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Resources use efficiency in *Bt*-cotton (*Gossypium hirsutum* L.) to nutrient management practices under supplemental irrigations

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Abstract

Experiment was laid out in split plot design with three fertilizer levels in main-plots and six foliar applications of nutrients in sub-plots with three replications at Agricultural College Farm, Raichur on vertisol during 2010-11. Effect of nutrient management practices differed significantly on efficiency of resources in cotton. Fertilizer levels of 156.25: 93.75:93.75 kg N:P_2O_5:K_2O ha^{-1} with 12.5 t ha^{-1} of farm yard manure recorded significantly higher seed cotton yield (17.1 q ha^{-1}) over other fertilizer levels. Besides, foliar applications of 0.5 per cent tracel (Zn, Fe, Mn and B) recorded significantly higher seed cotton yield (17.5 q ha^{-1}) against other treatments. In addition, interaction effect due to fertilizer levels of 156.25: 93.75:93.75 kg N:P_2O_5:K_2O ha^{-1} with 12.5 t ha^{-1} of farm yard manure with foliar applications of 0.5 per cent tracel recorded significantly higher seed cotton yield (19.9 q ha^{-1}), besides it was on par with fertilizer levels of 156.25: 93.75:93.75 kg N:P_2O_5:K_2O ha^{-1} with 12.5 t ha^{-1} of farm yard manure with foliar applications of 10 ppm planofix when compared to rest of the other treatment combinations.

Keywords: Fertilizer levels, foliar applications and seed cotton yield

Introduction

Intensive crop management practices increased the yield linearly with increased levels of inputs, while reverse trends was observed with efficiency of energy, nutrients and rain water productivity. Crop needs higher quantities of nutrients during vegetative and reproductive stages. Effect of continuous scheduling of macronutrients during initial stages has resulted in reduced yield, deficiency of micronutrients and reduced soil fertility status. Foliar applications of micronutrients with growth regulators, in addition to fertilizer doses reduces dropping of reproductive parts which further reflected in higher yield with available soil moisture received during crop growth stages. In crop production higher amount of energy is used for land preparation (20 - 25%), fertilizers (25 - 30%) and irrigation (25 - 35%) from commercial non-renewable sources of energy like petroleum products, which is liable to exhaust in near future. The steady decline in the energy use efficiency in the present agriculture is a matter of great concern. Efficient use of resources is an important indicator of agricultural sustainability. To increase the production, profitability and efficiency, it is essential to use best fertilizer management practices. Thus, field experiment were conducted to find out effectiveness and feasibility of different nutrient management practices

Material and methods

Experimental soil was clayey (53.5% clay) in texture with available nitrogen (218.0 kg ha^{-1}), phosphorus (35.0 kg ha^{-1}), potassium (345.0 kg ha^{-1}) and organic carbon (0.70%). Experiment was conducted during *Kharif*, 2010-11 at Agricultural College Farm, Raichur situated in North Eastern Dry Zone (Zone-2) of Karnataka at 16^{o} 12' N latitude and 77^{o} 20' E longitude with an altitude of 389 meters above the mean sea level. The experiment was laid out in split plot design with three fertilizer levels in main-plots (93.75:56.25:56.25 kg N:P_2O_5:K_2O ha^{-1} with 7.5 t ha^{-1} of farm yard manure, 125:75:75 kg N:P_2O_5:K_2O ha^{-1} with 10 t ha^{-1} of farm yard manure and 156.25:93.75:93.75 kg N:P_2O_5:K_2O ha^{-1} with 12.5 t ha^{-1} of farm yard manure). Whereas, six water soluble nutrients *i.e.*, control, 0.5% mahazinc ($ZnSO_4$), 10 ppm planofix (NAA), 0.5% nutriment ($FeSO_4$), 1% mangala $MgSO_4$ ($MgSO_4$) and 0.5% tracel (Zn, Fe, Mn and B) in sub-plots with three replications. Fertilizer doses *i.e.,* half of the nitrogen dose, entire dose of phosphorus and potassium in the form of urea, Di Ammonium Phosphate (DAP) and Muriate Of Potash (MOP) were applied as basal dose and remaining half of the nitrogen in the form of urea was top dressed in three equal splits at 50, 80 and 110 days after sowing in the ring formed 5 cm away from the plant. Whereas, foliar applications of nutrients was imposed at flowering (90 DAS) and boll formation stage (110 DAS). Crop was managed as per package of practices recommended for Zone 2. Fertilizer use efficiency was calculated as per Devasenapathy *et al*. (2008) [2], whereas, energy use efficiency by Devasenapathy *et al*. (2009) [3]. Fisher's method of analysis of variance was applied for analysis and interpretation of data as per by Panse and Sukhatme (1967) [7] and MSTATC.

Results and discussion

Effect of fertilizer levels on efficiency of resources differed significantly in cotton (Table 1, 2 and 3). Application of fertilizers through 156.25:93.75:93.75 kg $N:P_2O_5:K_2O$ ha^{-1} with 12.5 t ha^{-1} of farm yard manure recorded significantly higher rain water productivity (0.26 kg m^{-3}), as a result of higher seed cotton yield (17.1 q ha^{-1}) with available soil moisture due to adequate rainfall received during crop growth stages. Besides, fertilizer levels of 93.75:56.25:56.25 kg $N:P_2O_5:K_2O$ ha^{-1} with 7.5 t ha^{-1} of farm yard manure recorded significantly higher efficiency of nitrogen (14.3 kg yield kg^{-1} of nutrient applied), efficiency of phosphorus (23.8 kg yield kg^{-1} of nutrient applied) and efficiency of potassium (23.8 kg yield kg^{-1} of nutrient applied). Increased efficiency with lower fertilizer levels might be due to reduced nutrient losses and sustainable yields. Similarly, energy use efficiency (4.1) and energy productivity (0.066 kg MJ^{-1}) was higher with lower doses of fertilizer as a result of efficient utilization of resources which reflected in sustainable output (84.2×10^3 MJ ha^{-1}) and input energy (20.3×10^3 MJ ha^{-1}). Besides, higher output (97.0×10^3 MJ ha^{-1}) and input energy (33.1×10^3 MJ ha^{-1}) were recorded with 156.25:93.75:93.75 kg $N:P_2O_5:K_2O$ ha^{-1} with 12.5 t ha^{-1} of farm yard manure due to higher intensive management practices which reflected in higher seed cotton yield. Similar findings were also reported by Singh *et al*. (1997) [9] and Ganajaxi *et al*. (2011) [1].

Effect due to foliar applications of nutrients on efficiency of resources in cotton differed significantly (Table 1, 2 and 3). Foliar applications of Zn, Fe, Mn and B in the form of tracel recorded significantly higher rain water productivity (0.27 kg m^{-3}) over control (0.19 kg m^{-3}). Higher productivity might be due to higher seed cotton yield (17.5 q ha^{-1}) as a result of micronutrients which are essential during crop growth stages were supplied during flowering and boll formation stages with adequate rainfall conditions. Further, similar pattern of results were also recorded with efficiency of nitrogen (14.3 kg yield kg^{-1} of nutrient applied), efficiency of phosphorus (23.8 kg yield kg^{-1} of nutrient applied), efficiency of potassium (23.8 kg yield kg^{-1} of nutrient applied), energy use efficiency (3.7) and energy productivity (0.067 kg MJ^{-1}). Besides, this was followed by and on par with 10 ppm planofix. Micronutrients increased the use efficiency of nutrients which further reflected in higher seed cotton yield. Further this increased the efficiency of energy. Similar results were also recorded by Dipankarde (2006) [4] and Honnali and Chittapur (2014) [5].

Interaction effect of fertilizer levels and foliar applications of nutrients on efficiency of resources in cotton differed significantly (Table 1, 2 and 3). Fertilizer levels with respect to 156.25:93.75:93.75 kg $N:P_2O_5:K_2O$ ha^{-1} with 12.5 t ha^{-1} of farm yard manure and foliar applications of 0.5 per cent tracel recorded significantly higher rain water productivity (0.30 kg m^{-3}) when compared to other treatment combinations. This was on par with fertilizer levels of 156.25:93.75:93.75 kg $N:P_2O_5:K_2O$ ha^{-1} with 12.5 t ha^{-1} of farm yard manure and foliar applications of 10 ppm planofix. Besides, higher productivity might be due to higher seed cotton yield (19.9 q ha^{-1}) as a result of balanced and adequate nutrients supplied through soil and foliar applications under higher soil moisture conditions due to adequate rainfall during different crop growth stages. Further, fertilizer levels of 93.75:56.25:56.25 kg $N:P_2O_5:K_2O$ ha^{-1} with 7.5 t ha^{-1} of farm yard manure and foliar applications of 0.5 per cent tracel recorded significantly higher efficiency of nitrogen (16.0 kg yield kg^{-1} of nutrient applied), efficiency of phosphorus (26.7 kg yield kg^{-1} of nutrient applied) and efficiency of potassium (26.7 kg yield kg^{-1} of nutrient applied). Besides, this was on par with fertilizer levels of 93.75:56.25:56.25 kg $N:P_2O_5:K_2O$ ha^{-1} with 7.5 t ha^{-1} of farm yard manure and foliar applications of 10 ppm planofix. Higher efficiency might be due to efficient utilization of nutrients during vegetative and reproductive stages with lower fertilizer doses with foliar supplementation of micronutrients during peak nutrient requirement. Similar pattern of results were also recorded with efficiency of energy (4.4) and energy productivity (0.074 kg MJ^{-1}) as a result of lower energy input (20.3×10^3 MJ ha^{-1}). However, higher energy output (104.4×10^3 MJ ha^{-1}) was recorded with fertilizer levels of 156.25:93.75:93.75 kg $N:P_2O_5:K_2O$ ha^{-1} with 12.5 t ha^{-1} of farm yard manure and foliar applications of 0.5 per cent tracel as a result of higher yield of seed cotton. Besides, this was on par with fertilizer levels of 156.25:93.75:93.75 kg $N:P_2O_5:K_2O$ ha^{-1} with 12.5 t ha^{-1} of farm yard manure and foliar applications of 10 ppm planofix. Similar research findings were also obtained by Singh and Ahlawat (2015) [10], Kumar *et al*. (2015) [6] and Shilpha *et al*. (2018) [8].

Table 1: Seed cotton yield, rain water productivity and nitrogen use efficiency as influenced by nutrient management practices

Treatments	Seed cotton yield (q ha^{-1})							Rain water productivity (kg m^{-3})							Nitrogen use efficiency (kg yield kg^{-1} of nutrient applied)						
	S_1	S_2	S_3	S_4	S_5	S_6	Mean	S_1	S_2	S_3	S_4	S_5	S_6	Mean	S_1	S_2	S_3	S_4	S_5	S_6	Mean
F_1	12.3g	12.4g	14.3d-f	12.9fg	13.6e-g	15.0c-e	13.4c	0.19fg	0.19fg	0.22c-e	0.20e-g	0.21d-f	0.23cd	0.20c	13.1cd	13.2cd	15.2ab	13.7cd	14.5bc	16.0a	14.3a
F_2	12.1g	13.2fg	15.5cd	14.3d-f	15.4cd	17.7b	14.7b	0.18g	0.20e-g	0.24c	0.22c-e	0.23cd	0.27b	0.22b	9.7gh	10.6fg	12.4de	11.4ef	12.3de	14.2bc	11.8b
F_3	13.2fg	15.7cd	19.6a	16.1c	17.9b	19.9a	17.1a	0.20e-g	0.24c	0.30a	0.24c	0.27b	0.30a	0.26a	8.5h	10.1fg	12.5de	10.3fg	11.4ef	12.7de	10.9c
Mean	12.5d	13.8c	16.4b	14.4c	15.6b	17.5a		0.19d	0.21c	0.25b	0.22c	0.24b	0.27a		10.4d	11.3c	13.4b	11.8c	12.8b	14.3a	
	S.Em.±							S.Em.±							S.Em.±						
F	0.26							0.004							0.16						
S	0.31							0.005							0.26						
F at the same or different S	0.55							0.008							0.44						

Table 2: Phosphorus use efficiency, potassium use efficiency and energy input as influenced by nutrient management practices

Treatments	Phosphorus use efficiency (kg yield kg^{-1} of nutrient applied)							Potassium use efficiency (kg yield kg^{-1} of nutrient applied)							Energy input (× 10^3 MJ ha^{-1})						
	S_1	S_2	S_3	S_4	S_5	S_6	Mean	S_1	S_2	S_3	S_4	S_5	S_6	Mean	S_1	S_2	S_3	S_4	S_5	S_6	Mean
F_1	21.8c-e	22.0c-e	25.3ab	22.9c-e	24.2bc	26.7a	23.8a	21.8c-e	22.0c-e	25.3ab	22.9c-e	24.2bc	26.7a	23.8a	20.2	20.3	20.3	20.3	20.5	20.3	20.3
F_2	16.1hi	17.6gh	20.6ef	19.1fg	20.6ef	23.6b-d	19.6b	16.1hi	17.6gh	20.6ef	19.1fg	20.6ef	23.6b-d	19.6b	26.5	26.7	26.7	26.7	26.9	26.7	26.7
F_3	14.1i	16.8gh	20.9ef	17.2gh	19.0fg	21.2d-f	18.2c	14.1i	16.8gh	20.9ef	17.2gh	19.0fg	21.2d-f	18.2c	32.9	33.1	33.1	33.1	33.3	33.1	33.1
Mean	17.3d	18.8c	22.3b	19.7c	21.3b	23.8a		17.3d	18.8c	22.3b	19.7c	21.3b	23.8a		26.5	26.7	26.7	26.7	26.9	26.7	
	S.Em.±							S.Em.±							S.Em.±						
F	0.27							0.27							-						
S	0.44							0.44							-						
F at the same or different S	0.74							0.74							-						

Table 3: Energy output, energy use efficiency and energy productivity as influenced by nutrient management practices

Treatments	Energy output (× 10^3 MJ ha^{-1})							Energy use efficiency							Energy productivity (kg MJ^{-1})						
	S_1	S_2	S_3	S_4	S_5	S_6	Mean	S_1	S_2	S_3	S_4	S_5	S_6	Mean	S_1	S_2	S_3	S_4	S_5	S_6	Mean
F_1	77.3h	82.2f-h	86.7ef	83.2fg	86.7ef	89.3de	84.2c	3.8e	4.0d	4.3ab	4.1cd	4.2bc	4.4a	4.1c	0.061cd	0.061cd	0.070ab	0.063cd	0.066bc	0.074a	0.066c
F_2	77.9h	89.0de	93.4cd	90.9de	92.3cd	96.5bc	90.0b	2.9j	3.3hi	3.5fg	3.4gh	3.4gh	3.6f	3.4b	0.046gh	0.049fg	0.058de	0.054ef	0.057de	0.066bc	0.055b
F_3	79.0gh	96.6bc	104.5a	96.6bc	100.8ab	104.4a	97.0a	2.4k	2.9j	3.2i	2.9j	3.0j	3.2i	2.9a	0.040h	0.048fg	0.059de	0.049fg	0.054ef	0.060c-e	0.052a
Mean	78.1d	89.3c	94.8ab	90.2c	93.2b	96.7a		3.1d	3.4c	3.6ab	3.5bc	3.6ab	3.7a		0.049d	0.053c	0.062b	0.055c	0.059b	0.067a	
	S.Em.±							S.Em.±							S.Em.±						
F	0.68							0.02							0.0008						
S	0.96							0.04							0.0012						
F at the same or different S	1.67							0.06							0.0021						

Treatment details, Main-plots: F_1 - 75% RDF	**Sub-plots:** S_1: control	S_4: foliar spray of 0.5% nutriment ($FeSO_4$)
F_2 - 100% RDF	S_2: foliar spray of 0.5% mahazinc ($ZnSO_4$)	S_5: foliar spray of 1% mangala $MgSO_4$ ($MgSO_4$)
F_3 - 125% RDF	S_3: foliar spray of 10 ppm planofix (NAA)	S_6: foliar spray of 0.5% tracel (Zn, Fe, Mn and B)
* Means followed by same letter did not differ significantly by DMRT (p = 0.05), ** RDF includes 125:75:75 kg $N:P_2O_5:K_2O$ ha^{-1} with 10 t ha^{-1} of farm yard manure		
*** energy input data statistically not analyzed		

Conclusion
From the present investigation it may concluded that fertilizer levels with respect to 156.25:93.75:93.75 kg $N:P_2O_5:K_2O$ ha^{-1} with 12.5 t ha^{-1} of farm yard manure, foliar applications of 0.5 per cent tracel and their interaction performed better on efficiency of resources in cotton when compared to rest of the other treatment combinations.

References

1. Ganajaxi Halikatti SI, Hiremath SM, Chittapur BM. Productivity, profitability and energy- use efficiency of different cropping sequences in northern transition zone of Karnataka. Indian Journal of Agricultural Sciences. 2011; 81(10):921-926.
2. Devasenapathy P, Ramesh T, Gangwar B. Nutrient management studies. In: Efficiency Indices for Agriculture Management Research. New India Publishing Agency. Pitam Pura (New Delhi). 2008, 23-24.
3. Devasenapathy P, Senthilkumar G, Shanmugam PM. Energy management in crop production. Indian Journal of Agronomy. 2009; 54(1):80-90.
4. Dipankarde. Energy use pattern and future energy requirement for crop production by 2020. Journal of Agricultural Engineering. 2006; 43(3):71-77.
5. Honnali SN, Chittapur BM. Efficient cropping systems and their energetics for sustainable irrigated tropical ecosystems. Indian Journal of Agronomy. 2014; 59(4):556-560.
6. Kumar M, Mitra S, Tripathi MK, Naik MR, Naik RK, Jha AK *et al*. Energy and economic analysis for jute and allied fibres crops. Technical Bulletin 2. 2015; p. 26.
7. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers. ICAR Publications, New Delhi, 1967; p. 359.
8. Shilpha SM, Soumya TM, Mamathashree CM, Girijesh GK. Energetics in various cropping systems. International Journal of Pure and Applied Biosciences. 2018; 6(4):303-323.
9. Singh MK, Pal SK, Thakur R, Verma UN. Energy input-output relationship of cropping systems. Indian Journal of Agricultural Sciences. 1997; 67(6):262-264.
10. Singh RJ, Ahlawat IPS. Energy budgeting and carbon footprint of transgenic cotton – wheat production system through peanut intercropping and FYM addition. Environmental Monitoring and Assessment. 2015; 187(5):1-16.