ha) Nehra *et al*. [6]. Application of 100% recommended dose of NPK fertilizer (80:40:0 kg/ha) produced taller plants and more number of tillers in oat as observed by Jayanti *et al*. [7]. Similarly, Singh and Pareek [8] reported that application of 30 kg $P_2O_5$ / ha along with a uniform basal dose of 25 kg N/ha significantly increased plant height, branches per plant, number of nodules and nodule weight per plant over 15 kg $P_2O_5$/ ha and control mung bean. Jakhar [9] conducted a pot experiment on fenugreek in green house and reported that increasing levels of zinc (0, 10 and 20 mg / kg) significantly increased the plant height, number of pods per plant, number of seeds per pod, test weight, seed and straw yield of fenugreek. It is also observed that foliar spray of 2% DAP on green gram at 30 DAS significantly increased the plant height and dry weight of plants over the control Dixit and Elamathi [10]. Ravi *et al*. [11] found that combined foliar application of iron 0.5% + zinc 0.5% at 30 and 60 DAS in safflower recorded significantly higher growth parameters like plant height, number of leaves, primary and secondary branches/ plant and dry matter accumulation as compared to control. Tiwari and Kumar [12] reported that application of 60 kg $P_2O_5$/ha in green gram along with recommended dose (20 kg N and 20 kg $K_2O_5$/ha) resulted in increased number of nodules per plant. Choudhary *et al*. [13] reported that foliar application of zinc sulphate @ 0.5% at star bud stage + borax spray @ 0.20% at ray floret initiation stage in sunflower recorded significantly higher filled seeds/head (594.56), lower % chaffiness (6.33) and seed yield (53.80 g/plant) as compared to other treatments. Choudhary and Yadav [14] carried out a field study on loamy sand at Jobner (Rajasthan) and reported that application of 20 kg N + 40 kg $P_2O_5$/ha to cowpea produced significantly higher dry matter per metre row length, number of branches per plant, plant height, total chlorophyll content and number and weight of root nodules per plant over lower doses of nitrogen and phosphorus. Shakoor *et al*. [15] conducted a field experiment with the objective to optimize methods of B and Zn application in maize and found that foliar application of Zn and B produced more plant height, cob length and stem girth compared to soil application. Roy and Singh [16] reported the grain yield of wheat was found to increase significantly with successive increase in fertilizer level up to 180 kg N/ha and recommended fertilizer N + P + $ZnSO_4$ @ 120: 26 + 25 kg/ha). Sammauria and Yadav [17] reported that application of 5.0 kg Zn/ha as basal dose significantly increased number of pods per plant, seed, straw and biological yield, whereas, branches per plant increased up to the level of Zn @ 7.5 kg /ha and seeds per pod and test weight only up to 2.5 kg Zn/ha level. Guru Prasad *et al*. [18] revealed that 0.5% foliar spray of iron sulphate at 30 and 45 DAS and application of 25 kg iron sulphate at sowing registered significantly higher Fe and Zn uptake in groundnut crop. Rathore *et al*. [19] reported that progressive increase in level of phosphorus up to 40 kg/ha significantly increased the uptake of N, P and K by urd bean over preceding levels. Bhadauria *et al*. [20] also reported that soil application of zinc @ 10 kg/ha recorded significantly higher iron, manganese, copper and zinc uptake as compared to control in oilseed crops. Puniya *et al*. [21] reported that the application of phosphorus at 40 kg $P_2O_5$/ha significantly increased protein content in seed, phosphorus and zinc content in seed and straw and nitrogen, phosphorus and zinc uptake by moth bean over preceding levels.

## MATERIALS AND METHODS

*Experimental site and climate conditions*

This experiment was conducted at Agronomy Farm, MJRP College of Agriculture and Research Jaipur (Rajasthan) on field kharif, 2023. The climate of this region is a typically semi-arid, characterized by extremes of temperature during both summers and winters. During summers, the temperature may go as high as 43°C, while in winters, it may fall as low as-1.0 °C. The crop was irrigated from storage tank of the college which receives water from tala mode village.

*Experimental treatments*

The field experiment comprised of 10 treatments involving control, RDF, RDF+ Water spray, RDF + Urea 2% spray at FI, RDF + DAP 2% spray at FI, RDF+ MOP 2% spray at FI, 19:19:19 (N:P:K) 2% spray at FI, RDF+ B chelate 0.5% spray at FI, RDF + zinc chelates, 0.5% spray at FI, RDF + Iron chelate 0.5% spray at FI. The experiment was laid out in randomized block design with four replications.

The treatments were randomly allotted to different plots, using random number table of Fisher and Yates [22]. Varietal characteristics Hybrid 'RHB-173' was released from Agricultural Research Station, Durgapura (Jaipur). It is a medium maturity (78-80 days) hybrid and attains a height of about 190- 210 cm with 2-3 tillers. It has medium thick and long cylindrical head. This hybrid is medium in flowering (50 days). It has long ear heads (26-32 cm) with grain weight of 35 g/ear. The average yield of variety is 25- 30 q/ha under normal sowing and moderate level of management.

In treatment RDF through fertilizer, half dose of nitrogen and full dose of phosphatic fertilizers was drilled as per plan through urea and DAP at the time of sowing and remaining half dose of N was applied as top dressing in split by urea. The recommended dose of fertilizer is 60:40:0. The foliar spray were done at flowering initiation as per treatments. Seeds of the hybrid bajra variety, RHB-173 were sown on 13th July, 2023 an optimum plant population is essential for crop production which may be achieved by using proper seed rate. Healthy and good quality certified seeds were used and sown by 'Kera' method using a seed rate of 4 kg/ha.

The harvesting was done manually with the help of sickle on 4-10-2023 when the crop attained physiological maturity. The produce of each net plot was tied into bundles, dully labeled and allowed to sun drying for 3-4 day in respective plots. The weight of bundles was recorded from each plot by using balance. Then the bundle to each plot was transported to threshing yard and then store house. Threshing of the bundles of each plot was done separately by beating with wooden sticks, then seeds/grains were cleaned by using hand fan (Supa) manually. The weight of clean seeds obtained from each net plot was recorded. The straw yield was obtained by subtraction of grain yield from total biological yield (grain + straw).and converted into qh/ha.

In order to evaluate the effect of different treatments on growth, yield and quality of crop, necessary periodical observations were recorded. Plant stand per meter row length was counted at 20 DAS and at harvest from five randomly selected spots in each plot and average was worked out. Five plants were selected randomly from each plot, tagged permanently and used for measurement of plant height. The height of each tagged plant was measured periodically at 25, 50 DAS and at harvest stage from base of the plant to the tip of the main shoot by meter scale and average of five was computed as mean plant height. The mean plant height (cm) at each growth stage was recorded as plant height (cm) at respective stages. Dry matter production was recorded at 25, 50 DAS and at harvest stages. For this, plants from one meter row length were uprooted randomly from sample rows of each plot. Plants were oven dried and their weight was recorded with the help of electronic balance.

Total chlorophyll was determined with known volume of plant leaf extract by calorimetrically using acetone at wavelength 642 mm and 660 mm described by Arnon [23].

$$\text{Total chlorophyll (mg/g)} = \frac{A_{(652)} \times 29 \times \text{Total volume (ml)}}{l \times 100 \times \text{Weight of sample (g)}}$$

Where, $l$ = is the path length = 1cm

A meter scale was placed in each plot randomly at five spots and total tillers were counted at harvest and average was worked out. A meter scale was placed at five different rows marked randomly in each plot before harvesting. The tillers bearing ear heads were counted and their average was taken as effective tillers per meter row length. The length of ear head was measured from the base to the tip of the ear head on main tiller at harvest from the randomly selected five plants. Five ears were taken from selected plants. After drying, these ears were threshed separately and their number of grains were recorded and the average number of grains/ears was computed. The total biomass harvested from each net plot was threshed, winnowed and dried. Grains thus obtained were weighed separately in kg per plot and then converted into q/ha. Stover yield was obtained by subtracting the grain yield from the total biological yield of the respective net plot and was expressed as kg/ha and then converted into q/ha. The weight of thoroughly sun-dried harvested produce of each net plot was recorded separately before threshing as biological yield in kg per plot and then converted into q/ha.

Samples of grain and stover collected at the time of harvesting were first oven dried and then ground by electrical grinder and analyzed for their nitrogen, phosphorus and potassium concentrations. Nitrogen content in seed and straw was estimated by colorimetric method [24]. Plant samples were digested in sulphuric acid and treated with hydrogen peroxide to remove black colour. Nesselor's reagent was used to develop colour. The results so obtained were expressed as percent nitrogen concentration. Phosphorus concentration in seed and straw was determined by 'vanadomolybdo phosphoric acid (yellow colour) method' using triacid mixture for digestion. Potassium concentration Potassium concentration in seed and stover was determined by 'Flame photometer' method [25]. Boron, zinc and iron concentration B, Zn, and Fe content (ppm) in both grain and stover was estimated by Atomic Absorption Spectrophotometer [26]. Nutrient uptake the total uptake of nitrogen, phosphorus, potassium, boron, iron, or zinc at harvest was calculated by multiplying its percent concentration with dry matter Nutrient uptake = Nutrient content x yield (Kg/ha). Protein content 100 The protein content of grain was obtained by multiplying the nitrogen concentration in seed (%) by the factor of 6.25 [27].

*Statistical analysis*

The observations recorded for growth, yield and quality characters were subjected to statistical analysis in accordance with the 'Analysis of variance' technique as suggested by Fisher [28] for randomized block design. Appropriate standard error for each of the factor was worked out. Significance of differences among treatment effects was tested by 'F' test. Critical difference (CD) was worked out wherever the difference was found significant at 5 or 1 per cent level of significance. To elucidate the nature and the magnitude of effects, treatment summary tables along with $SEm^{+}$ and CD were prepared and given in the text of chapter "Experimental Results" and their analyses of variance in the appendices at the end. To assess the relationship, correlation and regressions coefficients between grain yield of pearl millet (Y) and the independent variables (X) such as dry mater accumulation and yield attributes were worked out using the method given by Snedecor and Cochran [29]. The regression equations were also fitted and tested for significance. The Economics of the treatments is the prime and important consideration before making any recommendation to the farmers for its adoption. The economics of various treatments was computed separately by taking into account the existing price of inputs and produce. The investment for fertilizers, labour and power for performing different operations such as ploughing, wedding, irrigation harvesting, threshing, winnowing etc. The cost of cultivation was taken into account for calculating economics of treatments and expressed as benefit cost ration (B:C).

## RESULT AND DISCUSSION

Stage wise data pertaining to the behavior of various treatments on growth, yield and quality parameters of hybrid pearl-millet were subjected to statistical analysis in order to test the significance of the results. The analysis of variance for various components are given in appendices and also illustrated graphically to provide better understanding of important trends, wherever necessary.

*Growth attributes*

*Plant height*

The data on plant height of pearl millet as influenced by foliar nutrition significantly increased that are presented in (Table 1). The plant height of pearl millet at 25, 50 DAS and at harvest stage was varies from 55.23 to 76.25 cm, 94.00 to 141.23 cm and 149.60 to 200.13 cm, respectively. Application of $T_5$ (RDF + DAP 2% spray at FI) recorded the maximum plant height (76.25, 141.23 and 200.13 cm) at 25, 50 DAS and at harvest. This treatment recorded significantly higher plant height as compared to $T_3$ (67.93, 124.33 and 185.33 cm) (RDF + water spray), $T_2$ (67.73, 122.23 and 182.33 cm) (RDF), $T_7$ (67.33, 122.53 and 183.33 cm) (19:19:19 (NPK) 2% spray at FI) and $T_1$ (55.23, 94.00 and 149.60 cm) (control) at 25, 50 DAS and at harvest, respectively. Application of $T_5$ (76.25, 141.23 and 200.13 cm) (RDF + DAP 2% spray at FI), remained at par with $T_6$ (76.23, 138.23 and 197.23 cm) (RDF + MoP 2% spray), $T_{10}$ (74.43, 131.53 and 194.43 cm) (RDF + Fe chelate 0.5% spray), $T_4$ (72.53, 135.33 and 192.23 cm) (RDF + urea 2% spray), $T_9$ (72.23, 129.13 and 189.43 cm) (RDF + Zn chelate 0.5% spray) and $T_8$ (69.43, 126.13, 186.43 cm) (RDF + B chelate 0.5% spray) at 25, 50 DAS and at harvest stage application of RDF + DAP 2% spray recorded an increase of

38.02, 31.32 and 34.76 per cent, 50.24, 47.05 and 39.12% and 33.77, 31.83 and 29.96% respectively, over control. The study clearly demonstrates that foliar nutrition significantly influences the plant height of pearl millet at various growth stages. Among the treatments, the application of RDF combined with a 2% DAP spray at flowering initiation ($T_5$) resulted in the highest plant height across all stages 25 DAS, 50 DAS, and at harvest. $T_5$ significantly outperformed the control and other treatments, recording up to 38.02%, 50.24%, and 33.77% increases in plant height at respective stages over the control. These findings highlight the effectiveness of foliar DAP application in enhancing the vegetative growth of pearl millet.

Table 1 Effect of foliar nutrition on plant height at 25, 50 DAS and at harvest of pearl millet

| Treatments | Plant height (cm) | | |
|---|---|---|---|
| | 25 DAS | 50 DAS | At harvest |
| $T_1$: Control | 55.23 | 94.00 | 149.60 |
| $T_2$: RDF | 67.73 | 122.23 | 182.33 |
| $T_3$: RDF + Water spray at FI | 67.93 | 124.33 | 185.33 |
| $T_4$: RDF + Urea 2% spray at FI | 72.53 | 135.33 | 192.23 |
| $T_5$: RDF + DAP 2% spray at FI | 76.25 | 141.23 | 200.13 |
| $T_6$: RDF + MoP 2% spray at FI | 76.23 | 138.23 | 197.23 |
| $T_7$: 19:19:19 (NPK) 2% spray at FI | 67.33 | 122.53 | 183.33 |
| $T_8$: RDF + B chelate 0.5% spray at FI | 69.43 | 125.13 | 186.43 |
| $T_9$: RDF + Zn chelate 0.5% spray at FI | 72.23 | 129.13 | 189.43 |
| $T_{10}$: RDF + Fe chelate 0.5% spray at FI | 74.43 | 131.53 | 194.43 |
| Sem ± | 2.05 | 3.67 | 4.55 |
| CD (P = 0.05) | 6.08 | 10.91 | 16.17 |

*Dry matter accumulation*

It is clear from data (Table 2) that application of foliar nutrient significantly increased the dry matter production of pearl millet. At 25, 50 DAS and at harvest, the maximum dry matter accumulation was recorded under treatment $T_5$ (132.43, 182.13 and 306.83 g) (RDF + DAP 2% spray at FI),it was remained at par with $T_6$ (132.33, 176.93 and 300.23 g) (RDF + MoP 2% spray at FI), $T_4$ (127.73, 174.23 and 298.13 g) (RDF + urea 2% spray at FI) and indicated a significant increase of 46.44, 46.33 and 41.24% over control. While, application of RDF + DAP 2% spray, RDF + MoP 2% spray, RDF + urea 2% spray, RDF + Fe chelate 0.5% spray at being at par with each other produced significantly higher dry matter production at all stages and indicated a significant increase of 41.81, 37.78, 35.66 and 33.94 percent at 50 DAS and 29.50, 26.71, 25.83 and 23.42 percent at harvest stage, respectively, over control.

Table 2 Effect of foliar nutrition on dry matter accumulation of pearl millet

| Treatments | Dry matter accumulation (g/plant) | | |
|---|---|---|---|
| | 25 DAS | 50 DAS | At harvest |
| $T_1$: Control | 90.43 | 128.43 | 236.93 |
| $T_2$: RDF | 122.33 | 162.13 | 282.13 |
| $T_3$: RDF + Water spray at FI | 111.83 | 164.83 | 281.13 |
| $T_4$: RDF + Urea 2% spray at FI | 127.73 | 174.23 | 298.13 |
| $T_5$: RDF + DAP 2% spray at FI | 132.43 | 182.13 | 306.83 |
| $T_6$: RDF + MoP 2% spray at FI | 132.33 | 176.93 | 300.23 |
| $T_7$: 19:19:19 (NPK) 2% spray at FI | 109.43 | 152.73 | 267.63 |
| $T_8$: RDF + B chelate 0.5% spray at FI | 112.23 | 167.03 | 282.63 |
| $T_9$: RDF + Zn chelate 0.5% spray at FI | 117.63 | 169.73 | 284.43 |
| $T_{10}$: RDF + Fe chelate 0.5% spray at FI | 122.43 | 172.03 | 292.43 |
| Sem ± | 3.87 | 4.79 | 8.50 |
| CD (P = 0.05) | 11.51 | 14.22 | 25.26 |

*Chlorophyll content*

An examination of data given in (Table 1-3) revealed that foliar application of nutrition significantly increased the chlorophyll content per plant in hybrid pearl millet. Treatment $T_5$ (5.77 mg/g) (RDF + DAP 2% spray at FI) recorded significantly higher chlorophyll content at 40 DAS than control and remained at par with $T_5$ (5.76 mg/g) (RDF + DAP 2% spray), $T_6$ (4.83 mg/g) (RDF + MoP 2% spray), $T_{10}$ (4.81 mg/g) (RDF + Fe chelate 0.5% spray) and $T_9$ (4.80 mg/g) (RDF + Zn chelate 0.5% spray). Application of $T_4$ (RDF + urea 2% spray at FI), $T_5$ (RDF + DAP 2% spray), $T_6$ (RDF + MoP 2% spray) and $T_{10}$ (RDF + Fe chelate 0.5% spray) registered an increase of 37.38, 37.14, 15 and 14.52 per cent in chlorophyll content of hybrid pearl millet leaves at 40 DAS over control, respectively.

*Effect of foliar nutrition*

*Growth parameters*

Results showed that foliar applied nutrients significantly increased the growth attributes of hybrid pearl millet viz. plant height and dry matter accumulation (Table 1-2). The maximum values of these parameters were observed with $T_5$ (RDF + DAP @ 2% spray at FI) (200.13 cm and 306.86 g respectively), $T_6$ (RDF + MoP 2% spray at FI) (197.23 cm and 300.23 g, respectively), $T_4$ (RDF + urea 2% spray at FI) (192.23 cm, and 298.13 g, respectively), $T_{10}$ (RDF + Fe chelate 0.5% spray at FI) (194.43 cm and 292.43 g, respectively), $T_9$ (RDF + Zn chelate 0.5% spray at FI) (189.43 cm and 284.43 g, respectively) and $T_8$ (RDF + B chelate 0.5% spray at FI) (186.43 cm and 282.63 g respectively). However, the chlorophyll content in leaves was recorded significantly maximum in treatment $T_4$ RDF + urea 2% spray at FI (5.77 mg/g).

The highest plant height recorded might be due to the better nutrition, which played a vital role in cell division and growth of the plant. The above trend of results is in agreement with the findings of Kishor *et al.* [30] reported in sorghum where 2% urea spray was superior over other foliar treatments. These results are in conformity with Pandey and Gupta [31] and Patil *et al.* [32] in pearl millet. As reported by Chouhan *et al.* [33] and Ananthi and Parasuraman [34], higher dose of potassium and foliar supplied nutrients might be the reason that improved the pollen germination due to enhancing nutrient supply to flower parts which helped in high spikelet fertility and thus produced high number of fertile filled grains in ear head than control.

Table 3 Effect of foliar nutrition on chlorophyll content at 40 DAS of pearl millet

| Treatments | Chlorophyll content 40 DAS (mg/g) |
|---|---|
| $T_1$: Control | 4.20 |
| $T_2$: RDF | 4.78 |
| $T_3$: RDF + Water spray at FI | 4.79 |
| $T_4$: RDF + Urea 2% spray at FI | 5.76 |
| $T_5$: RDF + DAP 2% spray at FI | 5.78 |
| $T_6$: RDF + MoP 2% spray at FI | 4.83 |
| $T_7$: 19:19:19 (NPK) 2% spray at FI | 4.75 |
| $T_8$: RDF + B chelate 0.5% spray at FI | 4.78 |
| $T_9$: RDF + Zn chelate 0.5% spray at FI | 4.80 |
| $T_{10}$: RDF + Fe chelate 0.5% spray at FI | 4.81 |
| Sem ± | 0.10 |
| CD (P = 0.05) | 0.30 |

Nitrogen is the most important nutrient in all the mineral nutrients required for growth and development of plant as it is the basis of structural constituents of all living matter and also plays an important role in plant metabolism by virtue of being a constituent of many essential compounds like amino acids, proteins, nucleic acids, enzymes, coenzymes, alkaloids and a number of hormones. The results of the present study also corroborate the findings of Narayan and Joshi [35] and Chaudhari *et al.* [36] in pearl millet and Kumar *et al.* [37] in pearl millet.

Application of micronutrient (Fe, Zn and B) might have increased the availability and steady supply of micro-nutrients for plant metabolism and photosynthetic activity resulting into optimum growth and development of the crop. In addition, zinc is important in the synthesis of tryptophan, a component of some proteins and a compound needed for production of growth hormones (auxins) like IAA [38]. Such improvement under increased availability of zinc in rhizosphere might have resulted in greater uptake by the plant consequently leading to a favourable stimulatory effect on physiological and metabolic processes of pearl millet plant. These favourable influences of nutrients resulted into greater meristematic activities and apical growth, thereby improving plant height and higher value of leaf area ultimately resulting in improved LAI, chlorophyll content. The results obtained in present investigation are in line with the findings of Naveenaa *et al.* [39] and Kishor *et al.* [30] who reported that the foliar applied nutrients enhance the mobilization of photosynthates from source to sink and improved the sink accumulation capacity which resulted in increased grain weight.

## CONCLUSION

The present study clearly demonstrated that foliar application of nutrients, particularly the treatment $T_5$ (RDF + DAP 2% spray at flowering initiation), significantly enhanced the growth parameters, including plant height, dry matter accumulation, and chlorophyll content in hybrid pearl millet. Among all treatments, $T_5$ consistently recorded the highest values for these parameters across all growth stages, indicating its superior efficacy in promoting vegetative and physiological growth. Treatments such as $T_6$ (RDF + MoP 2% spray), $T_4$ (RDF + urea 2% spray), and $T_{10}$ (RDF + Fe chelate 0.5% spray) also showed statistically comparable results, reinforcing the positive impact of foliar nutrition. The enhanced plant performance can be attributed to improved nutrient availability and uptake, leading to increased photosynthetic activity, better metabolic function, and overall improved plant vigor. These findings are supported by previous studies and suggest that strategic foliar nutrient application, particularly involving DAP, MoP, and micronutrient chelates, can serve as an effective agronomic practice to maximize the growth potential and productivity of hybrid pearl millet. Further studies focusing on yield and quality parameters are recommended to validate the long-term benefits of these treatments under varied agro-climatic conditions.

## LITERATURE CITED

1. Anonymous. 2020. *Annual Reports all India Coordinated Research Project on Pearl Millet*. Jodhpur. pp 62-63.
2. Yadav MK, Singh RK, Yadav SK. 2014. Production potential and nutrient uptake of wheat as affected by organic sources of nutrients and micronutrients. *Indian Journal of Agricultural Sciences* 84(1): 58-63.
3. Singh MV. 2011. Scenario of zinc deficiency in Indian soils and its influence on zinc enrichment in crops for improving human and animal health. *In*: 3rd International Zinc Symposium: Improving Crop Production and Human Health, Hyderabad, India, October 10–14, 2011.
4. Reddy BH, Bulbule AV, Gajbhiye PN, Patil DS. 2018. Effect of foliar application of plant nutrients on growth and yield of finger millet. *International Journal of Current Microbiology and Applied Science* 7(3): 2203-2209.
5. Rani Y, Sandhya U, Triveni, Patro Tssk, Anuradha N. 2017. Effect of nutrient management on yield and quality of finger millet (*Eleusine coracana* (L.) Gaertn). *International Journal of Chemical Studies* 5(6): 1211-1216.
6. Nehra AS, Hooda IS, Singh KP. 2001. Effect of integrated nutrient management on growth and yield of wheat (*Triticum aestivum* L.). *Indian journal of Agronomy* 46: 112-117.
7. Jayanti C, Malarvizhi P, Fazullakhan AK, Chinnusamy C. 2002. Integrated nutrient management in forage oat (*Avena sativa*). *Indian Journal of Agronomy* 47(1): 130-133.

8. Singh B, Pareek RG. 2003. Effect of phosphorus and bio-fertilizers on growth and yield of mung bean. *Indian Journal of Pulses Research* 16: 31-33.
9. Jakhar RK. 2006. Effect of different RSC waters and zinc fertilization on chemical pools of soil zinc and yield of fenugreek (*Trigonella foenum graecum* L.). *M. Sc. (Ag.), Thesis*, Rajasthan Agricultural University, Bikaner, Campus-Jobner.
10. Dixit PM, Elamathi S. 2007. Effect of foliar application of DAP, micronutrients and NAA on growth and yield of green gram (*Vigna radiate* L.). *Legume Research* 30(4): 305-307.
11. Ravi S, Channal HT, Hebsur NS, Dharmatti PR. 2008. Effect of Sulphur, zinc and iron nutrition on growth, yield and nutrient uptake of safflower (*Carthamus tinctorious* L.). *Karnataka Journal of Agricultural Science* 21: 382-385.
12. Tiwari D, Kumar K. 2009. Effect of bio-fertilizer and phosphorus levels on growth, nodulation and yield of mung bean in international conference on grain legumes: Quality improvement, value addition and trade held during 14-16 February 2009 at *Indian Institute of Pulses Research*, Kanpur.
13. Choudhary AR, Prabhakara S, Nagarathna TK. 2010. Growth and yield of sunflower (*Helianthus annuus* L.) as influenced by micro nutrients application in *alfisols*. *Karnataka Journal of Agricultural Sciences* 23: 495-496.
14. Choudhary GL, Yadav LR. 2011. Effect of fertility levels and foliar nutrition on cowpea productivity. *Journal of Food Legumes* 24: 66-67.
15. Shakoor A, Saleem SA, Shaid MF, Safeer MA, Khan M, Farooq IA, Ali I, Nazir U. 2017. Dynamics of soil and foliar applied boron and zinc to improve maize productivity and profitability. *Pakistan Journal of Agricultural Research* 30(3): 294-302.
16. Roy DK, Singh BP. 2006. Effect of level and time of nitrogen application with and without vermicompost on yield, yield attributes and quality of malt barley (*Hordeum vulgare*). *Indian Journal of Agronomy* 51(1): 40-42.
17. Sammauria R, Yadav RS. 2008. Effect of phosphorus and zinc application of growth and yield of fenugreek (*Trigonella foenumgraecum)* and their residual effect on succeeding pearl millet (*Pennisetum graucum*) under irrigated conditions of north west Rajasthan. *Indian Journal of Agricultural Science* 78: 61-64.
18. Guruprasad BP, Kaligod V, Hundekar ST. 2009. Influence of methods of iron sulphate application on yield and nutrient uptake by rulling groundnut genotype in calcareous soils. *Karnataka Journal of Agricultural Science* 22: 1104-1106.
19. Rathore DS, Purohit HS, Yadav BL. 2010. Integrated phosphorus management on yield and nutrient uptake of urd bean (*Vigna mungo* L.) under rainfed condition of southern Rajasthan. *Journal of Food Legume* 23(2): 128-131.
20. Bhadauria K, Ullah MB, Singh K. 2012. Effect of micronutrient actions on yield and quality parameters of mustard. *Current Advances in Agricultural Sciences* 4: 41-48.
21. Puniya MM, Shivran AC, Khangarot SS, Kuri BR, Choudhary SP. 2014. Effect of phosphorus and zinc fertilization on productivity and nutrient uptake of moth bean. *Annals of Agricultural Research New Series* 35(1): 58-61.
22. Fisher RA, Yates F. 1963. *Statistical Tables for Biological Agricultural and Medical Research*. Oliver and Boyd, London. pp 142-143.
23. Arnon DI. 1949. Copper enzymes in isolated chloroplast I poly phenol oxidase in *Beta vulgaris. Plant Physiology* 24: 1-15.
24. Snell FD, Snell CT. 1949. Colorimetric method and analysis. Third Edition, Vol. 11. B. Van. Nostt and Co. Inc. New York. *Soil Survey Staff, 1975. Soil Taxonomy. Agriculture Hand Book No.16, USDA* 436.
25. Jackson MK. 1973. *Soil Chemical Analys*is. Prentice Hall of India Pvt. Ltd., New Delhi.
26. Lindsay WL, Norvell WA. 1978. Development of DTPA soil test for Zn, Fe, Mn and Cu. *Soil Science Society of American Journal* 42: 421-428.
27. A.O.A.C. 1960. Official methods of analysis, 18th Edition. *Association of Official Agricultural Chemists,* Washington.
28. Fisher RA. 1950. *Statistical Method for Research Workers*. Oliver and Boyd, Edinburg, London.
29. Snedecor GW, Cochran WG. 1980. *Statistical Methods*. 7th Edition. Ames, Iowa: State University. Press.
30. Kishor K, Kaushik MK, Yadav VK, Gautam P. 2016. Effect of fertility levels on yield and yield attribute of different sorghum [*Sorghum bicolor* (L.) Moench] genotypes*. Journal of Pharmacognosy and Phytochemistry* 6(4): 541-543.
31. Pandey N, Gupta B. 2012. The impact of foliar boron sprays on reproductive biology and seed quality of black gram. Plant Nutrition and Stress Physiology Laboratory, Department of Botany, University of Lucknow.
32. Patil AS, Patel HK, Chauhan NP. 2013. Yield, quality and monetary returns of summer pearl millet (*Pennisetum glaucum*) as influenced by integrated nitrogen management and sowing methods. *Crop Research* 47(1/3): 24-28.
33. Naga CS, Bhadru SR, Kumar D, Kumar A, Jaiswal A. 2018. Effect of bio-organic and potassium on yield attributes of pearl millet (*Pennisetum glaucum* (L.) R.Br. Emend Stuntz. *International Journal of Chemical Studies* 6(2): 2038-2041.
34. Ananthi K, Parasuraman P. 2019. Response of micronutrients foliar spray on leaf, leaf area, leaf area index, TDMA and yield variation in Varagu under rainfed condition. *Journal of Pharmacognosy and Phytochemistry* 2: 32-34.
35. Narayan P, Joshi NL. 2000. Nutrient management of pearl millet in arid region of Rajasthan. *Fertilizer News* 75: 35-43.
36. Chaudhari AC, Meena NL, Jat RL. 2002. Effect of nitrogen and moisture conservation practices on growth and yield of rainfed pearl millet. *Annals of Agricultural Research* 23(2): 223-225.
37. Kumar LS, Sankaran VM, Hemalatha M, Suresh S. 2020. Effect of different level of fertilizers and foliar nutrition on yield attributes and yield of pearl millet under rainfed condition. *International Journal of Chemical Studies* 8(6): 979-982.
38. Umair Hassan M, Aamer M, Umer Chattha M, Haiying T, Shahzad B, Barbanti L, Nawaz M, Rasheed A, Afzal A, Liu Y. 2020. The critical role of zinc in plants facing the drought stress. *Agriculture* 10(9): 396.
39. Naveenaa M, Amaregouda A, Meena MK, Suma TC, Kuchanur PH. 2017. Influence of foliar nutrition at different vegetative stages on growth and yield performance of maize (*Zea mays* L.). *Journal of Pharmacognosy and Phytochemistry* 5: 249-255.