Original Research Article

Site-specific nutrient management in maize tract of Khammam -basedon STCR and Targeted yield approach

ABTRACTS

Soil variability is major factor behind the less yield, higher cost of cultivation and minimum profit. Geostatistics, principal component analysis and Fuzz C mean cluster algorithms are used to check soil spatial variability and help in reduction of spatial variability by diving field in to different management zone. Spatial variability of soil of Telangana was measured and also developed eight management zones for four ha using geostatistical analysis, Principal component analysis and Fuzz C mean cluster algorithm.Using above information,Field experiments were conducted at Khammam, Telanagana during *rabi*-2021 to demonstrate SSNM technique on farmer field using soil test crop response and targeted yield concept in maize crop. In this study, there are three treatments used: Treatment -1: - Fertilizer application based on eight soil sample testing, Treatment- 2: - Fertilizer application based on one soil sample testing, and Treatment -3: - Farmer fertilizer practices. The study concluded that grain yield over farmer fertilizer practices was highest in treatment -1 followed by treatment -2. Maximum gross return and gross return per ha over farmer fertilizer practice were observed in treatment -1 (**Rs.170170**and **Rs.26180.00respectively)**followed by treatment -2 (Rs.**157080and Rs. 13090.00respectively).**

Keywords:Gross return, Maize, Soil test fertilizer application, and Targeted yield.

Introduction

Maize is a significant economic crop in India, with an estimated acreage of 9.4 million hectares capable of producing 28.7 million tonnesper year (India stat, 2021-22). Telangana is one of India's most important maize-growing states, with maize mostly used as a commercial feed crop. Maize (Corn) is the second most important cultivated crop in Telangana, with roughly 6.3 lakh hectares producing 25.5 lakh tonnes yearly (India stat, 2021-22). Telangana's average maize production is 4057 kg ha^{-1}, greater than the national average of 3065 kg ha^{-1} (India stat 2021-22). Maize yield is determined by the variety, season, soil fertility, and crop management practices used by farmers. Maize is a demanding crop that necessitates a balanced supply of all three key nutrients (N, P, and K). Maize hybrids are very responsive to nutrient input from outside sources. The rate of fertilizer applications is determined by the soil nutrient status, which varies with soil heterogeneity. Variations in crop growth and yield per hectare basis could be due to this heterogeneity. SSNM approach has the capacity to supply key nutrients in an optimum amount to

maize to get maximum grain yield and high input use efficiency. The application of SSNM to maize increases farmer revenue significantly.To archive objective yield, site-specific nutrient management is a unique fertilizer delivery strategy based on spatial and temporal soil heterogeneity, crop nutrient requirements, and cropping system. This method is part of precision farming or site-specific crop management. The core concepts of SSNM are the diagnosis of geographical variability in the soil's nutrient-providing capacity and the use of appropriate instruments and procedures to treat this variability. It's a broad notion for balancing the supply and demand of nutrients based on their spatial and temporal variations. This method establishes a scientific foundation for providing nutrients to crops as and when they are required for individual fields in a given cropping season, hence avoiding over-or under-nutrition.SSNM for Asian irrigated rice systems was developed by IRRI in collaboration with national partners across Asia in the 1990s to overcome major limits originating from generalized fertilizers recommendations for large swathes, as practiced in Asia. The existence of SSNM reflects an awareness that future gains in productivity and input use efficiency would necessitate more knowledge-intensive soil and crop management systems that are customized to the unique characteristics of particular fields. It is described as the dynamic, field-specific management of nutrients during a given cropping season in order to optimize the supply and demand of nutrients based on their differences in cycling through the soil-plant system.On account of the above facts, the present investigation was contemplated in maize crop to get maximum yield using STCR and targeted yield approach.

Materials and Methods

A field experiment was conducted in farmer fields at Khammam district, Telangana State during *rabi*,2021-22. The objective of the present investigation was to study the influence of STCR and Targeted yield approach on maize grain yield and farmer income. There are three treatment used in the experiment:

T1: Application of fertilizer using STCR Model and Targeted yield approach based on eight soil sample collection testing data per ha (Eight soil sampling size was estimated using geostatistical analysis and Fuzz C mean cluster algorithm)

T2: Application of fertilizer using STCR Model and Targeted yield approach based on one soil sample collection testing data per ha.

T3: Farmer Fertilizer practices.

In STCR approach initial soil available nutrients N, P and K are required to compute the target yield equations at a particular field level. A target yield 70 qha^{-1} was taken for a test variety of DHM-117. The required quantity of fertilizers to attain the target yield was calculated based on the initial soil fertility status with the equation given below.

FN = 4.25 T- 0.24 SN

FP_2O_5= 0.9 T – 0.3 SP

FK_2O = 1.41T – 0.05 SK

In the above equation, FN, FP_2O_5, and FK_2O represent the fertilizer of nitrogen, phosphorus, and potassium in kg ha^{-1}. T means the target yield in q ha^{-1}.SN, SP, and SK are soil available N, P, and K respectively.The required nitrogen was applied through three splits, one third at basal, one third at knee high, and last dose of one third at the tasseling stage while phosphorus and potassium are applied as basal.

Table 1. Initial soil status of selected farmer field.

Sl.No.	Physico-chemical Properties	Value	Rating	Reference's
1	pH	8.32	ModeratelyAlkaline	Baruah and Barthakur, 1999
2	EC(dS m^{-1})	0.112	Non- Saline	Baruah and Barthakur, 1999
3	Organic Carbon(%)	0.42	Low	Weil*et al.*,2003
4	Available N (kg N ha^{-1})	135	Low	Estefan*et al.*, 2013
5	Available P (kg P ha^{-1})	32	High	Zhangand Kovar, 2009.
6	Available K (kg K ha^{-1})	384	High	Nayak*et al.*, 2016

Table 2. Available N, Available P and Available K (kg ha^{-1}) content in treatment I and II.

Treatment	Available N (kg ha^{-1})	Available P (kg ha^{-1})	Available K (kg ha^{-1})
Treatment - 1	**188**	**26.23**	**315.4**
Treatment - 2	**103**	**10.32**	**200.03**

Table 3. Fertilizer Application rate as per treatments.

Sl.No.	Treatments	Nitrogen (kg ha^{-1})	Phosphorus P_2O_5 (kg ha^{-1})	Potassium K_2O (kg ha^{-1})
1	Treatment – 1 (Fertilizer application based on eight soil samples tested per ha)	252	55	83
2	Treatment – 2 (Fertilizer application based on one soil sample tested per ha)	273	60	89
3	Treatment – 3 (Farmer fertilizers practice)	185	40	40

Result and Discussion

Grain yield

Grain yield of maize varied between 91 to 77 q ha^{-1} whereas the highest grain yield was 91 q ha^{-1} observed in the treatment -1 with the application of 252:55:83 N, P_2O_5, and K_2O kg ha^{-1} respectively (Table 4). Grain yield of maize in treatment -1 was 14 and 7 q ha^{-1} higher than treatment -3 and treatment -2 respectively. In STCR technology has recorded an additional mean yield over farmer fertilizer practice.The higher grain yield in STCR recommendation may be due to the application of fertilizers based on the needs of the crop. Fertilizers in the target yield approach consider the crop needs and nutrients present in the soil. It may be due to the coincidence fertilizers application with critical stages of crop. It might have resulted in better assimilation of photosynthates to grain. Similar results were obtained by Ray *et al.,* (2000), Meena *et al.,* (2001), Jayaprakash *et al.,* (2006), Arun Kumar *et al.,* (2007), Umesh (2008), Vikram *et al.,* (2015), Pradeep Kumar and Parmanand, (2018) and Prabhakar Reddy *et al.,* (2018).

Farmer Income

Among three treatments, Maximum gross return per ha was observed in treatment -1 followed by treatment -2 then treatment -1(Table 4) might be due to the proper allocation of fertilizer in treatment -1. Highest gross return per ha in treatment -1 due to the highest grain yield per ha in treatment -1 and more uptake of nutrient in it. It also noticed that gross return per ha over farmer fertilizer practices (Treatment -3) was highest in treatment -1 followed by treatment -2. Gross return over farmer fertilizer practices in treatments -1 and 2 was Rs. **26180.00**and Rs. **13090.00**respectively.This may be due to higher productivity and gross returns in the STCR

treatment over the farmer fertilizer practice treatment. It might be also due to nutrient balance in soil due to soil test-based fertilizer application and nutrient reserves in the soil. Similar results are reported by Pradeep Kumar and Parmanand (2018).

Table 4.Comparative study of grain yield, gross return and cost of fertilizer of maize.

Treatments	Grain yield (q ha^{-1})	Change in grain yield over farmer fertilizer practices (q ha^{-1})	Cost of Fertilizer (Rs. ha^{-1})	Gross return (Rs. ha^{-1})	Gross return over Farmer Fertilizer practices (Rs. ha^{-1})
Treatment – 1 (Fertilizer application based on eight soil sample tested per ha)	**91**	**14**	**8179.00**	**170170**	**26180.00**
Treatment – 2 (Fertilizer application based on one soil sample tested per ha)	**84**	**7**	**9476.00**	**157080**	**13090.00**
Treatment – 3 (Farmer fertilizers practice)	**77**	**-**	**5418.00**	**143990**	**-**

Conclusion

The present investigation concluded that the soil test-based fertilizer application on the basis of eight soil sample test (Treatment – 1)gave the highest grain yield and better outcomes over farmers' fertilizer recommendations due to balanced nutrient management.

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