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Effect of nutrient management and moisture conservation practices on plant NPK content (%), plant uptake at harvest and post-harvest soil fertility under rainfed Bt cotton

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Abstract
A field experiment was conducted on clay soil of Regional Agricultural Research Station, Lam, Guntur to find out the effect of nutrition and moisture conservation practices on NPK content (%) in plants, plant uptake at harvest and post-harvest soil fertility. The nutrient management and moisture conservation practices influenced the NPK content (%) in plants, plant uptake at harvest and post-harvest soil fertility. Application of 125%RDF (150:75:75) with opening furrow for every row during last intercultural operation + foliar nutrition with 2% KNO3at square formation, flowering, and boll development stages recorded maximum percentage of plant NPK, maximum nutrient uptake and seed cotton yield and was on a par with 125% RDF (150:75:75) fertilizer application + foliar nutrition with 2% KNO_3at square formation, flowering, and boll development stages and 100% RDF (120:60:60) + opening furrow for every row during last intercultural operation + foliar nutrition with 2%KNO_3at square formation, flowering and boll development stages and lowest seed cotton yield was recorded with application of 100% RDF (120:60:60kg ha-1).

Keywords: Post-harvest soil fertility, *in- situ*, soil moisture conservation and foliar nutrition

Introduction
Cotton is an important fibre (king of fibre) as well as cash crop of India**.** In India, *Bt* cotton is grown in an area of 12.2 m. ha with an annual production of 377 lakh bales and a productivity of 524 kg lint ha^{-1}**.** In the state of Andhra Pradesh, *Bt* cotton occupies an area of 5**.**44 lakh hectares with an annual production of 22 lakh bales and productivity of 688 kg lint ha^{-1} (AICCIP, Annual Report, 2017-2018) [1].
Nutrient management in cotton is complex phenomenon due to its simultaneous production of vegetative and reproductive structures during the active growth stage. Squaring, blooming and boll development are the stages where cotton needs the highest nutrients demand. The *Bt* cotton has three distinct characters of synchronized flowering, retention of most of the first formed bolls and reduced crop duration to an extent of one or two weeks, therefore there is a scope to increase the productivity with foliar nutrition coupled with soil application of fertilizers (Santosh *et al*., 2016) [10]. Augmentation of nutrient supply through foliar application at such critical stages may increase yield (Nehra and Yadav, 2012) [9]. Foliar nutrition when used as a supplement to the recommended soil fertilizer application is highly beneficial, as the crop gets benefitted from foliar applied nutrients when the roots are unable to meet the nutrient requirement of the crop at its critical stage (Ebelhar and Ware 1998) [3].
Foliar application of nutrients is one of the most efficient ways of supplying essential nutrient to the cotton crop at appropriate stage. Through foliar nutrition, the nutrients are taken into the foliage and distributed (transported) to all parts of the plant within a short period of time to get the needy effect. It is also effective in correcting the mid-season discrepancies in cotton crop growth that may be due to either intensive growth or inappropriate supply of nutrients from the soil abiotic stress condition (Kumari and Hema, 2009) [8]. It also regulates the biochemical changes in seed and increases yield of cotton.
Though the upland cotton is of more than 150 days duration, the major nutrient requirement is confined to only about 30 to 40 days, especially from flowering to boll-formation stage**.** The crop takes about 5 kg ha^{-1} day^{-1} during this period. Under these circumstances the uptake of these nutrients are more important because in *Bt* cotton synchronized boll development altered the source-sink relationship due to rapid translocation of saccharides and nutrients from leaves to the developing bolls and soil may not commensurate with the high demand for nutrients, in general and under rainfed conditions in particular.

Under such situation the foliar application of nutrients may supplement the soil- applied nutrients to meet the high demand of the crop during the critical fruiting period of cotton.

Material and Methods

A field experiment was conducted during *kharif* 2017-18 at Regional Agricultural Research Station, Lam, Guntur, the soil of the experimental field was clay in texture, neutral in reaction (7.45), low in total nitrogen and high in available phosphorus and potassium. The experiment was laid out in a randomized block design with three replications and eight treatments .The allocated treatments were T_1 – 100% RDF (120:60:60) NPK kg ha-^{1}, T_2 –125% RDF (150:75:75) NPK kg ha-^{1}, T_3 – 100% RDF (120:60:60) + opening furrow for every row during last intercultural operation, T_4 - 125% RDF (150:75:75) + opening furrow for every row during last intercultural operation, T_5 – 100% RDF (120:60:60) + Foliar nutrition with 2% KNO_3 at square formation, flowering and boll development, T_6 -125% RDF (150:75:75) + Foliar nutrition with 2 %KNO_3 at square formation, flowering and boll development, T_7 -100% RDF (120:60:60) +opening furrow for every row during last intercultural operation + foliar nutrition with 2% KNO_3 at square formation, flowering and boll development and T_8 –125% RDF (150:75:75)+ opening furrow for every row during last intercultural operation + Foliar nutrition with 2% KNO_3 at square formation, flowering and boll development. Phosphorus was applied as basal through SSP as per the treatments. Nitrogen and potassium was applied through urea and Murete of potash 1/3 at basal, 1/3 at 60 DAS and 1/3 at square initiation stage. The hirsutum Bt hybrid (jadoo) was sown at spacing of 105 cm x 60 cm on 15 July, 2017-18. The data on plant height, boll weight and number of bolls per plant were recorded from randomly selected five plants from each plot and seed cotton yield was recorded on /plot basis. Other agronomic practices and plant protection measures were followed as per recommendation.

Results and Discussion

The per cent of nitrogen, phosphorus and potassium at harvest stages in the cotton was recorded. In the study the nutrient management and moisture conservation practices did not influence the nitrogen, phosphorus and potassium per cent in plant Table 1

Nutrient uptake (NPK kg ha^{-1}) by plants at harvest was significantly influenced by nutrient management and soil moisture conservation practices. Fig. 1 and Table 1.

The data on nitrogen uptake at harvest presented in table (Table 1) and depicted in Fig. 4.5 revealed maximum uptake of nitrogen (69.5 kg ha-^{1}) by cotton was recorded with 125% RDF (150:75:75) +opening furrow for every row during last intercultural operation + foliar nutrition with 2% KNO_3 at square formation, flowering, and boll development and was on a par with125% RDF (150:75:75) + Foliar nutrition with 2% KNO_3 at square formation, flowering, and boll development and 125% RDF (150:75:75) +Opening furrow for every row during last intercultural operation. The lowest nitrogen uptake (59 kg ha-^{1}) was recorded with 100% RDF 120:60:60 NPK kg ha-^{1} Nitrogen uptake by plants was significantly higher with higher level of fertilizers which might be due to higher dry matter accumulation per unit area which is a result of vigorous growth of plants. These results are in conformity with Singh *et al*. (2003) [11] and Halemani *et al*. (2004) [6] and Devraj *et al*. (2011) [4].

Similarly to nitrogen uptake, phosphorus uptake was significantly influenced by varied nutrient management and soil moisture conservation practices (Table 1). Phosphorus uptake was significantly superior (18.8 kg P ha-^{1}) with 125% RDF (150:75:75) +opening furrow for every row during last intercultural operation + foliar nutrition with 2% KNO_3 at square formation, flowering, and boll development and was on par with 125% RDF (150:75:75), 125% RDF (150:75:75) +opening furrow for every row during last intercultural operation and 125% RDF (150:75:75) + foliar nutrition with 2% KNO_3 at square formation, flowering, and boll development, might be due to higher dry matter accumulation obtained from higher fertilizer application, opening of furrow at every row and foliar spray of KNO_3. The lowest phosphorus uptake (12.7 kg P ha-^{1}) was recorded with 100% RDF 120:60:60 NPK kg ha-^{1}. Similar results was observed by Dhillon *et al*. (2006) [5] and Jitendra S *et al*. (2016) [7].

Potassium uptake was significantly influenced by nutrient management and Soil moisture conservation practices (Table 1). maximum Potassium uptake (52.1 kg K ha-^{1}) was recorded with 125% RDF (150:75:75) +Opening furrow for every row during last intercultural operation + Foliar nutrition with 2% KNO_3 at square formation, flowering, and boll development and was on par with 125% RDF (150:75:75), 125% RDF (150:75:75) +opening furrow for every row during last intercultural operation and 125% RDF (150:75:75) + foliar nutrition with 2% KNO_3 at square formation, flowering, and boll development. The lowest potassium uptake *(*41.2 kg K ha^{-1}*)* was recorded at RDF (120:60:60) NPK kg ha-^{1}. Similar observations made by Babaria *et al*. (2010) [2], Jitendra S *et al*. (2016) [7].

The post-harvest available N, P_2O_5 and K_2O status of the soil was slightly increased due to nutrient management and moisture conservation practices (Table 2). Post-harvest soil fertility status with respect to available N, P_2O_5 and K_2O was found to be improved at each successive level of nutrient supply. The available N, P_2O_5 and K_2O status in post-harvest soil varies from 136.80 to 143.20, 45.10 to 52.70 and 391.90 to 399.10 kg ha^{-1}. Higher value (143.40, 52.70 and 399.10 kg ha^{-1}*)* of post-harvest soil available N, P_2O_5 and K_2O was registered with 100% RDF 120:60:60 kg ha^{-1} which was on par with remaining all treatments. Whereas, the lowest content (136.80, 45.10 and 391.90 kg ha^{-1}) of post-harvest soil available N, P_2O_5 was observed in plots which received 125% RDF (150:75:75) +opening furrow for every row during last intercultural operation + foliar nutrition with 2% KNO_3 at square formation, flowering, and boll development. The increase in the post-harvest available N, P_2O_5 and K_2O status of the soil might be due to extra application of fertilizer than normal recommended dose and also at 80 DAS of crop the leaves are begin to fall that in turn cause to increase the content in soil due to mineralization.

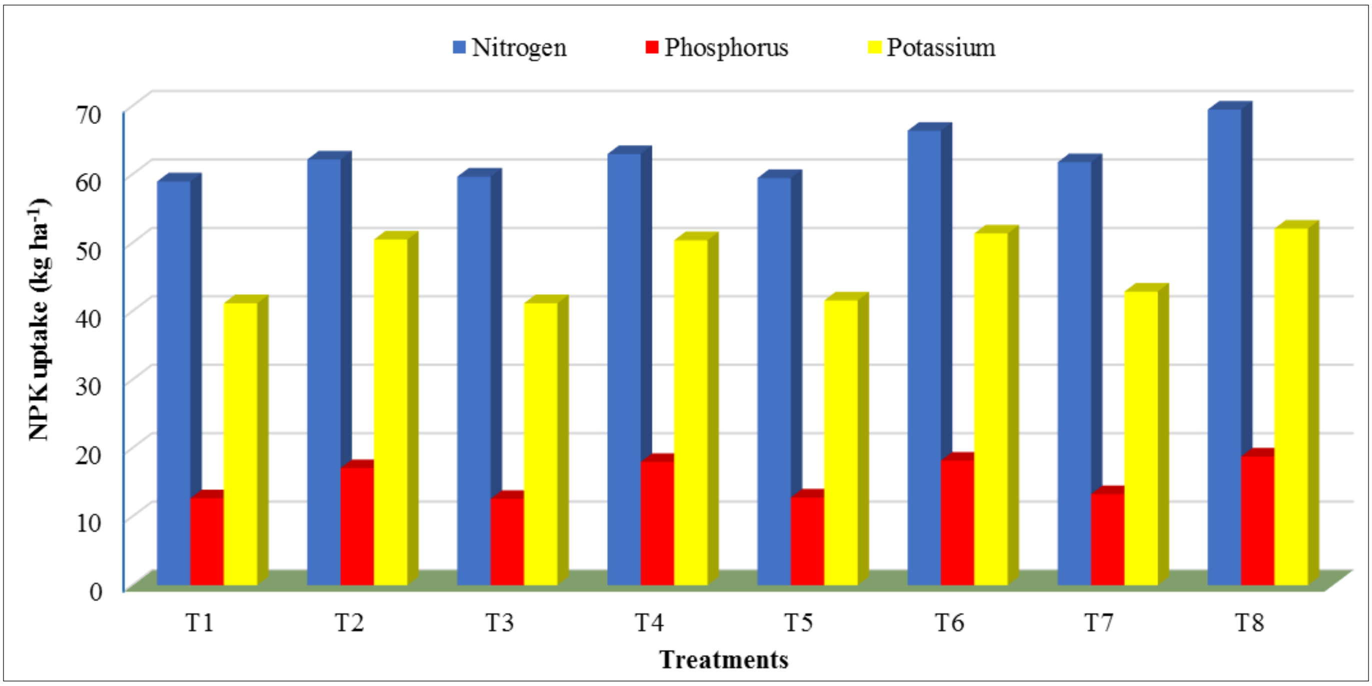

Fig 1: NPK uptake (kg ha-^{1}) at harvest stage of Bt cotton as influenced by nutrient management and moisture conservation practices

Table 1: Nitrogen content (%) and uptake (kg ha^{-1}), Phosphorus content (%) and uptake (kg ha^{-1}) and Potassium content (%) and uptake (kg ha^{-1}) at harvest and Available N (kg ha^{-1}), $P_2 0_5$ (kg ha^{-1}), $K_2 0$ (kg ha^{-1}) in soil after harvest of Bt cotton as influenced by nutrient management and soil moisture conservation practices

Treatments	Nitrogen			Phosphorus			Potassium		
	Content (%)	Uptake (kg ha^{1})	Available (kg ha^{-1})	Content (%)	Uptake (kg ha^{1})	Available (kg ha^{-1})	Content (%)	Uptake (kg ha^{-1})	Available (kg ha^{-1})
T_1 -100 %RDF)120:60:60(NPK	0.41	59.0	143.8	0.07	12.7	52.7	0.35	41.2	403.9
T_2 - 125 %RDF)150:75:75(NPK	0.48	62.2	138.2	0.08	17.1	48.1	0.36	50.5	391.4
T_1 +Opening furrow for every row during last intercultural operation.	0.43	59.7	142.8	0.07	12.6	50.4	0.35	41.2	402.8
T_2 +Opening furrow for every row during last intercultural operation.	0.49	63.0	137.4	0.09	16.0	46.3	0.38	50.4	391.1
T_1 +Foliar nutrition with 2 %KNO_3 at square formation, flowering, and boll development.	0.43	59.5	140.6	0.08	12.8	46.7	0.37	41.6	401.5
T_2 +Foliar nutrition with 2 %KNO_3 at square formation, flowering, and boll development.	0.49	66.4	136.8	0.09	18.2	45.7	0.42	51.4	390.6
T_3+ Foliar nutrition with 2 %KNO_3 at square formation, flowering, and boll development.	0.44	61.8	139.0	0.08	13.3	48.8	0.38	42.9	399.2
T_4+ Foliar nutrition with 2 %KNO_3 at square formation, flowering, and boll development.	0.50	69.5	136.8	0.09	18.8	45.1	0.44	52.1	390.2
S.Em±	0.011	1.9	7.9	0.002	0.5	3.0	0.009	1.6	12.3
CD)P=0.05(	NS	6.9	24.1	NS	1.5	9.3	NS	5.0	37.3
CV (%)	4.3	5.3	9.8	3.3	5.6	11.1	3.8	6.2	5.4

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