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Influence of Nitrogen and Plant Growth Regulators on Growth and Yield of Zaid Finger Millet (*Eleusine coracana* L.)

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ABSTRACT

A field experiment was conducted during *Zaid* season of 2022 at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (UP) India. To study the Response of Nitrogen and plant growth regulators on growth and yield of zaid finger millet. The treatments consist of Nitrogen 40,60,80 kg/ha and plant growth regulators Salicylic acid 40ppm, Benzyl Amino Purine 50ppm, Chlormequat chloride 200 ppm. There were 10 treatments each replicated thrice. During the experiment, the soil in the experimental plot had a sandy loam texture, nearly neutral in soil reaction (pH 7.8), had a low level of organic carbon (0.35%) and had a low level of available Nitrogen (163.42 kg/ha), available Phosphorus (21.96 kg/ha) and available Potassium (256.48 kg/ha). Results revealed that the higher plant height (79.76 cm), number of tillers/plant (7.85/plant), plant dry weight (25.92g/plant), seed yield (3.25 t/ha), straw yield (4.81 t/ha) and Harvest index (40.34%) were significantly influenced with application of nitrogen 80 kg/ha + salicylic acid 40 ppm.

Keywords Finger millet, Nitrogen, Plant growth regulators, Growth parameters, Yield attributes.

INTRODUCTION

Finger millet (*Eleusine coracana* L.), commonly referred to as ragi, holds a crucial position among small millet crops cultivated in India, boasting the highest productivity among all millets. This cereal crop is also referred to as African millet and Bird's foot millet. Moreover, it plays a significant role as a staple food crop in various parts of eastern and central Africa, as well as in India (Vamshi Krishna *et al.* 2019).

The bulkiness of fibers and the slower pace of digestion cause a person to feel satisfied after consuming foods with less calories, which may assist people avoid overindulging in calories. Because of its low sugar content and delayed release of glucose and sugar into the body, ragi is therefore seen to be a suitable diet for diabetics (Lakshmi and Sumathi 2002).

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Because of its exceptional capacity to tolerate unfavorable weather conditions and thrive in marginal and poor soils, it is a crucial crop in areas that are prone to drought. Additionally, finger millet stands out as a highly nutrient-dense cereal crop, containing substantial quantities of methionine, an essential amino acid that is absent in the diets of millions of the poor who live on starchy foods (Wanyera 2007).

Most annual crops get a significant amount of nitrogen fertilizer application since it is one of the nutrients that most severely limits crop output (Huber and Thompson 2007). It is crucial for the plant system's process of creating protein building blocks. N nutrition, thus, affects quality as well as production. Applying nitrogen to finger millet has been shown to boost growth, dry matter production, and yield in dry/rainfed environments. According to research on N fertilization, applications of N ranging from 0 to 90 kg ha^{-1} resulted in greater grain yields (Bekele *et al.* 2016, Nigade *et al.* 2011).

Plant growth regulators like salicylic acid (SA) and gibberellic acid (GA_3) are identified endogenous regulator of plant metabolism, which specifically involved in biotic and abiotic stress. GA_3 work as a hormone in regulating plant growth. Which can stimulate the rapid stem and root growth and growth velocity of germination. Boric acid has significantly served as an inspiration for enhancing various growth factors such as plant height, leaf number, leaf area, and both fresh and dry weight of the haulm. Salicylic acid, known as ortho-hydroxybenzoic acid, functions as a secondary metabolite analogous to growth-regulating compounds. When applied foliarly at physiological concentrations, salicylic acid exerts a notable influence on plant growth metabolism, thus operating as one of the agents regulating plant growth. SA will increase cell metabolic rate. Naripogu and Umesha (2022).

MATERIALS AND METHODS

A field experiment was conducted during *rabi* season of 2021-22 at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (UP. India. The experimental plot was characterized by a sandy loamy soil texture, exhibiting a nearly neutral soil pH (pH 7.8), and a relatively low organic carbon content (0.35%). The applied treatments included the combination of Nitrogen 40 kg/ha+Salicylic acid 40 ppm, Nitrogen 40 kg/ha+Benzyl Aminopurine 50 ppm, Nitrogen 40 kg/ha+chloromequat chloride 200 ppm, Nitrogen 60 kg/ha+Salicylic acid 40 ppm, Nitrogen 60 kg/ha+Benzyl Aminopurine 50 ppm, Nitrogen 60 kg/ha+chloromequat chloride 200 ppm, Nitrogen 80 kg/ha+Salicylic acid 40 ppm, Nitrogen 80 kg/ha+ Benzyl Aminopurine 50 ppm, Nitrogen 80 kg/ha+ chloromequat chloride 200 ppm, control. A Randomized Block Design was employed for setting up the experiment, with 10 treatments replicated thrice. The observations were recorded for Plant height, Plant dry weight, Number of tillers/plant, Crop growth rate (g/ m^2/day), Relative growth rate (g/g/day), Test weight (g), Grain yield (kg/ha), Straw yield (kg/ha) and Harvest index (%). The data were subjected to statistical analysis by analysis of variance method (Gomez and Gomez 1976).

RESULTS AND DISCUSSION

Growth parameters

Plant height – At harvest significantly higher plant height (79.76 cm) was observed in treatment-7 (Nitrogen 80 kg/ha+ Salicylic Acid 40 ppm). However, treatment-8 (Nitrogen 80 kg+ Benzyl Amino Purine 50 ppm) was statistically at par with treatment-7 (Nitrogen 80 kg/ha+ Salicylic Acid 40 ppm). The significant increase in plant height could be attributed to the application of 80 kg/ha of nitrogen. In conjunction with the administration of plant growth regulators, the elevation in plant height facilitated by salicylic acid could potentially stem from its synergistic interplay with present endogenous auxins. This phenomenon could be discernible in the context of cell wall flexibility and cellular elongation, as documented in the case of chenna millet, thereby aligning with established findings (Datta and Nanda 1985).

Plant dry weight - During the harvest, a considerable rise in plant dry weight (26.32 g/plant) was noted in treatment-7 (Nitrogen 80 kg/ha+ Salicylic Acid 40ppm). Nevertheless, treatment-8 (Nitrogen 80kg + Benzyl Amino Purine 50 ppm) exhibited statistically similar results to treatment-7 (Nitrogen 80 kg/ha + Salicylic Acid 40 ppm). The augmentation in plant dry weight could potentially be linked to the impact of applying 80kg/ha of nitrogen. With, increase in nitrogen application, the availability of nutrients will be higher in soil and there by uptake of nutrients and it is higher at higher levels N (Gupta *et al.* 2012). Along with that seed treatment or foliar spray of salicylic acid induces reduction in sodium absorption and toxicity which is further reflected in low membrane injury, high water content and high dry matter production (El-Tayeeb 2005).

Number of tillers/plant - At the point of harvest, a notably elevated count of tillers per plant (7.85/plant) was witnessed in treatment-7 (Nitrogen 80 kg/ha + Salicylic Acid 40 ppm). In contrast, treatment-8 (Nitrogen 80 kg + Benzyl Amino Purine 50 ppm) displayed statistically similar results to treatment-7 (Nitrogen 80 kg/ha + Salicylic Acid 40ppm). This outcome is likely a consequence of the salicylic acid application Devi *et al*. (2011) reported that Salicylic acid (C7H6O3) is an endogenous growth regulator of phenolic nature, which participates in the regulation of physiological processes in plant, such as stomatal closure, ion uptake, inhibition of ethylene biosynthesis, transpiration and stress tolerance.

Crop growth rate - At 80 DAS – During the harvest period, a distinctly superior crop growth rate of 20.20 $g/m^2/day$ (Table 1) was identified in treatment-7 (Nitrogen 80kg/ha + Salicylic Acid 40 ppm). Moreover, treatment-4 (Nitrogen 60 kg/ha + Salicylic Acid 40ppm) exhibited comparable results statistically to treatment-7 (Nitrogen 80 kg/ha + Salicylic Acid 40 ppm). In contrast, treatment-7 (Sulfur 40 kg/ha + Zinc 15 kg/ha) was not found to be statistically comparable with either of the aforementioned treatments.

Yield attributes

Test weight - A notably elevated test weight of 3.26 g was evident in treatment-7 (Nitrogen 80 kg/ha + Salicylic Acid 40 ppm), showcasing its superiority over all other treatments by a margin of 9. Conversely, treatment-8 (Nitrogen 80 kg + Benzyl Amino Purine 50ppm) exhibited statistical equivalence with treatment-7 (Nitrogen 80 kg/ha + Salicylic Acid 40 ppm). The application of nitrogen stood out as the driving factor behind the observed significant increase in test weight. There are reports that, P uptake increased with progressive increase in supply of N and P_2O_5 to crops because of more availability of these nutrients and there by higher biomass roduction (Arulmozhi-selvan *et al.* 2013).

Grain yield - The significant and higher Grain yield (3.15 t/ha) (Table 2) was observed in treatment-7 (Nitrogen 80 kg/ha+ Salicylic Acid 40 ppm). Which was superior over all other treatments. However, treatment-8 (Nitrogen 80kg+ Benzyl Amino Purine 50ppm) was statistically at par with treatment-7 (Nitrogen 80kg/ha+ Salicylic Acid 40 ppm). The significant and higher grain yield was observed with

Table 1. Impact of nitrogen and plant growth regulators on growth attributes of finger millet.

Sl. No.	Treatment combinations	Plant height	Dry weight	No. of tillers/ plant	Crop growth rate
1	Nitrogen 40 kg + Salicylic acid 40 ppm	76.79	23.48	6.54	17
2	Nitrogen 40 kg + Benzyl Amino purine 50 ppm	76.3	23.09	6.37	11.24
3	Nitrogen 40 kg + Chloromequat chloride 200 ppm	75.63	22.76	6.06	8.16
4	Nitrogen 60 kg + Salicylic acid 40 ppm	78.19	24.85	6.92	19.42
5	Nitrogen 60 kg + Benzyl Amino purine 50 ppm	77.57	24.31	6.53	12.28
6	Nitrogen 60 kg + Chloromequat chloride 200 ppm	77.32	23.91	6.47	8.83
7	Nitrogen 80 kg + Salicylic acid 40 ppm	79.76	25.92	7.85	20.2
8	Nitrogen 80 kg + Benzyl Amino purine 50 ppm	79.11	25.59	7.64	13.12
9	Nitrogen 80 kg + Chloromequat chloride 200 ppm	78.51	25.11	7.44	9.73
10	Control	74.65	22.11	5.98	7.62
	F test	S	S	S	S
	SEm (±)	0.72	0.19	0.18	2.39
	CD (p=0.05)	2.16	0.58	0.53	7.1

Table 2. Impact of nitrogen and plant growth regulators on the yield attributes of finger millet.

Sl. No.	Treatment combinations	Test weight	Grain yield	Straw yield	Harvest index
1	Nitrogen 40 kg + Salicylic acid 40 ppm	2.69	2383	4423	35.01
2	Nitrogen 40 kg + Benzyl Amino purine 50 ppm	2.63	2310	4327	34.80
3	Nitrogen 40 kg + Chloromequat chloride 200 ppm	2.5 5	2220	4243	34.34
4	Nitrogen 60 kg + Salicylic acid 40 ppm	2.89	2810	4600	37.92
5	Nitrogen 60 kg + Benzyl Amino purine 50 ppm	2.79	2723	4610	37.13
6	Nitrogen 60 kg + Chloromequat chloride 200 ppm	2.75	2610	4487	36.78
7	Nitrogen 80 kg + Salicylic acid 40 ppm	3.24	3257	4817	40.34
8	Nitrogen 80 kg + Benzyl Amino purine 50 ppm	3.12	3157	4800	39.67
9	Nitrogen 80 kg + Chloromequat chloride 200 ppm	2.97	2983	4727	38.69
10	Control	2.19	1960	4077	32.47
	F test	S	S	S	S
	SEm (±)	0.03	37.58	33.31	0.41
	CD (p=0.05)	0.08	111.64	98.98	1.21

increasing uptake at higher levels of N application helps in improvement in production of photosynthates due to sufficient assimilation of nutrients which in turn results in vigoros plant growth and synthesizes carbohydrates and translocate them to the developing ear heads. This makes in better filling and more grain weight at increased levels of N application leading to increased yield attributes and grain yield and also, with the application of plant growth regulators. This effect could potentially be attributed to the augmentation of growth-related characteristics such as plant height, dry matter production, and the count of tillers per square meter. Furthermore, this enhancement could extend to yield-related factors like the number of productive tillers per square meter, ear head weight, and the uptake of nutrients by finger millet Dawood *et al.* (2012).

***Stover yield* -** The stover yield, both significantly higher and amounting to 4.8 t/ha (Table 2), was evident in treatment-7 (Nitrogen 80 kg/ha + Salicylic Acid 40 ppm). This outcome marked its superiority over all other treatments. Conversely, treatment-8 (Nitrogen 80 kg + Benzyl Amino Purine 50 ppm) displayed statistical comparability to treatment-7 (Nitrogen 80 kg/ha + Salicylic Acid 40 ppm). The application of 80 kg/ha of nitrogen was linked to the substantial and significant rise in stover yield. It is noteworthy that the application of nitrogen has consistently shown to enhance growth, dry matter production, and yield, particularly under dry or rainfed conditions. (Hari Prasanna 2016). The studies on N fertilization indicate that higher grain yield was obtained with application of N ranging from 0 to 90 kg/ha.

CONCLUSION

It was concluded that with the application of Nitrogen 80 kg/ha along with the Salicylic acid 40ppm (Treatment-7), has performs positively and improves growth and yield parameters. Maximum plant height, plant dry weight, crop growth rate, number of tillers/plants, test weight, grain yield and stover yield were also recorded with application of Nitrogen 80 kg/ha along with the salicylic acid 40 ppm (Treatment-7). These findings are based on one season therefore; further trials may be required for further confirmation.

REFERENCES

Arulmozhiselvan KM, Elayarajan, Sathya S (2013) Effect of long-term fertilization and manuring on soil fertility, yield and uptake by finger millet on inceptisol. *Madras Agric J* 100 (4-6): 490-494.

Bekele Anbessa, Getahun Dereje, Dereje Alemu (2016) Determination of optimum rates of nitrogen and phosphorus fertilization for finger millet (*Eleusine coracana* L. Gaertn) production at Assosa Zone, in Benishangul-Gumuz region of Ethiopia. Advances in Sciences and Humanitie, pp 2472-0941.

Datta KS, Nanda KK (1985) Effect of some phenolic compounds and gibberellic acid on growth and development of Cheena millet (*Panicum miliaceum*). *Ind J Pl Physiol* 28 : 298-302.

Dawood MG, Sadak MS, Hozayen M (2012) Physiological role of salicylic acid in improving performance, yield and some biochemical aspects of sunflower plant grown under newly reclaimed sandy *Soil Aust J Basic Appl Sci* 6(4): 82-89.

Devi KN, Vyas AK, Singh MS, Singh NG (2011) Effect of bioregulators on growth, yield and chemical constituents of soybean (*Glycine max*). *J Agric Sci* 3 (4): 151-159.

El-Tayeeb MA (2005) Response of barley grains to the interactive effect of salinity and salicylic acid. *Pl Growth Regul.* 45: 215-224.

Gomez KA, Gomez A A (1976) Three or more factor experiment. In: Statistical Procedure for Agricultural Research.2nd (edn), pp 139 -141.

Gupta Nidhi, Atul Gupta K, Gaur Vikram S, Kumar Anil (2012) Relationship of Nitrogen Use Efficiency with the Activities of Enzymes Involved in Nitrogen Uptake and Assimilation of Finger Millet Genotypes Grown under Different Nitrogen Inputs. The Scientific World Journal.

Hari Prasanna K (2016) Nutritional importance and cultivation aspects, Indian institute of Millets Research, Rajendranagar, Hyderabad 500030, Telangana, India. *Ind Frmg.* 65 (12) : 25-29.

Huber DM, Thompson MI (2007) Nitrogen and plant disease. In: Datnoff WH, Elmer Huber DM (eds). Mineral nutrition and plant disease St. Paul, MN: The American Phyto patho logical Society, pp 31–44.

Lakshmi Kumari, Sumathi S (2002) Effect of consumption of finger millet on hyper glycemia in noninsulin dependent diabetes mellitus (NIDDM) subjects: Plant foods for human nutrition 2002, v.57 no.3/4, pp 205-213.

Naripogu Amulya Manasa Umesha C (2022) Effect of spacing and plant growth regulators on growth and yield of finger millet (*Eleusine coracana* L.). *Int J Pl Soil Sci* 34 (13) : 106-111.

Nigade RD, Jadhav BS, Bhosale AS (2011) Response of long duration finger millet (*Eleusine coracana* L.) variety to different levels of nitrogen under rainfed condition. *Int J Agric Sci* 7(1): 152-155.

Vamshi Krishna K, Deepthi CH, Devender M, Raju PS, Pal Arunabha (2019) Effect on nitrogen and phosphorus levels on growth and yield of finger millet during summer. Agricultural Research Communication Center, pp 0367-8245.

Wanyera NMW (2007) Finger millet (*Eleusine coracana* (L.) Gaertn) in Uganda. In: Mgonja MA, .Lenne JM, Manyasa E, Sreenivasaprasad S (eds). Proceedings of the first international finger millet stake-holders workshop, projects R8030 and 8445, UK Department for international development – crop protection program held on 13th -14th September 2005 at Nairobi, pp 1-9.