

International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; SP-8(12): 124-128
www.biochemjournal.com
Received: 20-09-2024
Accepted: 28-10-2024

Shant PU
M.Sc. (Agri). Student,
Department of Agronomy,
College of Agriculture, Dhule,
Maharashtra, India

Gunjal BS
Assistant Professor of
Agronomy, College of
Agriculture, Nandurbar,
Maharashtra, India

Dokhe PK
M.Sc. (Agri). Student,
Department of Agronomy,
College of Agriculture, Dhule,
Maharashtra, India

Jagtap PM
M.Sc. (Agri). Student,
Department of Agronomy,
College of Agriculture, Dhule,
Maharashtra, India

Surywanshi RT
Assistant Professor of
Agronomy, Bajara Research
Scheme, College of Agriculture,
Dhule, Maharashtra, India

Ghutke TD
M.Sc. (Agri). Student,
Department of Soil Science,
College of Agriculture, Dhule,
Maharashtra, India

Corresponding Author:
Shant PU
M.Sc. (Agri). Student,
Department of Agronomy,
College of Agriculture, Dhule,
Maharashtra, India

Studies on the yield maximization, quality and nutrient uptake of pearl millet (*Pennisetum glaucum* L.) hybrid Phule Aadishakti through fertilizer equations of STCRC

Shant PU, Gunjal BS, Dokhe PK, Jagtap PM, Surywanshi RT and Ghutke TD

DOI: <https://doi.org/10.33545/26174693.2024.v8.i12Sb.3091>

Abstract

An experiment entitled “Studies on the yield maximization, quality and nutrient uptake of pearl millet (*Pennisetum glaucum* L.) hybrid Phule Aadishakti through fertilizer equations of STCRC” was conducted during kharif 2023 at Bajra Research Scheme, College of Agriculture, Dhule. The experiment consisted of seven treatments laid out in a randomized block design with three replications. The treatments viz., (T₁) application of fertilizer as per RDF (60:30:30 kg NPK ha⁻¹), (T₂) application of fertilizer as per soil test (75:30:15 kg NPK ha⁻¹), (T₃) application of fertilizer for 40 q ha⁻¹ yield target (60:68:33 kg NPK ha⁻¹), (T₄) application of fertilizer for 45 q ha⁻¹ yield target (77:85:41 kg NPK ha⁻¹), (T₅) application of fertilizer for 50 q ha⁻¹ yield target (93:102:49 kg NPK ha⁻¹), (T₆) application of fertilizer for 55 q ha⁻¹ yield target (110:119:58 kg NPK ha⁻¹), (T₇) application of fertilizer for 60 q ha⁻¹ yield target (126:135:65 kg NPK ha⁻¹), were used in this experiment. Among different yield target based fertilizer application treatments, the application of fertilizer for 60 q ha⁻¹ yield target (T₇) produced significantly higher grain and straw yield of pearl millet (46.08 q ha⁻¹ and 91.86 q ha⁻¹) respectively, than other yield target based fertilizer application treatments and it was found to be at par with the application of fertilizer for 55 q ha⁻¹ yield target (T₆) for grain yield only. The application of fertilizer for 60 q ha⁻¹ yield target (T₇) observed significantly higher protein content (9.75%) and protein yield (449.05 kg ha⁻¹) than the rest of yield target based fertilizer application treatments and it was found to be at par with the application of fertilizer for 55 q ha⁻¹ yield target (T₆). Among different yield target based fertilizer application treatments, the maximum uptake of N, P and K in the grains of 71.88 kg ha⁻¹, 24.42 kg ha⁻¹ and 38.71 kg ha⁻¹, respectively was recorded with the application of fertilizer for 60 q ha⁻¹ yield target (T₇), but was found to be statistically at par with application of fertilizer for 55 q ha⁻¹ yield target (T₆). Similarly, the maximum uptake of N, P and K in the straw of 105.65 kg ha⁻¹, 32.15 kg ha⁻¹ and 132.29 kg ha⁻¹ respectively was recorded with the application of fertilizer for 60 q ha⁻¹ yield target (T₇), which was highly superior over the rest of the treatments. The highest available nitrogen (166.33 kg ha⁻¹) was recorded with application of fertilizer as per soil test (T₂), but was found statistically at par with application of fertilizer for 60 q ha⁻¹ yield target (T₇) with 163.0 kg ha⁻¹ available nitrogen. The highest available phosphorus (101.21 kg ha⁻¹) was recorded with the application of fertilizer for 60 q ha⁻¹ yield target (T₇) which was highly superior over the rest of the treatments. The application of fertilizer as per RDF (60:30:30 kg NPK ha⁻¹) (T₁) recorded the highest available potash (494 kg ha⁻¹) in soil after harvest of pearl millet and it was highly superior over the rest of the treatments.

Keywords: STCRC, yield target, pearl millet, fertilizer

Introduction

Pearl millet (*Pennisetum glaucum* L.) commonly known as bajra, Kumbu is a multipurpose cereal crop belonging to the family Poaceae. It is considered to be a poor man's food as it provides staple food for the poor in a short period. It is the world's hardiest warm season cereal crop. It's generally grown as a rainfed crop during kharif season. Globally it ranks sixth after rice, wheat, maize, barley and sorghum in terms of area and share 42 per cent of total world production (Baby *et al.*, 2020) [4].

It is one of fourth most important food crop in India after rice, wheat and sorghum and well adapted to drought, low soil fertility and acidic soil conditions (Choudhary *et al.*, 2014) [7].

Pearl millet is an indispensable arid and semiarid crop of India cultivated as dual-purpose crop, grains are used for human consumption and its straw as cattle feed. Its straw is an important component of livestock ration during the dry period of the year. (Khairwal *et al.*, 2007) ^[8].

Pearl millet contains Vitamin A, Vitamin B, Folic acid, magnesium, and other major, minor as well as micro nutrients. Pearl millet grain is nutritionally better than many cereals as it is good source of protein having higher digestibility (12.1%), fats (5%) and high levels of iron, zinc and insoluble dietary fiber and is the major source of dietary carbohydrates (69.1%) in the human diet (Kumar *et al.*, 2021) ^[9].

The productivity of pearl millet in Maharashtra is low as compared to India due to several factors *viz.* variation in soils, erratic and scanty nature of rainfall, improper method of sowing, poor plant stand, low and imbalance use of inorganic fertilizer and scanty use of organic manures. Among the various reasons, less fertilization is the main reason for low productivity of pearl millet. On an average production of tones of dry fodder removes 9.4 kg N, 1.45 kg P, 1.4 kg K, 4.61 kg Ca, 2.65 kg Mg and 1.85 kg S (Bose and Balakrishnan, 2001) ^[5]. It is therefore, necessary to increase the production and productivity of pearl millet by adopting scientific innovations.

Application of imbalanced and/or excessive nutrients led to declining nutrient-use efficiency making fertilizer consumption uneconomical and producing adverse effects on atmosphere (Aulakh and Adhya, 2005) ^[2] and groundwater quality (Aulakh *et al.*, 2009) ^[3] causing health hazards and climate change.

The soil test crop response (STCR) are cost effective and plant need based approaches. The STCR approach provide principles and tools for supplying crop nutrients as and when needed to achieve higher yield. The STCR approach not specifically aim to either reduce or increase fertilizer use. Instead, they aim to apply nutrients at optimal rates and time to achieve higher yield and high efficiency of nutrient use by the crop, leading to more net returns per unit of fertilizer applied. Soil test calibration permits balanced fertilization through right kind and amount of fertilizers. In this regard, targeted yield approach had been found to be beneficial recommending balanced fertilization considering the soil available nutrient status and crop needs.

Integrated nutrient management strategies that include site specific knowledge of crop nutrient requirements, soil nutrient supply, and recovery efficiency of applied fertilizer, are required to sustain high yields and maintain or build up soil fertility at a level that ensures 3 maximum efficiency from nutrient inputs (Sharma *et al.*, 2015) ^[16]. Several approaches have been used for fertilizer recommendation based on chemical soil test so as to attain maximum yield per unit of fertilizer use. Among the various approaches, the target yield approach (Ramamoorthy *et al.*, 1967) ^[14] has found popularity in India.

Targeted yield approach not only estimates soil test based fertilizer dose but also the level of yield the farmer can achieve with that particular dose. The basic data required for formulating fertilizer recommendation using this approach are nutrient requirement for a unit grain yield, nutrient contribution from soil i.e., nutrient supplying capacity of

soil and the nutrient contribution from fertilizer i.e., recovery efficiency of fertilizer nutrient. Quantitative fertilizer requirements based on this approach have been estimated for specific yield target of crops like rice and wheat (Ahmed *et al.*, 2002) ^[11]. Recommendations based on Soil Test Crop Response Correlation concept are more quantitative precise and meaningful because combined use of soil and plant analysis is involved in it. It gives a real balance between applied nutrients and the available nutrients already present in the soil.

Hence, need based estimation of N, P and K correlating their requirement with specific yield depending on their native soil status may fit to balanced application of NPK fertilizers. The 'yield equation' (YE) is considered as a soil and fertilizer based precision farming strategy to meet nutrient demands for a specified yield. Therefore, it is important to study the response of bajra to manure and fertilizer application, estimate the nutrient requirement of bajra and develop quantitative relationship to estimate requirement for target yield of bajra.

Materials and Methods

A field experiment entitled, "Studies on the yield maximization and nutrient uptake of pearl millet (*Pennisetum glaucum* L.) hybrid Phule Aadishakti through fertilizer equations of STCRC" was carried out during the *kharif* season of 2023. The field experiment was conducted at Bajra Research Scheme, College of Agriculture, Dhule, M.S. (India).

The Bajra Research Scheme Farm is located in Northern Maharashtra's Agro-climatic Zone-6, often known as the scarcity zone. It is located at 20.4 °N latitude and 74 °E longitude. The elevation is 258 meters above mean sea level. It is located at the intersection of National Highways No. 3 and 6. This location has a subtropical climate and is located in the northern subtropics. Monsoon season typically begins in the third week of June and ends at the end of September, with an average annual rainfall of 608.3 mm at College of Agriculture, Dhule. This is largely due to the South-West monsoon. The majority of rain falls on 34 to 40 rainy days each year. The mean annual maximum and minimum temperature and evaporation ranges from 46.6 °C and 6.8 °C, 18.0 mm and 0.7 mm respectively. The maximum sunshine hours are 8.70 hrs. Some climatic criteria, such as relative humidity and sunlight hours, were more or less favourable for *kharif* pearl millet growth and development in 2023. Also, the rainfall distribution obtained throughout crop development was uniform. Off season rains of 42.4 mm were received during the *kharif* season.

In general, the weather conditions were found favourable for normal crop growth and development. The experiment had seven treatment, and three replications was set up in a randomized block design. The seven treatments included T₁-Recommended dose of fertilizer as per the treatment (60:30:30 kg NPK ha⁻¹), T₂-Fertilizer as per soil test, T₃ - Fertilizer for 40 q ha⁻¹ yield target, T₄ -Fertilizer for 45 q ha⁻¹ yield target, T₅ -Fertilizer for 50 q ha⁻¹ yield target, T₆ - Fertilizer for 55 q ha⁻¹ yield target, T₇ -Fertilizer for 60 q ha⁻¹ yield target. Where, 5 t ha⁻¹ FYM and Azospirillum biofertilizer 25 g kg⁻¹ of seed common to all treatment.

Table 1: Treatment details

Tr. No.	Treatment Details
T ₁	Recommended dose of fertilizer as per the treatment (60:30:30 kg NPK ha ⁻¹)
T ₂	Fertilizer as per soil test
T ₃	Fertilizer for 40 q ha ⁻¹ yield target
T ₄	Fertilizer for 45 q ha ⁻¹ yield target
T ₅	Fertilizer for 50 q ha ⁻¹ yield target
T ₆	Fertilizer for 55 q ha ⁻¹ yield target
T ₇	Fertilizer for 60 q ha ⁻¹ yield target

Yield Target Equation for Pearl millet

$$1. FN = 3.31 T - 0.38 SN$$

$$2. FP_2O_5 = 3.38 T - 4.11 SP$$

$$3. FK_2O = 1.65 T - 0.06 SK$$

Where, FN, FP₂O₅, FK₂O= Fertilizer N, P₂O₅, FK₂O (kg ha⁻¹)

T = Yield Target (q ha⁻¹)

SN, SP, SK = Soil available nitrogen, phosphorus, potassium (kg ha⁻¹)

(Note: Initial available status of N, P, K in soil is used for calculations of fertilizer doses through the yield target equation mentioned)

Grain yield per net plot was recorded after threshing all the ear heads from each net plot and converted into hectare basis. Straw yield per net plot was obtained by using a weighing balance on field after harvesting when stover become totally dry.

The uptake of nitrogen, phosphorus and potassium by grain and fodder was calculated by multiplying per cent N, P and K in grain and fodder with their respective yields. Total uptake was recorded by summing up the respective uptake by grain and fodder.

Protein content (%) in grains of maize was calculated by multiplying nitrogen percentage in grain with the conversion factor 6.25 (A.O.A.C., 1960). For protein yield (kg ha⁻¹) of maize was calculated by multiplying protein content (%) in grain of maize with the grain yield (kg ha⁻¹) of maize.

The data collected and analysis of data was carried out by "Analysis of Variance method" by Panse and Sukhatme, 1967^[13]. When the treatment differences were significant standard error (S.E.±) and critical difference (C.D.) were calculated at 5% probability level and when the treatment differences were not significant, only standard error was worked out.

Results and Discussion

Yield studies

The grain and straw yield of pearl millet (q ha⁻¹) which recorded significantly maximum (46.08 q ha⁻¹ and 91.86 q ha⁻¹, respectively) with application of fertilizer for 60 q ha⁻¹ yield target (T₇) as compared to other treatments of targeted yield based fertilizer application treatments, but was found to be statistically at par with application of fertilizer for 55 q ha⁻¹ yield target (T₆) for grain yield only with value 43.97 q

ha⁻¹.

Increase in grain yield under the pearl millet fertilized as per STCR with 60 q ha⁻¹ yield target (T₇) followed by pearl millet fertilized as per STCR with 55 q ha⁻¹ yield target (T₆). This might be due to increase in fertilizer dose of fertilizer as per yield target equation of STCR formulated for pearl millet crop and balanced fertilization through STCR increased crop yield probably by making more nutrients available to plants which in turn increased crop growth and yield attributes which increased the grain and fodder yield.

The similar trends were noticed from the researches conducted on yield target based fertilizer recommendation on pearl millet, finger millet and paddy by Shetty *et al.* (2018)^[18]; Chandrasekhar *et al.* (2020)^[6]; Narmada *et al.* (2023)^[12]; Murthy *et al.* (2023)^[10].

Higher stover yield under the pearl millet fertilized as per STCR with 60 q ha⁻¹ yield target treatment (T₇) followed by decreasing order of treatments *i.e.*, T₇ > T₆ > T₅ > T₄ > T₃ > T₂ > T₁. This might be due to adequate supply of NPK through inorganic sources that played vital role in physiological and developmental processes in plant life and also higher values of growth and yield attributes and balanced fertilization through STCR increased crop yield probably by making more nutrients available to plants which in turn might have accelerated the growth processes that in result increased straw yield in treatment applied higher dose of fertilizer as per yield target.

Similar results obtained from the research conducted on targeted yield based fertilizer recommendation on pearl millet, finger millet, paddy by Shetty *et al.* (2018)^[18]; Chandrasekhar *et al.* (2020)^[6]; Narmada *et al.* (2023)^[12]; Murthy *et al.* (2023)^[10].

Table 2: Grain yield (q ha⁻¹), stover yield (q ha⁻¹), Protein content (%) and Protein yield (kg ha⁻¹) of pearl millet as influenced by different treatments

Tr. No.	Treatments	Grain yield (q ha ⁻¹)	Stover yield (q ha ⁻¹)	Protein content (%)	Protein yield (kg ha ⁻¹)
T ₁	Recommended dose of fertilizer (60:30:30 kg NPK ha ⁻¹)	30.23	57.77	9.25	279.62
T ₂	Fertilizer as per soil test	35.49	65.77	9.25	328.16
T ₃	Fertilizer for 40 q ha ⁻¹ yield target	38.19	70.90	9.38	358.23
T ₄	Fertilizer for 45 q ha ⁻¹ yield target	39.24	80.04	9.44	370.36
T ₅	Fertilizer for 50 q ha ⁻¹ yield target	40.21	82.70	9.56	384.14
T ₆	Fertilizer for 55 q ha ⁻¹ yield target	43.97	83.27	9.69	426.08
T ₇	Fertilizer for 60 q ha ⁻¹ yield target	46.08	91.86	9.75	449.05
	SE (m.) ±	1.81	2.73	0.06	16.12
	CD at 5%	5.57	8.41	0.19	49.67
	General mean	39.06	76.04	9.47	370.8

Protein content (%) and protein yield (kg ha⁻¹) of pearl millet recorded significantly maximum (9.75% and 449.05 kg ha⁻¹, respectively) with application of fertilizer for 60 q ha⁻¹ yield target (T₇) as compared to other treatments of targeted yield based fertilizer application treatments, but was found statistically at par with application of fertilizer for 55 q ha⁻¹ yield target (T₆).

This is due to the fact that the nitrogen is the most important element in protein synthesis as the nitrogen is the base of nucleic acid and protein building. Hence an increase in optimum conditions like fertilizer application through inorganic sources the availability of nitrogen increases and the protein content in grain also increases. The similar trends was noticed by Sekaran *et al.* (2019) [17]. The

application of fertilizer for 60 q ha⁻¹ yield target (T₇) has produced higher grain yield and as protein yield is product of protein content and grain yield thus present reflection was noticed by Sekaran *et al.* (2019) [17].

Nutrient content and nutrient uptake

The treatment receiving an application of fertilizer for 60 q ha⁻¹ yield target (T₇) obtained significantly highest content of nitrogen, phosphorous and potassium% in grain (1.56% N, 0.52% P and 0.84% K) and stover (1.15% N, 0.35% P and 1.44% K) and was found statistically at par with treatment application of fertilizer for 55 q ha⁻¹ yield target (T₆) having 1.55% N, 0.51% P and 0.83% K in grain and 1.14% N, 0.35% P and 1.43% K in stover.

Table 3: Nutrient content (%) of pearl millet grain and stover as influenced by different treatments

Tr. No.	Treatments	Nutrient content in grain (%)			Nutrient content in stover (%)		
		N	P	K	N	P	K
T ₁	Recommended dose of fertilizer (60:30:30 kg NPK ha ⁻¹)	1.48	0.47	0.79	1.09	0.27	1.36
T ₂	Fertilizer as per soil test	1.48	0.47	0.80	1.09	0.27	1.37
T ₃	Fertilizer for 40 q ha ⁻¹ yield target	1.50	0.49	0.82	1.11	0.29	1.37
T ₄	Fertilizer for 45 q ha ⁻¹ yield target	1.51	0.50	0.82	1.11	0.30	1.39
T ₅	Fertilizer for 50 q ha ⁻¹ yield target	1.53	0.50	0.83	1.12	0.33	1.42
T ₆	Fertilizer for 55 q ha ⁻¹ yield target	1.55	0.51	0.83	1.14	0.35	1.43
T ₇	Fertilizer for 60 q ha ⁻¹ yield target	1.56	0.52	0.84	1.15	0.35	1.44
	SE (m.) ±	0.009	0.006	0.008	0.007	0.005	0.005
	CD at 5%	0.029	0.019	0.025	0.023	0.017	0.017
	General mean	1.52	0.50	0.82	1.12	0.31	1.39

The higher concentration of N, P and K led to higher uptake of nutrients by crops. The added N, P and K through fertilizers has increased the availability of them to plants, which in turn might have resulted in profuse shoot and root growth, thereby activating greater absorption from the soil and improving the grain and fodder yields. It might be also

due to the fact that the balanced use of various plant nutrient sources results in proper absorption, translocation and assimilation of nutrients, ultimately increasing the dry matter accumulation and nutrient contents of crop. The present trend of increased nutrient uptake is in line with those of Singh *et al.* (2021) [15]; Murthy *et al.* (2023) [11].

Table 4: Available nitrogen, phosphorus and potassium (kg ha⁻¹) and Nutrient uptake (kg ha⁻¹) in soil after harvest and Economics as influenced by different treatments

Tr. No.	Treatments	Nutrient uptake by grain (kg ha ⁻¹)			Nutrient uptake by stover (kg ha ⁻¹)			Available Nutrients (kg ha ⁻¹)		
		N	P	K	N	P	K	N	P	K
T ₁	Recommended dose of fertilizer (60:30:30 kg NPK ha ⁻¹)	44.75	14.21	23.88	62.97	15.60	78.56	156.67	18.27	494.0
T ₂	Fertilizer as per soil test	52.53	16.68	28.39	71.69	17.76	90.11	166.33	19.38	473.0
T ₃	Fertilizer for 40 q ha ⁻¹ yield target	57.28	18.71	31.31	78.70	20.56	97.13	133.33	45.34	469.0
T ₄	Fertilizer for 45 q ha ⁻¹ yield target	59.25	19.62	32.18	88.84	24.01	111.25	138.00	57.66	475.0
T ₅	Fertilizer for 50 q ha ⁻¹ yield target	61.53	20.11	33.38	92.62	27.29	117.43	152.33	71.26	478.0
T ₆	Fertilizer for 55 q ha ⁻¹ yield target	68.16	22.43	36.50	94.92	29.14	119.07	158.33	85.40	479.0
T ₇	Fertilizer for 60 q ha ⁻¹ yield target	71.88	24.42	38.71	105.65	32.15	132.29	163.00	101.21	480.0
	SE (m.) ±	2.72	0.88	1.47	3.08	0.91	3.87	2.47	2.49	2.53
	CD at 5%	8.40	2.73	4.54	9.50	2.81	11.93	7.63	7.70	7.80
	General mean	59.34	19.45	32.05	85.06	23.79	106.55	152.57	56.93	478.3
	Initial Status							191.46	16.46	560

The maximum uptake of N, P and K in the grains of 71.88 kg ha⁻¹, 24.42 kg ha⁻¹ and 38.71 kg ha⁻¹, respectively was recorded with the application of fertilizer for 60 q ha⁻¹ yield target (T₇), but was found to be statistically at par with application of fertilizer for 55 q ha⁻¹ yield target (T₆), with N, P and K uptake in the grains of 68.16 kg ha⁻¹, 22.43 kg ha⁻¹ and 36.50 kg ha⁻¹, respectively.

The maximum uptake of N, P and K in the stover of 105.65 kg ha⁻¹, 32.15 kg ha⁻¹ and 132.29 kg ha⁻¹ respectively was recorded with the application of fertilizer for 60 q ha⁻¹ yield target (T₇), which was highly superior over the rest of the treatments.

The highest available nitrogen (166.33 kg ha⁻¹) was recorded with application of fertilizer as per soil test (T₂), but was found statistically at par with application of fertilizer for 60 q ha⁻¹ yield target (T₇) with 163.0 kg ha⁻¹ available nitrogen. The highest available phosphorus (101.21 kg ha⁻¹) was recorded with the application of fertilizer for 60 q ha⁻¹ yield target (T₇) which was significantly superior over the rest of the treatments. The application of fertilizer as per RDF (60:30:30 kg NPK ha⁻¹) (T₁) recorded the highest available potassium (494 kg ha⁻¹) in soil after harvest of pearl millet and it was highly superior over the rest of the treatments.

Conclusion

The following conclusions are drawn from the present investigation.

1. The integrated fertilizer prescription equations found beneficial and valid for achieving the higher pearl millet yield for Dhule region. The fertilizer equation for pearl millet was valid upto 40 q ha⁻¹ of targeted yield.
2. The maximum attainable yield for grains was obtained upto 46.08 q ha⁻¹ under fertilizer for 60 q ha⁻¹ yield target, which was found statistically at par with fertilizer for 55 q ha⁻¹ yield target having grain yield of 43.97 q ha⁻¹.
3. The STCR approach for targeted yield obtained significantly higher values of yield, of pearl millet, quality parameters and nutrients uptake of pearl millet. Fertilizer for 60 q ha⁻¹ yield target obtained significantly higher gross returns (₹ 120707 ha⁻¹), net returns (₹ 80371 ha⁻¹) and B:C ratio (2.99).

References

1. Ahmed M, Chaudhry GM, Iqbal M, Khan DA. Wheat productivity, efficiency, and sustainability: A stochastic production frontier analysis [with comments]. Pak Dev Rev. 2002;643-663.
2. Aulakh MS, Adhya TK. Impact of agricultural activities on emission of greenhouse gases—Indian perspective. In: International Conference on Soil, Water and Environmental Quality—Issues and Strategies; 2005 Dec 12-14; New Delhi, India. New Delhi: Indian Society of Soil Science; 2005. p. 319-335.
3. Aulakh MS, Khurana MPS, Singh D. Water pollution related to agricultural, industrial, and urban activities, and its effects on the food chain: Case studies from Punjab. J New Seeds. 2009;10(2):112-137.
4. Baby T, Raheem MA, Kumar VS, Gokari P, Yadav A, Kaur A. Pearl millet (*Pennisetum glaucum*) production in the 21st century. Dev. 2020;8.
5. Bose SC, Balakrishnan V. Forage production technologies. New Delhi: South Asian Publishers; 2001. p. 253.
6. Chandrasekhar CN. Validation of inductive cum targeted yield model-based fertilizer prescription equations for pearl millet (var. CO 10) on Inceptisol. Madras Agric J. 2020;107.
7. Choudhary R, Yadav LR, Shivran AC, Parihar S. Effect of vermicompost and fertility levels on growth, yield, nutrient uptake and net returns in pearl millet (*Pennisetum glaucum* L.). Indian J Agric Sci. 2014;84(11):1428-1430.
8. Khairwal IS, Rai KN, Diwakar B, Sharma YK, Rajpurohit BS, Nirwan B, Bhattacharjee R. Pearl millet crop management and seed production manual. 2007.
9. Kumar R, Krishna B, Kumar B, Mishra JS. Millets: Panacea for future multiple securities. Indian Farming. 2021;71(3).
10. Murthy RK, Bhavya N, Govinda K, Kumar SN, Basavaraja PK. Validation of targeted yield equations for finger millet under southern dry zone of Karnataka. Int J Plant Soil Sci. 2023;35(10):84-91.
11. Murthy RK, Basavaraja PK, Bhavya N, Dey P, Mohamed Saqueebulla H, Gangamurtha GV, et al. Development and validation of soil test-based fertilizer prescription equations for enhancing yield, uptake and nutrient use efficiency of foxtail millet (*Setaria italica*) under dryland condition. J Plant Nutr. 2023;46(13):3082-3100.
12. Narmada S, Santhi R, Maragatham S, Iyanar K, Devi RP. Fertilizer recommendations for pearl millet through soil test crop response-integrated plant nutrition system approach on Alfisol. Int J Plant Soil Sci. 2023;35(18):1070-1080.
13. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. Revised ed. New Delhi: Indian Council of Agricultural Research (ICAR); c1985.
14. Ramamoorthy B, Narasimham RL, Dinesh RS. Fertilizer application for specific yield targets of Sonora 64 (wheat). Indian Farming. 1967;17:43-45.
15. Singh YV, Singh SK, Dey P, Sharma VK. STCR-based nutrient management in chickpea (*Cicer arietinum*) for higher productivity and profitability. Indian J Agric Sci. 2021;91(4):555-558.
16. Sharma GK, Mishra VN, Maruti Sankar GR, Patil SK, Srivastava LK, Thakur DS, Rao CS. Soil-test-based optimum fertilizer doses for attaining yield targets of rice under midland Alfisols of Eastern India. Commun Soil Sci Plant Anal. 2015;46(17):2177-2190.
17. Sekaran U, Santhi R, Dey P, Meena S, Maragatham S. Validation of soil test and yield target-based fertilizer prescription model developed for pearl millet on Inceptisol. Res Crops. 2019;20(2):266-274.
18. Shetty YV, Kumar MD. Effect of NPK application through different approaches on yield and major nutrient uptake by finger millet (*Eleusine coracana* L.) under rainfed conditions. J Pharmacogn Phytochem. 2018;7(3):3661-3665.