Studies on Creation of Operational range of soil fertility to evolve Fertilizer Prescription Equations under Soil Test Crop Response correlation studies on Rainfed Bt cotton

ABSTRACT. In the view of deriving Fertilizer prescription equations for rainfed *Bt* cotton under Soil Test Crop Response studies based on targeted yield approach, a gradient experiment was conducted with *fodder sorghum as exhaustive crop* during *kharif* in Cotton Research station, Perambalur district of Tamil Nadu, India. Following the inductive cum yield taget methodology, three fertility gradients were created by dividing the experimental field into three equal strips which were fertilized with $N_0P_0K_0$, $N_1P_1K_1$ and $N_2P_2K_2$ levels. An exhaust crop of fodder sorghum was grown so that the fertilizers could undergo transformations in the soil with plant and microbial agencies. The recommended fertilizers ($N_1P_1K_1$) were 60, 345 and 96 kg ha^{-1} of N, P_2O_5 and K_2O, respectively. By growing the exhaust crop, the operational range of soil fertility was created in the fertility strips which were evaluated in forms of variations in fodder yield uptake and soil test values.

Keywords: Fertility gradient; fertilizer prescription equations and fodder sorghum

INTRODUCTION

The present levels of fertilizer production in India are not enough to meet the total plant nutrient requirement in order to feed growing population of the country. The continuous injudicious use of chemical fertilizers adversely affects the sustainability of agriculture production and causing environmental pollution. Because of imbalanced and inadequate fertilizer use coupled with low efficiency of other inputs response ratio to added nutrients has declined under intensive agriculture.

Bt cotton is one of the important commercial cash crops grown in India has the largest acreage (95.30 lakh hectares) at global level and has the productivity of 553 kg lint ha^{-1} and ranks second in production (310 lakh bales) after China during 2007-08. The productivity is still below the world average (642 kg ha^{-1}). Though in area wise, India ranks first in global scenario, it ranks third next to USA and China in respect of production (Biology of cotton, 2009 and Season and crop report, 2009). Nearly one third of foreign exchange (Rs.50,000 crores) is being earned through cotton and textile export.

The fertilizer application practices indicated the possibility of enhancing production potentials of rainfed *Bt* cotton. It will be always better to calculate soil fertility and crop requirement before fertilizing the crops. Such studies are possible only through inductive-cum-targeted yield approach (Ramamoorthy *at al.,* 1967) which provides a scientific basis for balanced fertilization not only among the fertilizer nutrients but also with soil available nutrients (Subba Rao and Srivastava, 1999). The *Bt* cotton is widely cultivated in Perambalur district of Tamil Nadu, India and so far STCR studies have not been conducted in this regard. Hence, the present study was undertaken to create soil fertility gradient in the experimental field at operational range in order to develop a balanced fertilization by conjoint use of organic and inorganic fertilizers based on targeted yield approach.

MATERIALS AND METHODS

The soil of the experimental field is clayey loam in texture with pH 8.1 and EC 0.30 dSm^{-1}. The available nitrogen, phosphorus and potassium in the soil was low, medium and medium level respectively. The soil is deep Vertisol belonging to Pilamedu series (Typic Haplusterts).In order to create fertility variation in the experimental field, a gradient experiment with fodder sorghum as exhaustive crop was conducted prior to test crop experiment involving BRAHMA BG -II. For this purpose, an initial composite soil sample was collected from experimental field and analyzed for available nutrient status, P and K fixing capacities of soil. The standard dose of N_1 was fixed based on the blanket recommendation and P_1 and K_1 were fixed based on the P and K fixing capacities of the soil.

The experimental field was divided in to three equal strips with plot size of 627 m^2 viz., $N_0P_0K_0$ (strip I), $N_1P_1K_1$ (strip II) and $N_2P_2K_2$ (strip III) for the creation of different fertility gradients. Eight pre sowing samples from each fertility strip thus making a total of 24 samples were collected before applying fertilizers and sowing of gradient crop. The first strip ($N_0P_0K_0$) received no fertilizer, the second ($N_1P_1K_1$) were 60, 345 and 96 kg ha^{-1} of N, P_2O_5 and K_2O, and third ($N_2P_2K_2$) received single and double dose as that of the standard dose of N, P_2O_5 and K_2O respectively ($N_1P_1K_1$). The fodder sorghum was sown and routine agronomic practices were carried out periodically as per the crop production guide. The crop was harvested after two months and strip wise yield was recorded. After the harvest of gradient crop, soil samples were collected from each

fertility strip and analysed for available N, P and K with a view to know the effect of application of graded doses of fertilizers.

Results and Discussion

Green Fodder Yield and Nutrient uptake

The green fodder yield of fodder sorghum in strip I where the crop received no fertilizers ($N_0P_0K_0$) was 12.2 t ha^{-1}. In strip II and III, the fodder yield was 32.7 and 42.7 t ha^{-1} respectively. The nitrogen uptake by the crop was 29.25, 58.86 and 66.61 kg /ha in strip I, strips II and strip III respectively. Similarly P uptake was 6.30, 17.46 and 20.49 kg /ha in strip I, strips II and strip III respectively. The potassium uptake was 35.14 kg /ha in strip I, 68.67 kg /ha in strip II and 74.30 kg /ha in strip III. There was a progressive increase in fodder yield and NPK uptake from strip I to strip III and the data confirmed the variations in fertility gradients among the three strips as reported by Deshmukh, et al.,2011.

Available nutrient status of pre sowing and post harvest soil

The twenty four soil samples collected before sowing of the gradient crop showed that mean $KMnO_4$ –N values of 162, 167 and 160 kg ha^{-1} respectively in strip I, II and III. The mean Olsen –P status of 11.8, 10.3 and 10.7 kg ha^{-1} was recorded in strip I, II and III respectively. The mean NH_4OAc –K values were 120, 122 and 128 kg ha^{-1} in strip I, II and III respectively.

Similarly, the mean $KMnO_4$ –N status in the soil after the harvest of fodder sorghum were 144, 180 and 202 kg ha^{-1} in strip I, II and III respectively. Regarding Olsen –P, it was 10.2, 23.1 and 26.3 kg ha^{-1} in strip I, II and III respectively. The mean NH_4OAc –K of the soil after the harvest of gradient crop was found to be 107, 175 and 218 kg ha^{-1} in strip I, II and III respectively. The results showed that there was a progressive increase in available N, P and K with the increased levels of N, P_2O_5 and K_2O applied. Thus the creation of soil fertility gradients for the three primary nutrients was reflected well in the soil analytical data also (Abishek *et al*.2024).

Conclusion

The findings of the above study indicated that by growing the exhaust crop, the operational range of soil fertility was created in the fertility strips which were evaluated

in forms of variations in fodder yield uptake and soil test values. The above data clearly indicated that a wide variability existed in the soil test values under gradient experiment. The creation of soil fertility gradients for the three primary nutrients was reflected well in the soil analytical data also. This serves as a plat form to develop fertilizer prescription equations under IPNS for desired yield target of rainfed Bt cotton in Perambalur district of Tamil Nadu, Indial.

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