

# ON-FARM CROP RESPONSES AND ECONOMICS TO NUTRIENT APPLICATION UNDER RAINFED CONDITIONS IN ANDHRA PRADESH AND MAHARASHTRA

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## ABSTRACT

On-Farm trials (OFTs) were conducted in Andhra Pradesh and Maharashtra to assess the performance of crops with recommended fertilizer application based on soil test values for predominant crops grown under different farming situations. During 2008-09 to 2012-13, a total of 539 different trials were conducted in different farming situations. The OFTs were conducted in a participatory mode incorporating the farmers' perceptions. The results obtained from the large scale trials conducted across the states revealed that substantial increase in yield of grain and oilseed crops was obtained by application of fertilizers as recommended which supplied balanced nutrition over the yield obtained with farmers' practice of imbalanced fertilization. The yield was further enhanced when fertilizer was applied based on soil test values. The present study will help to obtain the achievable yields of different crops as the trials were conducted under on-farm conditions with farmers' management systems.

**Key words:** Farming situation, rainfed cereals and oilseed crop, On-farm trials, Balanced fertilization, soil test values

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## INTRODUCTION

Plant nutrient supply to soil through chemical fertilizers is the most influential component of the production factors in increasing productivity of crops, irrespective of soil, agro-ecological zone and farming situations. This has been well established from the research conducted at research stations, both under irrigated and rainfed farming situations, particularly when high yielding varieties (HYV) of crops have been grown. A comprehensive review on fertilizer and integrated nutrient use made by Mankotia (2007), Ummed Singh and Ahlawat (2006), Vyas et al (2006) and Singh and Das (1984) have brought out different aspects of soil fertility management and fertilizer use for sustainable development of rainfed agriculture and highlighted the aspect of nutrient management in the compendium of improved technologies for rainfed farming. However, these analyses are based on the findings of the research and trials conducted under research station conditions. On-farm conditions are different from research station ones in that the real farming situations are influenced by many unsourced problems which are not under control of the farmers that influence the output from the input supply for raising crops. In that sense the performance of the crops grown under on-farm conditions reflects the true potential of a given technology in influencing the productivity of the crops. Such information is scattered while a historical perspective of farming system research in India has been provided by Kanwar et al (1992). Recently, Kokate et al (2010) had brought out in sharp focus the advantages in increasing the productivity of various crops such as cereal, coarse cereal, oilseeds, pulses, vegetable and

food crops due to balanced fertilizer application from the data generated by the KVKs under on-farm conditions. In this context the data generated by the Krishi Vigyan Kendras (KVK) by conducting on-farm trials in farmer's fields incorporating their perceptions in designative trails are significant milestones. This paper highlights the response of different crops to recommended fertilizer application from the data generated by the KVKs of Andhra Pradesh and Maharashtra by conducting on-farm trials (OFTs) on a large scale under on-farm conditions.

## MATERIALS AND METHODS

### Background of the study

A total of 539 on-farm trials were conducted in KVKs for multi-location testing for the last 5 years (2008-09 to 2012-13) including millet, oilseeds, pulses and fiber crops covering an area of 226.6 ha. These demonstrations were conducted on response of crops to recommended fertilizer application, soil test-based fertilizer application for different crops under different farming situations by different KVKs in Andhra Pradesh and Maharashtra. The soil types, mean annual rainfall and initial soil chemical analysis is given in Table 1. The OFTs were conducted by different KVKs under various farming situations covering the thematic areas of response of different field crops to balanced fertilization (use of recommended fertilizer doses and soil test based fertilizer use). The need for conducting the OFTs was assessed through agro-eco system analysis using the tools of participatory rural appraisal (PRA) and the treatments were finalized with the participating farmers as partners. The recommended fertilizer levels that have emerged from

the technology generation institutions of the concerned regions were selected. The same have been mentioned in the respective tables, including the farmer's practices. Comparison of the performance of the balanced fertilization was made against the farmers' practices. Sorghum, blackgram, pigeonpea, groundnut, soybean, castor and cotton crops which are important for the respective regions and all the crops were grown under different farming situations.

The benefit- cost ratio of balanced nutrient application was computed using the data of grain yield and the cost incurred towards chemical fertilizers at the prevailing market price. The area covered under OFTs has been mentioned in the respective tables and the data generated over the years across the locations have been pooled and averaged (weighted average) and presented in this paper.

**Table 1. Soil and climatic conditions of demonstration districts in Andhra Pradesh and Maharashtra**

District	Soil type	Mean annual rainfall(mm)	pH	E.C (dsm <sup>-1</sup> )	OC (%)	Available Nutrient status (kg/ha)		
						N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
<b>Andhra Pradesh</b>								
Anantapur	Red soil	552.0	7.75	0.15	0.30	282	8.4	312
Kadapa	Red soil	700.0	7.21	0.12	0.28	230	8.9	328
Nalgonda	Red soil	753.0	7.50	0.22	0.35	268	12.5	261
Ranga Reddy	Red soil	781.0	7.92	0.19	0.24	192	9.9	299
<b>Maharashtra</b>								
Ahmednagar	Black soil	561.6	8.25	0.31	0.47	252	13.2	440
Beed	Black soil	743.4	8.02	0.21	0.32	245	11.5	320
Hingoli	Black soil	946.6	8.09	0.25	0.40	205	8.8	295
Satara	Black soil	768.0	8.20	0.30	0.45	272	9.5	365

## RESULTS AND DISCUSSION

Response of crops to application of recommended doses of N, P and K was evaluated under rainfed conditions. The yield advantage was determined over the yield obtained by farmer's practice (check). The crops such as millets, oilseeds, pulses and fiber crops were included for this study. The data have been averaged over years across the locations indicating the acreage under experimentation. The findings were recorded from OFTs at farmer's fields on different types of crops under different farming situations.

### Response of field crops to nutrient application in Andhra Pradesh

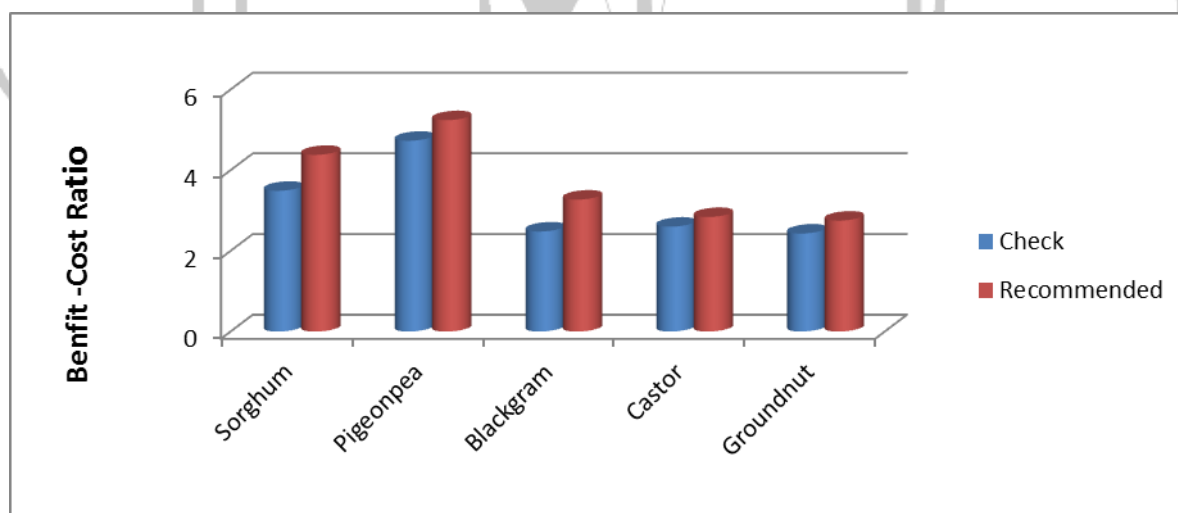
In Andhra Pradesh, the grain yield of sorghum, pigeonpea, blackgram, castor and groundnut was significantly higher at recommended dosage as compared to farmer's practice (Table 2). Yield of sorghum was increased by 53.2 per cent over the yield of 1070 kg/ha obtained with farmer's practice. Yield increase in pigeonpea and blackgram was 25.5 and 45.7 per cent, respectively due to balanced fertilization. However, no statistically significant difference was found in yield of pigeonpea over the farmer's practice.

**Table 2. Impact of soil test based nutrient application on crop yields & nutrient use efficiency in Andhra Pradesh**

Districts	Crop	Farming situation	N-P <sub>2</sub> O <sub>5</sub> - K <sub>2</sub> O application (kg/ha)		No. of Demo	Area (ha)	Yield (kg/ha)		LSD (0.05) for yield	Increase in yield (%)	Nutrient Use Efficiency (NUE)	
			Farmers practice (FP)	Recommended dose (RD)			FP	RD			FP	RD
Anantapur	Groundnut	Rainfed red soil	22-58-00	20-40-50	25	10.0	540	750	163.44*	38.9	6.8	6.8
Kadapa	Blackgram	Rainfed red soil	25-25-00	20-50-00	16	6.6	700	1020	290.67*	45.7	14.0	14.6
Nalgonda	Pigeonpea	Rainfed red soil	25-25-00	20-50-00	25	10.0	580	728	NS	25.5	11.6	10.4
Nalgonda	Castor	Rainfed red soil	45-20-20	60-40-30	25	10.0	820	1020	182.21*	24.4	9.6	7.8
Ranga Reddy	Sorghum	Rainfed red soil	50-35-00	60-40-30	40	16.0	1070	1640	283.97**	53.2	12.6	12.6

Nutrient application at recommended levels significantly increased the yield of rainfed castor and groundnut, both grown in red soils. The increase in yield of these crops was 24.4 and 38.9 per cent, respectively as shown in Table 2. The benefit cost ratio of fertilizer application

as that of farmers' practice and recommended doses for grain and oilseed crops is presented in Fig.1. In all the cases studied, use of fertilizer doses at recommended levels gave higher B:C ratio.



**Fig1. Benefit cost Ratio of Fertilization practices adopted for growing crops in Andhra Pradesh**

### Response of different field crops to nutrient application in Maharashtra.

Results illustrated in Table 3 indicated that the application of N-P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O as per

the recommendations of the respective locations has significantly increased the grain yield of sorghum, groundnut and

soybean over the yield obtained under farmer's practices at all the locations .The increase in yield was to the tune of 21.1 per cent for sorghum. However, there is

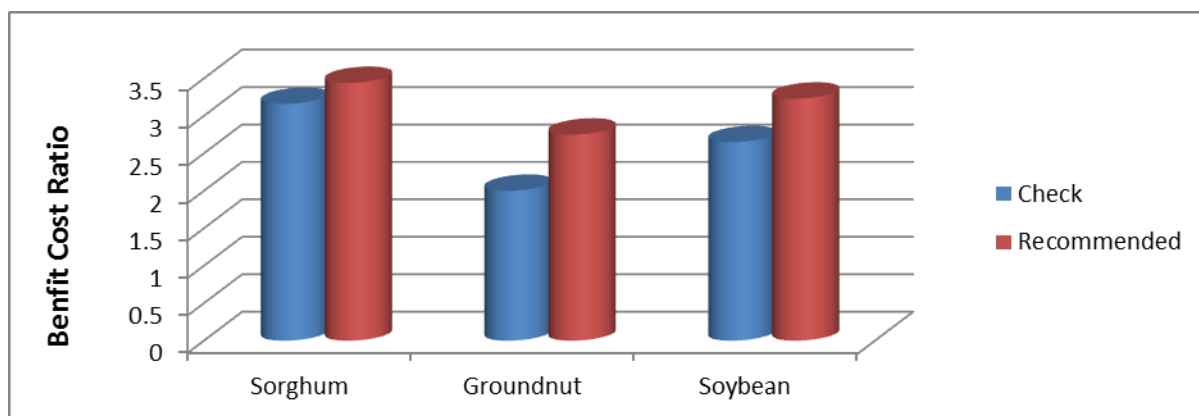
no significant difference was found in yield of sorghum over the farmer's practice

**Table 3 Yield of major crops grown in Maharashtra as influenced by nutrient application in predominant farming situations**

District	Crop	Farming situation	N-P <sub>2</sub> O <sub>5</sub> - K <sub>2</sub> O (kg/ha)		No. of Demo	Area (ha)	Yield (kg/ha)		LSD (0.05) for yield	Increase in yield (%)	Nutrient Use Efficiency (NUE)	
			Farmers practice (FP)	Recommended dose (RD)			FP	RD			FP	RD
Ahmednagar	Soybean	Rainfed black soil	30-50-00	25-60-00	78	34.8	1520	1800	257.99*	18.4	19.0	21.2
Beed	Sorghum	Rainfed black soil	45-30-00	60-25-00	188	80.6	1140	1380	NS	21.1	15.2	16.2
Satara	Groundnut	Rainfed black soil	30-45-00	25-40-40	42	17.6	750	1110	276.16*	48.0	10.0	10.6

In the case of oilseed crops, significantly higher yield of groundnut and soybean was realized with the application of NPK at the recommended levels when compared to the farmer practice due to balanced nutrient application in demonstrations (Table 3). The increase in yield was 48.0 and 18.4 percent for groundnut and soybean, respectively over the farmer's practice .The

economics of fertilizer application, expressed as benefit cost ratio (B:C) that have accrued. In all the cases, higher B:C ratio was the outcome of fertilizer doses applied in balanced form as in the case of recommended ones. Higher B:C ratio in sorghum production (3.16-3.44) was due low cash input required associated with lower level of fertilizer use.



**Fig2. Benefit cost ratio of fertilization practices adopted for growing crops in Maharashtra**

The data in tables 2&3 revealed that the average grain yield of all crops under demonstrations was higher than the grain yield produced under farmers practice in both the states due to balanced nutrient management in demonstrations. The recommended dosage of nutrients per hectare was high in Andhra Pradesh state when compared to Maharashtra state in all crops. The percentage of yield increase was high in recommended practice when compared to farmers practice irrespective of crop and farming situation in both states. Fertilizer

requirement/application per unit area was high in Andhra Pradesh state as compared to Maharashtra state.

#### **Soil test based Nutrient application:**

The advantage of application of fertilizers based on soil-test values was evaluated through on-farm testing (OFT) using soybean and cotton as test crops. In this approach balanced fertilization is achieved which leads to enhanced yield and profitability without stressing the soil health. Results obtained from some of the OFTs are presented below.

**Table 4 Yield of crops as influenced by soil test based nutrient management in Maharashtra**

District	Crop	Farming situation	Nutrient application (N-P <sub>2</sub> O <sub>5</sub> - K <sub>2</sub> O (kg/ha))		No. of Demos	Area (ha.)	Yield (kg/ha)		LSD (0.05) for yield	Increase in yield (%)	B:C ratio (Rs/ha)	
			Recommended dose (RD)	Soil test based (STB)			RD	STB			RD	STB
Beed	Soybean	Rainfed black soil	30-60-30	40-75-15	38	15.2	1114	1655	433.29*	48.6	2.22	2.53
Hingoli	Cotton	Rainfed black soil	120-60-60	160-90-30	62	25.8	2429	2765	249.13*	13.8	3.94	4.18

The data in table 4 revealed that the average grain yield of soybean was significantly increased by 48.6 per cent with application of fertilizers based on soil test values (1655 kg/ha) over the yield obtained with application of recommended doses of N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O (1114 kg/ha). The significant increase in yield of seed cotton by 13.8 per cent in STB (2765 kg/ha) was noted over the yield obtained by using recommended levels of N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O (2429 kg/ha). Soil test based fertilizer application reduced the requirement of potassium by 50 per cent in both soybean and cotton crops in rainfed black soils of Maharashtra. Similar

trends were noticed in the findings of Bera et al., (2006).

The results of the trails presented in this paper clearly indicated that the need of balanced nutrient management based on recommendations to reap maximum yield and returns from the investment on plant nutrition. Further soil test based nutrient management not only ensure sustainable crop production but will also steer the farmers towards economic usage of fertilizers depending on their financial status and prevailing market price of the crop under consideration. The findings have special relevance in that the trials were conducted under on-farm

situations with the participating farmers as partners. The data also suggest the quantum of yield which is achievable and such information is necessary for decision making process on fertilization for increasing productivity of crops.

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