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Effect of Enriched FYM Levels and Fertilizers Levels on Yield and Nutrient uptake by Hirsutum Cotton variety (*Gossypium hirsutum* L.)

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ABSTRACT: A field experiment was conducted during *Kharif*-2021 at Main Agricultural Research Station, Raichur, Karnataka to study the "Effect of enriched FYM levels and fertilizers levels on yield and nutrient uptake by *hirsutum* cotton variety (*Gossypium hirsutum* L.)''. Among enriched FYM levels, application of 7.5 t ha^{-1} enriched FYM through spot application (M_3) recorded significantly higher total dry matter production (287.48 g plant^{-1} at harvest), seed cotton yield (2629 kg ha^{-1}), harvest index (0.210), uptake of N (100.07 kg ha^{-1}), P_2O_5 (24.44 kg ha^{-1}), K_2O (116.85 kg ha^{-1}), Fe (266.10 g ha^{-1}) and Zn (1249.14 g ha^{-1}) by *hirsutum* cotton variety. Among sub plot treatments, significantly higher total dry matter production (293.39 g plant^{-1} at harvest), seed cotton yield (2676 kg ha^{-1}), harvest index (0.210), uptake of N (100.83 kg ha^{-1}), P_2O_5 (24.63 kg ha^{-1}), K_2O (117.57 kg ha^{-1}), Fe (1267.51 g ha^{-1}) and Zn (273.81 g ha^{-1}) were noticed at application of 150 per cent RDF (F_3) over remaining two other treatments *i.e.*, 125 per cent RDF and 100 per cent RDF.

Keywords: Enriched FYM, Fertilizer levels, Seed cotton yield, Nutrient uptake.

INTRODUCTION

The estimated global requirement of total fibre may reach 85.26 million MT and the cotton requirement would be 33.15 million MT by 2050, which is possible only through increased productivity (Anon., 2015). India is the largest producer of the cotton accounting for about 24.97 per cent of the world's cotton production. It has the distinction of having the largest area of 13.48 million hectares under cotton and ranks first in production with 6.05 million MT. The productivity is about 462 kg lint ha^{-1}; which is however much below the world's average productivity of 759 kg lint ha^{-1} (Anon., 2021). It is mainly due to the fact that more than 65 per cent of the cotton area is under rainfed condition, low fertilizer consumption and low fertilizer use efficiency. Among various production constraints, imbalanced and inadequate nutrition to cotton crop is considered to be one of the important factor. Supply of nutrients is the major limiting factor in cotton production and most of the soils in rainfed areas are not only thristy but also hungry. It is well established that sufficient quantities of nutrients at proper time are needed for achieving higher yield. Nutrient management in cotton is a complex phenomenon due to simultaneous production of vegetative and reproduction structures during the active growth phase. Cotton crop being a heavy feeder requires adequate supply of nutrients to optimize the seed cotton yield, quality and net profit in cotton production. The yields can be maximized only when the soil has capacity to supply sufficient nutrients in balanced proportion. No doubt, chemical fertilizers increases the productivity but due to high fertilizer cost, the profit margin per unit of input applied was low. After introduction of exhaustive high yielding varieties and hybrids in many crops including cotton, increased use of chemical fertilizers devoid of micro nutrients and inadequate application of organic manures due to its scarcity resulted in wide spread nutrient deficiency and nutrient imbalance which adversely affected cotton yields. Zinc deficiency in Indian soils is expected to increase from 42 per cent in 1970 to 63 per cent by 2025 due to continuous

depletion of soil fertility (Singh, 2011). Zn deficiency has received great attention in India, because nearly half of the Indian soils are poor in available Zn content (Shivay *et al*., 2014). Based on these facts, micronutrients like Zn and Fe need to be utilized for increasing cotton crop yields by enriching organics with Zn and Fe. Higher productivity of crops in sustainable manner without deteriorating the soil and other natural resources could be achieved only by applying appropriate combination of different enriched organic manures and inorganic fertilizers. Keeping these points in view, the present investigation was undertaken to find out the optimum enriched FYM and fertilizer level.

MATERIALS AND METHODS

The experiment was laid out in split plot design and replicated thrice. There are twelve treatment combinations comprising of four levels of enriched FYM application (M_1-2.5 t ha^{-1} enriched FYM through spot application, M_2-5.0 t ha^{-1} enriched FYM through spot application, M_3-7.5 t ha^{-1} enriched FYM through spot application and M_4-10 t ha^{-1} normal FYM through broadcasting) and three levels of fertilizers (F_1-100 % RDF, F_2-125% RDF and F_3-150 % RDF). The enriched FYM levels were allotted to main plot and fertilizer levels were allotted to sub plot. The soil of experimental plot was *Vertisols i.e.*, clayey in texture. The recommended dose of fertilizers was 80:40:40 kg NPK ha^{-1}. Half of nitrogen, entire dose of phosphorous and potassium in the form of urea, di ammonium phosphate (DAP) and muriate of potash (MOP), respectively were band placed as per treatments. Remaining half dose of nitrogen in the form of urea was top dressed in three equal splits at 50, 75 and 100 days after sowing. Variety BGDS-1063 was selected for study.

Note: Preparation of enriched FYM: Known quantity of FYM as per treatments requirement are enriched with micronutrients like Zn and Fe at the recommended dose of 15 kg $ZnSO_4$ and $FeSO_4$ each per 10 tonnes of FYM and the FYM were allowed to ferment for a month by frequently sprinkling of water and mixing the contents 2 to 3 times a day. The enriched FYM were applied at the time of sowing as per the treatments.

RESULTS AND DISCUSSION

Effect of enriched FYM levels

Total dry matter accumulation (kg ha^{-1}) and seed cotton yield (kg ha^{-1}). At harvest, significantly higher dry matter production per plant was recorded at application of 7.5 t ha^{-1} enriched FYM as spot application (M_3) (287.48 g plant^{-1}) than application of 5.0 t ha^{-1} enriched FYM as spot application (M_2) (263.06 g plant^{-1}) and 10 t ha^{-1} FYM as broadcasting (M_4) (243.27 g plant^{-1}). Application of 2.5 t ha^{-1} as spot application recorded lower total dry matter accumulation (M_1) (232.50 g plant^{-1}). Higher dry matter production per plant could be ascribed to the higher and consistent nutrient availability from organics. Application of 7.5 t ha^{-1} enriched FYM as spot application (M_3) recorded higher seed cotton yield (2629 kg ha^{-1}) and harvest index (0.210) than rest other main plot treatments (Table 1). Anilkumar and Kubsad (2017) stated that significantly higher grain yield of sorghum was noticed at application of recommended dose of fertilizers along with enriched vermicompost application.

Nutrient uptake by *hirsutum* cotton variety. Among main plot treatments, application of 7.5 t ha^{-1} enriched FYM through spot application (M_3) recorded significantly higher uptake of N (100.07 kg ha^{-1}), P_2O_5 (24.44 kg ha^{-1}), K_2O (116.85 kg ha^{-1}), Zn (266.10 gha^{-1}) and Fe (1249.14 g ha^{-1}) and their availability over rest other levels of enriched FYM application (Table 2). Nutrient uptake by crop is the product of total dry matter production and nutrient concentration in plant tissue. The higher concentration of nutrient in plant tissue could be due to increased availability of nutrients in soil solution. Treatments received zinc and iron through enriched FYM increased availability of NPK and Zn and Fe nutrients in the soil solution. The increase in availability of nutrients might be due to the potential effect of enriched organics in improving microbial and physico-chemical properties of soil which inturn facilitated and accelerated the uptake of N, P, K, Zn and Fe nutrients. The results were supported by findings of Anilkumar and Kubsad (2020) and they stated that increased availability of nutrient concentration in soil treated with enriched organics resulted in higher uptake of nutrients by sorghum crop. Veeranagappa *et al.* (2010) stated that higher uptake of nutrients was recorded at application of NPK along with Zn enriched compost than the NPK along with normal compost.

Effect of fertilizer levels

Total dry matter accumulation (kg ha^{-1}) and seed cotton yield (kg ha^{-1}). Among NPK levels, application of 150 per cent recommended dose of fertilizers (F_3) gave significantly higher dry matter production per plant (293.39 g plant^{-1}) followed by 125 per cent RDF (F_2) (254.64 g plant^{-1}) over 100 per cent RDF (F_1) (221.70 g plant^{-1}). Among various levels of NPK, 150 per cent RDF (F_3) recorded higher seed cotton yield (2676 kg ha^{-1}) over 125 per cent (F_2) (2312 kg ha^{-1}) and 100 per cent RDF (F_1) (1987 kg ha^{-1}). This could be attributed to higher availability of nutrients through the inorganic nutrients which increases the photosynthetic activity resulted in higher dry matter accumulation. Harvest index increases with increasing the levels of NPK. Ghule *et al.* (2013) stated that seed cotton yield increases with increasing the levels of NPK. Similar findings were reported by Hiwale *et al*. (2018); Malik *et al*. (2021).

Table 1: Effect of enriched FYM levels and fertilizer levels on total dry matter accumulation at harvest (kg ha^{-1}), seed cotton yield (kg ha^{-1}) and harvest index.

Treatment	Total dry matter accumulation at harvest (kg ha^{-1})	Seed cotton yield (kg ha^{-1})	Harvest Index
Main plot (M): Manure levels			
M_1-2.5 t ha^{-1} enriched FYM through spot application	232.50	2072	0.200
M_2-5.0 t ha^{-1} enriched FYM through spot application	263.06	2390	0.210
M_3-7.5 t ha^{-1} enriched FYM through spot application	287.48	2629	0.210
M_4-10.0 t ha^{-1} FYM through broadcasting	243.27	2208	0.200
S. Em.±	**2.10**	**44**	**0.003**
C. D. at 5%	**7.28**	**153**	**0.009**
Sub plot (F): Fertilizer levels			
F_1-80:40:40 kg NPK ha^{-1}	221.70	1987	0.200
F_2-100:50:50 kg NPK ha^{-1}	254.64	2312	0.200
F_3-120:60:60 kg NPK ha^{-1}	293.39	2676	0.210
S. Em.±	**2.66**	**48**	**0.002**
C. D. at 5%	**7.97**	**143**	**0.007**

Table 2: Effect of enriched FYM levels and fertilizer levels on N uptake (kg ha^{-1}), P_2O_5 uptake (kg ha^{-1}), K_2O uptake (kg ha^{-1}), Fe uptake (g ha^{-1}) and Zn uptake (g ha^{-1}) by *hirsutum* cotton variety.

Treatment	N uptake (kg ha^{-1})	P_2O_5 uptake (kg ha^{-1})	K_2O uptake (kg ha^{-1})	Fe uptake (g ha^{-1})	Zn uptake (g ha^{-1})
Main plot (M): Manure levels					
M_1-2.5 t ha^{-1} enriched FYM through spot application	84.17	20.99	102.20	990.25	201.08
M_2-5.0 t ha^{-1} enriched FYM through spot application	93.13	22.99	110.48	1137.80	236.85
M_3-7.5 t ha^{-1} enriched FYM through spot application	100.07	24.44	116.85	1249.14	266.01
M_4-10.0 t ha^{-1} FYM through broadcasting	88.15	21.88	106.35	1054.99	214.66
S. Em.±	**1.05**	**0.42**	**1.43**	**14.84**	**5.15**
C. D. at 5%	**3.65**	**1.45**	**4.95**	**51.34**	**17.80**
Sub plot (F): Fertilizer levels					
F_1-80:40:40 kg NPK ha^{-1}	81.27	20.50	99.25	951.59	184.71
F_2-100:50:50 kg NPK ha^{-1}	92.05	22.60	110.08	1105.38	230.43
F_3-120:60:60 kg NPK ha^{-1}	100.83	24.63	117.57	1267.51	273.81
S. Em.±	**0.97**	**0.31**	**0.83**	**16.43**	**4.02**
C. D. at 5%	**2.91**	**0.92**	**2.48**	**49.26**	**12.04**

Nutrient uptake by *hirsutum* cotton variety. Significantly higher uptake of N (100.83 kg ha^{-1}), P_2O_5 (24.63 kg ha^{-1}), K_2O (117.57 kg ha^{-1}), Fe (1267.51 g ha^{-1}) and Zn (273.81 g ha^{-1}) were noticed at application of 150 per cent RDF (F_3) over remaining two other treatments *i.e*., 125 per cent RDF and 100 per cent RDF. This increase in uptake of nutrients may be attributed to higher total dry matter production at higher level of nutrient application. This results are in accordance with Katkar *et al*. (2002); Bhalerao *et al*. (2012); Hemlata *et al*. (2016).

CONCLUSIONS

From the results of the present study, it is concluded that there was significant response of enriched FYM application on cotton crop. Among main plot treatments (*i.e.*, enriched FYM levels), application of 7.5 t ha^{-1} enriched FYM through spot application recorded significantly higher total dry matter production, seed cotton yield and nutrient uptake.

There was linear increase in dry matter production, seed cotton yield (kg ha^{-1}), harvest index and nutrient uptake with increasing levels of major nutrients. Among three levels of NPK application, 150 per cent RDF found superior in yield and nutrient uptake over 125 % and 100 %.

FUTURE SCOPE

As BGDS-1063 is a newly released variety by University of Agricultural Sciences, Raichur, there is need to standardize package of practices for this variety. If we manage *hirsutum* cotton varieties properly, these varieties also yield as much as by hybrids**.** In future if *Bt* hybrids fail by any cause then these varieties palys a crusial role in maintainig fibre security of India.

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Conflict of Interest. None.

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