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Influence of site-specific nutrient management (SSNM) on growth and yield of finger millet (*Eleusine coracana* L.) in Vertisols under irrigated condition

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Abstract
Field experiment was conducted during *rabi*/summer 2021-2022 at Agricultural Research Station, Siruguppa, Karnataka, India to study the influence of Site-Specific Nutrient Management (SSNM) in enhancing the yield of finger millet through target yield approach under irrigated condition in deep Vertisols. The experiment comprised of seven treatments allotted in randomized complete block design with five targeted yields *viz*., 30, 35, 40, 45 and 50 q ha^{-1} along with RDF and control, each replicated thrice. Application of inorganic nutrients based on soil test for all the targeted yields resulted in higher growth and yield attributes of finger millet. The treatment targeting the yield of 50 q ha^{-1} (T_7) recorded significantly higher growth characteristics like plant height, number of tillers, dry matter accumulation plant^{-1} and yield attributes like number of ear heads, length and weight of ear head, grain weight plant^{-1} and test weight. However, T_7 was on par with the treatments targeting the yield of 45 q ha^{-1} (T_6) and 40 q ha^{-1} (T_5). Significantly higher grain yield (42.99 q ha^{-1}) was registered in T_7, but it was on par with T_6 (42.46 q ha^{-1}) and T_5 (42.19 q ha^{-1}). Further, significantly lower growth and yield attributes were noticed in RDF and control.

Keywords: Site-specific nutrient management, growth, yield, *Eleusine coracana* L.

Introduction
Site-Specific Nutrient Management (SSNM), a component of precision agriculture, focuses on providing the right quantity of nutrients to cover the gap between high yielding crop nutrient requirements and nutrient availability from naturally occurring indigenous sources such as soil, crop wastes and manure. SSNM dynamically tries to adjust the fertilizer levels by monitoring all the pathways of nutrient flow and avoids indiscriminate use of fertilizers. It doesn't specifically aim to either reduce or increase fertilizer use, instead it aims to achieve high yields and high efficiency of nutrient use resulting to high cash value of produce per unit of fertilizer added.
Crop nutrient requirements for growth and yield can significantly vary among fields, seasons and years due to differences in crop growing conditions, crop and soil management practices and climate, it is crucial to evaluate soil fertility and formulate fertilizer prescriptions for sustained crop production. To maximize productivity and profit, SSNM may be used to a variety of crops and cropping seasons. It is a crucial nutrient management strategy for millets as well because they play a significant role in ensuring food and livelihood security for millions of households. It is also one of the ways to promote farm diversification, which not only boosts farmers income but also aids in long-term climate change mitigation.
Small-grained cereals known as millets are produced all over the world and are considered "crops of the future" because of their nutrient-richness and ability to thrive in a variety of agro-climatic zones. Majority of millets are produced in India and since they are so nutrient-dense, they are now referred to as "nutria-cereals". Finger millet (*Eleusine coracana* L.), which ranks third in significance among millets in India after sorghum (*Sorghum bicolor* L.) and pearl millet (*Pennisetum glaucum* L.), is one of the most important small seeded crops cultivated in low rainfall regions of the semi-arid tropics of the globe, with a yield of 1.98 million tonnes and an

average productivity of 1661 kg ha^{-1}, finger millet is grown in 1.19 million hectares in India (Sakamma *et al*., 2018) [11] with an annual production of 12.72 lakh tonnes and a production area of 7.88 lakh hectares, Karnataka is India's top finger millet producer. It is primarily grown by marginal and small farmers as both an irrigated and rainfed crop. In addition to having the highest calcium content among cereals (344 mg/100 g) and the highest potassium content (408 mg/100 g), which helps to strengthen bones, finger millet is an excellent source of nutrients, containing about 5-8% protein, 65-75% carbohydrates, and 1.3% low fat (primarily unsaturated fat). It is appropriate for diabetics and helps to maintain blood sugar levels because of its high dietary fibre content (15-20%) and low glycemic index.

Despite being a low input fertilizer crop that traditional farmers cherish, finger millet suffers from low yields in these circumstances (Rurinda *et al*. 2014) [10]. Most semi-arid soils are lacking in major and micronutrients, where finger millet is cultivated. This is mostly because of repeated cropping, lack of usage of mineral fertilizers and low rate of organic matter application (Rao *et al*., 2012) [8].

Due to the poor management and low fertility of the soil where finger millet is grown, fertilizer has a significant impact on crop yield. Because the crop's production potential is substantially greater than the state average, there is opportunity to boost the output by providing balanced nutrition. As a result, it appears that the development and promotion of SSNM is the only practical solution to the complicated soil fertility issues that have already surfaced that improves crop yield and nutrient use efficiency (Dwivedi., 2009) [1]. In light of this, the present field experiment was conducted to study the effect of SSNM on growth and yield of finger millet.

Material and Methods

A field experiment was conducted during *rabi/*summer 2021-2022 to study the effect of SSNM on growth and yield of finger millet (*Eleusine corcana* L.) under irrigated condition at Agricultural Research Station, Siruguppa, Karnataka, India. The experiment was laid out in randomized block design with seven treatments replicated three times. The treatments are

T_1: Absolute control
T_2: 100:50:50 kg $N:P_2O_5:K_2O$ ha^{-1} (RDF)
T_3: SSNM approach (Target yield of 30 q ha^{-1})
T_4: SSNM approach (Target yield of 35 q ha^{-1})
T_5: SSNM approach (Target yield of 40 q ha^{-1})
T_6: SSNM approach (Target yield of 45 q ha^{-1})
T_7: SSNM approach (Target yield of 50 q ha^{-1})

The finger millet variety GPU-28 was sown with the spacing of 30 x 10 cm in the month of January 2022. The initial soil properties of experimental site were analyzed and revealed that the soil was deep clayey in texture, moderately alkaline in nature having low nitrogen and high in phosphorus and potassium content. The average amount of nutrients taken in by finger millet to produce one quintal of grain is 2.8, 0.8, and 0.8 kg of NPK, respectively.

Considering this, the amount of nutrients required by the crop to produce the pre-determined target yields was calculated. As soil nitrogen was low, 30 per cent more fertilizer was supplied than required amount and further as phosphorus and potassium was high in soil, 30 per cent less fertilizer was applied than required in the form of urea, DAP and MOP, respectively. Observations were recorded on growth parameters like plant height, number of tillers, dry matter accumulation at various growth stages and yield attributes like number of ear heads, length and weight of ear head, test weight and yield at harvest.

Results and Discussion

Growth parameters

The results regarding the effect of target yield approach on growth and yield performance of finger millet revealed that there was significant variation in growth attributes of finger millet. Treatments involving SSNM were superior over RDF for plant height, number of tillers and dry matter accumulation at all growth stages of the crop. T_7: SSNM approach reported considerably higher values (54.46, 88.88, 107.13 and 125.18 cm, respectively) for plant height at 30, 60, 90 DAS and harvest which was on par with T_6 and T_5. Number of tillers plant^{-1} were also recorded highest in T_7 (2.44, 2.66 and 2.87 plant^{-1}), however it was on par with T_6, T_5, T_4 at 30, 60 DAS and at harvest. Dry matter accumulation plant^{-1} was noticed significantly higher in T_7 (3.67 and 29.72 g plant^{-1}) which was on par with T_6 at 30 and 90 DAS and with T_6 at harvest. However, significantly lower plant height, number of tillers and dry matter accumulation was noticed in RDF and control at all growth stages of finger millet.

Growth characteristics increased when fertilizer dosages were adjusted based on the desired output. A plant's growth qualities are invariably the most important aspect and having more total dry matter in both the leaves and stems is the key to increasing yields.

Table 1: Plant height (cm) at various growth stages of finger millet as influenced by SSNM

Treatment	Plant height (cm)			
	30 DAS	60 DAS	90 DAS	At harvest
T_1 : Absolute control	24.48	54.15	76.81	86.73
T_2 : RDF (100:50:50 kg ha^{-1})	39.33	68.28	86.69	100.33
T_3 : SSNM approach (Target yield of 30 q ha^{-1})	40.10	69.64	88.51	104.59
T_4 : SSNM approach (Target yield of 35 q ha^{-1})	45.40	74.22	95.17	111.73
T_5 : SSNM approach (Target yield of 40 q ha^{-1})	49.55	81.69	99.33	116.17
T_6 : SSNM approach (Target yield of 45 q ha^{-1})	52.08	84.51	103.95	119.12
T_7 : SSNM approach (Target yield of 50 q ha^{-1})	54.46	88.88	107.13	125.18
S.Em ±	1.65	2.42	3.37	3.77
CD at 5%	5.07	7.45	10.38	11.61

Table 2: Number of tillers plant^{-1} at various growth stages of finger millet as influenced by SSNM

Treatment	Number of tillers plant^{-1}		
	30 DAS	60 DAS	90 DAS
T_1 : Absolute control	1.49	1.59	1.64
T_2 : RDF (100:50:50 kg ha^{-1})	1.97	2.13	2.19
T_3 : SSNM approach (Target yield of 30 q ha^{-1})	2.05	2.24	2.38
T_4 : SSNM approach (Target yield of 35 q ha^{-1})	2.24	2.39	2.47
T_5 : SSNM approach (Target yield of 40 q ha^{-1})	2.30	2.58	2.66
T_6 : SSNM approach (Target yield of 45 q ha^{-1})	2.37	2.62	2.79
T_7 : SSNM approach (Target yield of 50 q ha^{-1})	2.44	2.66	2.83
S.Em ±	0.08	0.10	0.08
CD at 5%	0.23	0.32	0.25

Table 3: Total dry matter accumulation at various growth stages of finger millet as influenced by SSNM

Treatment	Dry matter accumulation (g plant^{-1})			
	30 DAS	60 DAS	90 DAS	At harvest
T_1 : Absolute control	2.50	7.04	17.93	19.67
T_2 : RDF (100:50:50 kg ha^{-1})	3.01	7.96	23.80	26.56
T_3 : SSNM approach (Target yield of 30 q ha^{-1})	3.15	8.02	24.03	27.64
T_4 : SSNM approach (Target yield of 35 q ha^{-1})	3.24	8.48	26.22	30.56
T_5 : SSNM approach (Target yield of 40 q ha^{-1})	3.39	8.84	27.41	32.16
T_6 : SSNM approach (Target yield of 45 q ha^{-1})	3.48	9.06	28.70	33.38
T_7 : SSNM approach (Target yield of 50 q ha^{-1})	3.67	9.15	29.72	34.78
S.Em ±	0.11	0.25	0.90	0.85
CD at 5%	0.33	0.77	2.76	2.62

The height of a plant and the number of tillers that can support and hold the leaves are important factors in determining how much dry matter is generated overall, which will ultimately lead to a greater grain yield. A comparable increase in the dry matter yield per plant of finger millet was reported by Radhakrishna (1979) [7] and Hanumantha Rao *et al*. (1982) [2] in response to higher NPK levels.

Yield and yield attributes

The data on yield attributes *viz*., Number of ear heads plant^{-1}, length of ear head, weight of ear head, grain weight plant $^{-1}$, test weight and grain and straw yield of finger millet recorded at harvest varied significantly in the treatments involving SSNM when compared to RDF and control. Number of ear heads (2.72 plant^{-1}), length of ear head (6.36 cm) and weight of ear head (7.16 g),) were noted significantly higher in T_7. However, number of ear heads (2.66 and 2.63 plant^{-1}), length of ear head (6.32 cm), weight of ear head (7.01 and 6.94 g) in T_6 and T_5, respectively were on par with T_7. It was discovered that in SSNM treatments, there was gradual increase in yield attributes with increase in the nutrients supplied in order to attain the targeted yield, followed by RDF and least in control (Table 4 and 5).

Table 4: Number, length and weight of ear heads of finger millet as influenced by SSNM

Treatment	No. of ear heads plant^{-1}	Length of ear head (cm)	Weight of ear head (g)
T_1 : Absolute control	1.35	4.55	3.58
T_2 : RDF (100:50:50 kg ha^{-1})	2.23	5.24	5.95
T_3 : SSNM approach (Target yield of 30 q ha^{-1})	2.38	5.48	6.01
T_4 : SSNM approach (Target yield of 35 q ha^{-1})	2.46	5.79	6.35
T_5 : SSNM approach (Target yield of 40 q ha^{-1})	2.63	6.32	6.94
T_6 : SSNM approach (Target yield of 45 q ha^{-1})	2.66	6.32	7.01
T_7 : SSNM approach (Target yield of 50 q ha^{-1})	2.72	6.36	7.16
S.Em ±	0.07	0.17	0.22
CD at 5%	0.22	0.52	0.68

Table 5: Grain weight and 1000 grain weight of finger millet as influenced by SSNM

Treatment	Grain weight (g plant^{-1})	1000 grain weight (g)
T_1 : Absolute control	6.18	2.16
T_2 : RDF (100:50:50 kg ha^{-1})	9.56	2.29
T_3 : SSNM approach (Target yield of 30 q ha^{-1})	9.75	2.46
T_4 : SSNM approach (Target yield of 35 q ha^{-1})	10.53	2.72
T_5 : SSNM approach (Target yield of 40 q ha^{-1})	11.45	2.93
T_6 : SSNM approach (Target yield of 45 q ha^{-1})	11.72	3.02
T_7 : SSNM approach (Target yield of 50 q ha^{-1})	11.95	3.06
S.Em ±	0.29	0.09
CD at 5%	0.89	0.28

Table 6: Grain yield, straw yield and harvest index of finger millet as influenced by SSNM

Treatment	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest index (%)
T_1 : Absolute control	18.63	53.96	25.66
T_2 : RDF (100:50:50 kg ha^{-1})	32.32	73.55	30.52
T_3 : SSNM approach (Target yield of 30 q ha^{-1})	33.10	73.85	30.94
T_4 : SSNM approach (Target yield of 35 q ha^{-1})	38.01	81.81	31.72
T_5 : SSNM approach (Target yield of 40 q ha^{-1})	42.19	88.57	32.26
T_6 : SSNM approach (Target yield of 45 q ha^{-1})	42.46	93.86	31.15
T_7 : SSNM approach (Target yield of 50 q ha^{-1})	42.99	103.43	29.36
S.Em ±	1.25	2.64	1.14
CD at 5%	3.84	8.14	3.52

Significantly grain yield of finger millet varied from 18.63 to 42.99 q ha^{-1} with the application of different doses of nutrients and grain yield increased gradually as nutrient levels increased. Among the various target yields established, target yield of 50 q ha^{-1} (T_7) recorded higher grain and straw yield (42.99 and 103.43 q ha^{-1}, respectively), followed by the treatment targeting the yield of 45 q ha^{-1} (T_6) (42.46 and 93.86 q ha^{-1}, respectively) and 40 q ha^{-1} (T_5) (42.19 and 88.57 q ha^{-1}, respectively), but both were found on par with T_7. Significantly lower grain yield was noticed in RDF (32.32 q ha^{-1}) and control (18.63 q ha^{-1}) (Table 6).

Due to the sufficient supply of nutrients especially nitrogen as per crop demand through inorganic sources through SSNM approach that have resulted in higher availability of nutrients in soil for the growth of crop and therefore affecting the growth parameters *viz.*, plant height, number of tillers and dry matter accumulation and due to increased production of photosynthates brought on by adequate nutrient uptake, which in turn aided in strong plant development and would have synthesised the carbohydrates and moved them to developing fingers and reproductive organs.

Similar results were obtained by Maithra *et al*. (2001) [3], who noted greater values of yield contributing characteristics with increased applications of nitrogen by chemical fertilizer and Nagarajan *et al*. (2018) [4] who concluded that crop growth and production were reduced in finger millet when there was insufficient nitrogen availability. The findings of Reddy *et al*. (1986) [9], Purushotham *et al*. (1990) [6], Nigade and More (2013) [5] and Triveni *et al*. (2017) [12] confirm that increased nutrient availability lead to higher dry matter buildup in reproductive portions and larger photosynthetic area, which in turn improve the yield components.

Conclusion

Application of nutrients based on target yield resulted in higher growth and yield attributes of finger millet. Though application of nutrients for target yield of 45 q ha^{-1} and 50 q ha^{-1} resulted in higher grain yield but both didn't achieve the targeted grain yield, instead resulted in higher cost of cultivation due to increase in fertilizer levels. Therefore, through site-specific nutrient management, the yield of finger millet can be increased only up to the target yield of 40 q ha^{-1}.

References

1. Dwivedi BS, Singh D, Swarup A, Yadav RL, Tiwari KN, Meena MC, *et al*. On-farm evaluation of SSNM on pearl millet-based cropping sequence on alluvial soils. Indian Journal of Fertilizers. 2009;3(2):20-28.
2. Rao HY, Reddy BT, Reddy YT, Sankara S. Effect of different levels of nitrogen, phosphorus and potassium on the growth and yield of finger millet. Andhra Agricultural Journal. 1982;29:37-41.
3. Maitra S, Ghosh DC, Sounda G, Jana PK. Performance of intercropping legumes in finger millet (*Eleusine coracana*) at varying fertility levels. Indian Journal of Agronomy. 2001;46(1):38-44.
4. Nagarajan G, Ramesh T, Janaki P, Rathika S. Enhancement of finger millet productivity through land configuration and nitrogen management under sodic soil. Madras Agricultural Journal. 2018;105(7-9):257-261.
5. Nigade RD, More SM. Performance of finger millet varieties to different levels of fertilizer on yield and soil properties in sub-Montana zone of Maharashtra. International Journal of Agricultural Sciences. 2013;9(1):256-259.
6. Purusotham S, Sadashivaiha S, Kulkarni KR. Response of ragi varieties to nitrogen levels during summer season. Current Research. 1990;19:116-119.
7. Radhakrishna K. Pattern of post-flowering dry matter accumulation in genotypes in finger millet. Mysore Journal of Agricultural Sciences. 1979;14:276-277.
8. Rao BKR, Krishnappa K, Srinivas Rao C, Wani SP, Sahrawat KL, Priyadarshini G. Alleviation of multi-nutrient deficiency for productivity enhancement of rainfed soybean and finger millet in semi-arid region in India. Communications in Soil Science and Plant Analysis. 2012;43(10):1427-1435.
9. Reddy MGRK, Reddy SR, Reddy PR, Subramanyam K, Subramanyam MMR. Effect of nitrogen on nitrogen and phosphorus uptake of finger millet. Indian Journal of Agronomy. 1986;34(1):29-32.
10. Rurinda J, Mapfumo P, Wijk VMT, Mtambanengwe F, Rufino MC, Chikowo R, *et al*. Comparative assessment of maize, finger millet, and sorghum for household food security in the face of increasing climatic risk. European Journal of Agronomy. 2014;55:29-41.
11. Sakamma S, Umesh KB, Girish MR, Ravi SC, Satishkumar M, Bellundagi V. Finger millet (*Eleusine coracana* L.) production system: status, potential, constraints and implications for improving small farmers' welfare. Journal of Agricultural Science. 2018;10(1):162-163.
12. Triveni U, Rani SY, Patro TSSK, Anuradha N, Divya M. Assessment of production potential of finger millet (*Eleusine coracana* L. Gaertn.) under rice-fallow conditions of north coastal zone of Andhra Pradesh, India. International Journal of Current Microbiology and Applied Sciences. 2017;6(7):918-923.