Plant Archives Vol. 25, No. 1, 2025 pp. 333-339 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2025.v25.no.1.051

EFFECT OF DIFFERENT COTTON GENOTYPE, NUTRIENT MANAGEMENT AND CANOPY MANAGEMENT PRACTICES ON NUTRIENT STATUS OF SOIL IN *BT* COTTON UNDER DRIP IRRIGATED

Avinash Gawate[1]*, S.U. Kakade[1], N.D. Parlawar[2] and S.A. Ambore[4]

[1]Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra, India.
[2]Retd. Associate Dean, Vasantrao Naik College of Agriculture Biotechnology, Yavatmal, Maharashtra, India.
*Corresponding author E-mail : avinashfgawate@gmail.com
(Date of Receiving-21-11-2024; Date of Acceptance-06-02-2025)

ABSTRACT

The experiment was laid out in split-split plot design with 16 treatment combination replicated thrice. A field experiment was conducted at Cotton Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the season *kharif* 2021-2022 and *kharif* 2022-2023. In cotton genotype (V_2) PDKV JKL 116 recorded significantly highest uptake of NPK (117.89, 17.64, 72.44 and 107.88, 24.40 68.05 NPK kg ha^{-1}) over (V_1) PKV Hy-2 (100.12, 22.68, 63.85 and 85.55, 17.76, 56.03 NPK kg ha^{-1}). Among different nutrient management treatment application of 125% Recommended dose of N and K ha^{-1} (N_2) recorded significantly highest NPK uptake (114.35, 26.67, 70.61 and 104.58, 23.57, 65.88 NPK kg ha^{-1}) (N_1) over application of100% Recommended dose of N and K ha^{-1} (103.66, 23.65, 65.67 and 88, 18.60, 58.20 NPK kg ha^{-1}). In different canopy management practices treatment C_2 (monopodia removal at 60 DAS and detopping at 75-80 DAS) recorded significantly highest NPK uptake (121.48, 28.15, 73.61 and 116.83, 24.18, 70.51 NPK kg ha^{-1}) over C_1 (control) 96.61, 22.24, 62.41 and 80.32, 14.56, 50.80 NPK kg ha^{-1} during both the year of study. In Partial factor productivity (PFP) of cotton genotype PDKV JKL 116 (V_2) observed significantly highest PFP (14.70 and 13.80 kg kg^{-1}) over PKV Hy-2 (V_1) 12.64 and 11.45. Among different nutrient management practices application of 100% Recommended dose of N and K ha^{-1} (N_1) recorded significantly highest PFP (14.23 and 13.52 kg kg^{-1}) over application of 125% recommended dose of N and K kg ha^{-1} (13.10 and 11.72 kg kg^{-1}). In canopy management practices removal of monopodia at 60 DAS and detopping at 75-80 DAS recorded significantly highest PFP (15.16 and 14.18 kg kg^{-1}) over control treatment (C_1) 12.31 and 11.69 during both the year of experiment (2021-22 and 2022-23).

Key words : Canopy management, Drip irrigation, Detopping, Mepiquat chloride (MC), Monopodia removal, Nutrient management.

Introduction

Cotton is considered to be the main fiber and commercial crop grown in India. India accounts for 23% of the world's cotton production. India ranks first in terms of cotton cultivation, 40% of the world's cotton area is in India (ICAC, 2023). Cotton production is done in two major states in India, namely Maharashtra and Gujarat. The area of cotton cultivation is the highest in Maharashtra but the production is higher in Gujarat. There are some main reasons for the decline in cotton production, such as 67% of cotton production in India is based on rain water and the remaining 33% area is dependent on irrigation only. The second reason is that the production decreases due to improper use of the fertilizer, and most of the nutrients in the given fertilizer are used for its vegetative growth, so its reproductive growth decreases and due to this also there is a decrease in our cotton production. If we want to improve cotton productivity, we need to use proper canopy management practices and fertilizers use. In canopy management, we can do various agronomic practices like de-topping, monopodia cutting and spraying with Mepiquat chloride which stops the vegetative growth of the trees and promotes reproductive growth, thus increasing our production. In

this paper, we have studied how production can be increased by using different fertilizer doses and different canopy management practices.

Materials and Methods

The present experiment was carried out in two growing season kharif 2021-22 and kharif 2022-23 at Cotton research Unit Dr. Panjabrao Deshmukh Krushi Vidyapeeth, Akola, Maharashtra. The experimental site was located at 20.7039246 N and 77.0655831 E. The soil of experimental site was slightly saline in texture with pH (8.2), organic carbon (0.52%), electric conductivity (0.34 dSm^{-1}), available nitrogen (170 kg ha^{-1}), available phosphorus (19.18 kg ha^{-1}) and available potassium (308 kg ha^{-1}) during two years of experiment (*rabi* 2021-22 and *rabi* 2022-23). The present experiment was laid out in split-split plot design with 16 treatment combination replicated thrice. The treatment detail was, in main plot (factor A) two cotton genotype is used i.e V_1-PKV Hy 2 and V_2- PDKV JKL 116, in Factor B, two nutrient doses was used *i.e* N_1 -100% Recommended dose of N and K ha^{-1} in four unequal splits and 125% Recommended dose of N and K ha^{-1} in four unequal splits. Application of 100% recommended dose of Phosphorus at the time of sowing. In sub plot four canopy management treatment is used namely, C_1- Control, C_2- Monopodia removal of at 60 DAS and detopping at 75-80 DAS, C_3- Monopodia removal at 60 DAS and spraying of mepiquat chloride 5% w/w at 75 DAS and C_4- Spraying of mepiquat chloride 5% w/w at 75 DAS.

The splits application of nutrient, quantity of fertilizer and stages of application given following:

N and K fertilizer dose	Quantity of N and K	No. of splits	Stages of crop
100% N & K	120 kg N & 60 kg K	**4 splits**	
		20% N and K	At sowing
		30% N and K	At 30 DAS
		30% N and K	At 60 DAS
		20% N and K	At 90 DAS
125% N & K	150 kg N & 75 kg K	**4 splits**	
		20% N and K	At sowing
		30% N and K	At 30 DAS
		30% N and K	At 60 DAS
		20% N and K	At 90 DAS

Note - Application of 100% P at the time of sowing

The data of growth parameter was recorded by 30, 60, 90, 120 DAS and at harvest and Yield, yield attributing character and nutrient status was recorded by after harvesting of crop.

Results and Discussion

Available nutrient

Initial available nitrogen, phosphorus and potassium status of soil before sowing were 170, 19.18 and 308 kg ha^{-1}, respectively. The post-harvest residual NPK status was determined and available soil NPK as affected by different treatments are presented in Table 1. In general, an increase in soil available NPK at post-harvest was noticed as compared to initial soil nutrient status. The different treatments showed significant influence on post-harvest soil available nutrient status. The maximum soil available nitrogen, phosphorus and potassium were recorded with PDKV JKAL-116 (221.38, 20.28, 329.82 and 225.52, 21.11, 337.74 NPK kg ha^{-1}) over PKV Hy-2 (214.10, 19.86, 308.74 and 218.90, 20.64, 315.16 NPK kg ha^{-1}) it might be due to less varietal duration of PDKV JKL 116 than PKV Hy 2.

Among nutrients doses application of 125% recommended dose of N and K ha^{-1} (N_2) recorded significantly highest available NPK (220.34, 20.20, 331.77 and 224.68, 21.00, 338.22 NPK kg ha^{-1}) (N_1) over application of100% Recommended dose of N and K ha^{-1} (215.14, 19.93, 306.79 and 219.74, 20.76, 314.67 NPK kg ha^{-1}). The great improvement in available nitrogen status of soil can be ascribed to the cumulative effect of added nitrogen to the soil and indirect addition through leaf drop and root debris backed up by favourable soil microbial activity because of good soil moisture availability through drip irrigation throughout the crop growth which might have converted immobilized organically bound nitrogen into inorganic available form. These results are in accordance with the results of Suganya *et al*. (2007), Gokila (2012), Pawar *et al*. (2013) and Kakade *et al*. (2017). Increase in available P with increase in fertilizers levels might be attributed to the contribution from inorganic phosphorus in the fertilizer to the available phosphorus pool and also due to mobilization of the residual P through rhizosphere acidification due to adequate soil moisture during the period of experimentation. Supply of water at shorter interval and N and K supply through drip irrigation created a favourable condition rendering more nutrients available in the soil. Increasing the soil nutrient availability with drip fertigation was reported earlier by Veeraputhiran (2000), Sathyaprakash (2007), Gokila (2012).

The soil available nitrogen, phosphorus and potassium after harvest of crop was influenced significantly due to different canopy management practices. Significantly higher soil available nitrogen, phosphorus and potassium was maximum under monopodia removal at 60 DAS and detopping at 75-80 DAS (C_2) (222.72, 20.78, 331.29 and

Table 1 : Nutrient status of soil (NPK kg ha^{-1}) at initial and after harvesting of cotton as influenced by different *Bt* cotton hybrids, fertigation levels and canopy management practices in cotton.

Treatment	2021-22			2022-23		
	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
Varieties						
V_1- PKV Hy 2	214.10	19.86	308.74	218.90	20.64	315.16
V_2- PDKV JKAL 116	221.38	20.28	329.82	225.52	21.11	337.74
SE (m)±	1.13	0.35	3.58	1.04	0.36	2.90
CD at 5 %	3.90	NS	12.40	2.59	NS	10.05
Nutrient management						
N_1- 100% RDNK in 4 splits	215.14	19.93	306.79	219.74	20.76	314.67
N_2- 125% RDNK in 4 splits	220.34	20.20	331.77	224.68	21.00	338.22
SE (m) ±	1.13	0.35	3.58	1.04	0.36	2.90
CD at 5%	3.90	NS	12.40	3.59	NS	10.05
Canopy management Practices						
C_1- Control	211.60	19.45	308.31	215.65	20.23	315.37
C_2- Monopodia removal at 60 DAS and detopping at 75-80 days	222.72	20.78	331.29	229.32	21.62	339.95
C_3- Monopodia removal at 60 DAS and spraying of mepiquat chloride 5% w/w at 75 DAS	217.95	20.29	320.65	223.64	21.12	328.61
C_4- Spraying of mepiquat chloride 5% w/w at 75 DAS	218.69	19.75	316.87	220.23	20.55	321.86
SE (m) ±	2.49	0.56	5.13	1.91	0.58	4.06
CD at 5%	7.26	NS	14.97	5.59	NS	11.84
Levels of interaction (V X N X C)						
SE (m) ±	4.98	0.83	10.26	3.83	1.16	8.11
CD at 5%	NS	NS	NS	NS	NS	NS
GM	217.74	20.18	319.28	222.21	20.88	326.45
Initial value	170	19.18	308	170	19.18	308

229.32, 21.62, 339.95 NPK kg ha^{-1}) than Control (C_1) (211.60, 19.45, 308.31 AND 215.65, 20.23, 315.37 NPK kg ha^{-1}). However, C_3 (monopodia removal at 60 DAS and spraying of mepiquat chloride 5% w/w at 75 DAS) and C_4 (spraying of mepiquat chloride 5% w/w at 75 DAS) were found significantly at par with each other in respect of available nitrogen and potassium in soil after harvest of crop during 2021-22 and 2022-23.

Nutrient's uptake

Nitrogen uptake

The data revealed that, the *Bt* cotton hybrids on nitrogen uptake was influenced significantly among the treatments. The cotton hybrid PDKV JKAL-116 recorded highest nitrogen uptake (117.89 and 107.88 N kg ha^{-1}), which was followed by PKV Hy-2 (100.12 and 85.55 N kg ha^{-1}) it might be due to growth habit of cotton genotype.

Fertigation schedule with various fertilizer doses had a substantial impact on nitrogen uptake, by *Bt.* cotton. During both years of the experiment the highest values of nitrogen uptake (114.35 and 104.58 N kg ha^{-1}) in *Bt.* cotton and total uptake were observed in fertigation scheduling with the highest fertilizer level of application of 125% recommended dose of NPK kg ha^{-1} (N_2) and the lowest (103.66 and 88.00 N kg ha^{-1}) in fertigation scheduling with the lowest fertilizer level of 100 percent recommended dose of NPK kg ha^{-1} (N_1) during 2021-22 and 2022-23 it might be due to, application of nutrients in

Table 2 : Uptake of NPK (kg ha^{-1}) by crop as influenced by different *Bt* cotton hybrids, fertigation levels and canopy management practices in cotton during 2021-22 and 2022-23.

Treatment	2021-22			2022-23		
	N uptake (kg ha^{-1})	P uptake (kg ha^{-1})	K uptake (kg ha^{-1})	N uptake (kg ha^{-1})	P uptake (kg ha^{-1})	K uptake (kg ha^{-1})
Varieties						
V_1- PKV Hy 2	100.12	22.68	63.85	85.55	17.76	56.03
V_2- PDKV JKAL 116	117.89	27.64	72.44	107.88	24.40	68.05
SE (m) ±	1.54	0.32	0.68	2.68	0.88	1.54
CD at 5 %	5.31	1.11	2.36	9.29	3.05	5.34
Nutrient management						
N_1- 100% RDNK in 4 splits	103.66	23.65	65.67	88.00	18.60	58.20
N_2- 125% RDNK in 4 splits	114.35	26.67	70.61	104.58	23.57	65.88
SE (m) ±	1.54	0.32	0.68	2.68	0.88	1.54
CD at 5%	5.31	1.11	2.36	9.29	3.05	5.34
Canopy management Practices						
C_1- Control	96.61	22.24	62.41	80.32	14.56	50.80
C_2- Monopodia removal at 60 DAS and detopping at 75-80 days	121.48	28.15	73.61	116.83	24.18	70.51
C_3- Monopodia removal at 60 DAS and spraying of mepiquat chloride 5% w/w at 75 DAS	111.54	25.81	69.42	99.54	22.50	65.69
C_4- Spraying of mepiquat chloride 5% w/w at 75 DAS	106.40	24.45	67.12	90.16	19.09	61.15
SE (m) ±	2.34	0.49	1.58	3.73	1.67	2.62
CD at 5%	6.83	1.44	4.61	10.88	4.87	7.64
Levels of interaction (V X N X C)						
SE (m) ±	4.68	0.99	3.16	7.46	3.34	5.23
CD at 5%	NS	NS	NS	NS	NS	NS

a greater number of splits through drip irrigation resulted in minimum or no wastage of nutrients either through deep percolation or volatilization ultimately led to higher uptake and higher nutrient uptake with higher level of fertigation over lower level of fertigation levels was also reported by Veeraputhiran *et al*. (2004), Bhalerao *et al*. (2011), Pawar *et al*. (2013), Ayyadurai and Manickasundaram (2014) and Kakade *et al*. (2017).

Among different canopy management practices, the maximum uptake of nitrogen (121.48 and 116.83 N kg ha^{-1}) by *Bt*. cotton was found with treatment monopodia removal at 60 DAS and detopping at 75-80 DAS (C_2), followed by C_3 and C_4, where biological yield was maximum. Minimum uptake of nitrogen (96.61 and 80.32 kg ha^{-1}) by crop was recorded with control treatment (C_1), where no canopy management practices were done during both year of experiment. It might be due high dry matter production and yield. Similar finding was reported by Norton *et al*. (2005).

Phosphorus uptake

During both years of the study, phosphorus uptake in *Bt*. Cotton hybrids and total uptake were strongly influenced by different *Bt*. Cotton hybrid. The largest phosphorus uptake (27.64 and 24.40 N kg ha^{-1}) was reported in genotype PDKV JKAL-116 (V_1) followed by (V_1) PKV HY-2 (22.68 and 17.76 P kg ha^{-1}). It might be due to different genetic makeup of cotton genotype.

Maximum and significantly higher phosphorus uptake (26.67 and 23.57 P kg ha^{-1}) as well as total phosphorus uptake by plant was observed with 125 per cent recommended dose of N and K in four unequal splits

(N_2) as compared to (N_1) 100 per cent recommended dose of N and K in four unequal splits (23.65 and 18.60 P kg ha^{-1}). The increased nutrient uptake might be due to adequate and sustained availability of nutrients throughout the growth stages of crop and mineralization of fixed phosphorus to *Bt* cotton. Similar results were reported by Ayyadurai *et a*l., (2014), Kakade *et al* (2017).

The phosphorus uptake by plant was influenced significantly due to different canopy management practices. The phosphorus by plant was significantly higher (28.15 and 24.18 P kg ha^{-1}) under monopodia removal at 60 DAS and detopping at 75-80 DAS (C_2) than rest of treatments. However, which was followed by C_3 and C_4 treatment during both years (Norton *et al*., 2005).

Potassium uptake

Among the *Bt* cotton hybrids, potassium uptake by plant was influenced significantly among the treatments. Significantly maximum potassium uptake and total uptake by plant was recorded in PDKV JKAL-116 (72.44 and 68.05 K kg ha^{-1}), as compared to PKV Hy-2 (63.85 and 56.03 K kg ha^{-1}) during both the year of study.

Fertigation scheduling with varying quantities of fertilizer had a substantial impact on potassium uptake and overall potassium uptake by plant. During both years of the experiment. The highest values of potassium uptake (70.61 and 65.88 K kg ha^{-1}) in plant parts and total uptake were observed in fertigation schedule with the highest fertilizer level of 125 percent recommended dose of N and K kg ha^{-1} (N_2) and the lowest (65.67 and 58.20 K kg ha^{-1}) in fertigation schedule with the lowest fertilizer level of 100 per cent recommended dose of N and K kg ha^{-1} (N_1) during both years. This might be due to fertigation with water soluble K fertilizers like MOP which allows easy application of nutrients in splits to the rhizosphere so as to match the physiological needs of the crop for better root development and boll development stages. Application of higher and optimum dose of fertilizers through fertigation resulted in maximum uptake of nutrients at all the stages, which indicates that increasing the dose, increased the availability which in turn resulted in higher uptake by plants. Similar results were also reported by Ayyadurai and Manickasundaram (2014), Kakade *et al*. (2017) in respect of more K uptake due to higher level of fertigation over lower levels of fertigation.

The maximum uptake of potassium (73.61 and 70.51 K kg ha^{-1}) by *Bt* cotton was found with treatment monopodia removal at 60 DAS and detopping at 75-80 DAS (C_2) over all the other treatments. However, monopodia removal at 60 DAS and spraying of mepiquat chloride 5% w/w at 75 DAS (C3) was found significantly at par with C_2 treatment. Minimum uptake of potassium by crop (62.41 and 50.80 K kg ha^{-1}) was recorded with control treatment, where no canopy management practices were done during both the year (Norton *et al*., 2005).

Nutrient Use Efficiency (partial factor productivity)

The influenced of *Bt* cotton hybrids on nutrient use efficiency was found significant among the treatments. The significantly higher nutrient use efficiency of (14.70, 13.80 and 14.25 kg kg^{-1}) nutrient applied was recorded in

Table 3 : Nutrient Use Efficiency (Partial factor productivity) as influenced by different *Bt* cotton hybrids, fertigation levels and canopy management practices in cotton.

Treatments	Nutrient use efficiency (kg kg^{-1}) (Partial factor productivity)		
	2021	2022	Pooled
Varieties			
V_1- PKV Hy 2	12.64	11.45	12.04
V_2- PDKV JKAL 116	14.70	13.80	14.25
SE (m) ±	0.29	0.23	0.20
CD at 5 %	1.01	0.78	0.70
Nutrient management			
N_1- 100% RDNK in 4 splits	14.23	13.52	13.88
N_2- 125% RDNK in 4 splits	13.10	11.72	12.41
SE (m) ±	0.29	0.23	0.20
CD at 5%	1.01	0.78	0.70
Canopy management Practices			
C_1- Control	12.31	11.69	12.00
C_2- Monopodia removal at 60 DAS and detopping at 75-80 days	15.16	14.18	14.67
C_3- Monopodia removal at 60 DAS and spraying of mepiquat chloride 5% w/w at 75 DAS	13.81	12.59	13.20
C_4- Spraying of mepiquat chloride 5% w/w at 75 DAS	13.40	12.02	12.71
SE (m) ±	0.35	0.53	0.36
CD at 5%	1.04	1.54	1.04
Levels of interaction (V X N X C)			
SE (m) ±	0.71	1.06	0.71
CD at 5%	NS	NS	NS

hybrid PDKV JKAL-116 as compared to PKV Hy-2 (12.64, 11.45 and 12.04 kg kg^{-1}) during both years and pooled analysis. It might be due to genetic variability on genotype to absorption of nutrients, similar results were also observed by Sattelmacher *et al.* (2007).

Drip fertigation with 100 per cent recommended dose of N and K ha^{-1} has recorded significantly a highest NUE of (14.23, 13.52 and 13.88 kg kg^{-1}) nutrient applied as against (13.10, 11.72 and 12.41 kg kg^{-1}) 125 per cent recommended dose of N and K in four splits during two years of study and pooled analysis. In spite of higher nutrient uptake at higher fertigation doses, 125 per cent recommended dose of N and K fertigation has resulted in lower NUE. The trend of increasing NUE is inversely proportional to the fertigation doses. The maximum nutrient use efficiency could be attributed to regular application of N and K (as high as five splits in drip fertigation) combined with irrigation water in the active root zone of the crop and their interaction in even N distribution in the soil with minimum leaching of nutrients away from the root zone. These results are in accordance with the findings of Balsubramanium *et al*. (2000), Veeraputhiran (2000), Sathyaprakash (2007), Gokila (2012), Pawar *et al*. (2013) and Kakade (2014).

Nutrient use efficiency was positively influenced by canopy management practices. The maximum nutrient use efficiency of 15.16, 14.18 and 14.67 kg seed cotton kg^{-1} nutrient applied were obtained in monopodia removal at 60 DAS and detopping at 75-80 DAS (C_2) followed by 13.81, 12.59 and 13.20 kg seed cotton kg^{-1} nutrient applied in C_3 *i.e.*; monopodia removal at 60 DAS and spraying of mepiquat chloride 5% w/w at 75 DAS. This was mainly due to higher seed cotton production per unit of nutrient applied and nutrient uptake. Lowest NUE of 12.31, 11.69 and 12.00 kg kg^{-1} was recorded in control treatment (C_1) during both year of experiment and pooled analysis. Similar results were reported by Hallikeri *et al.* (2010).

Interaction

The data on nutrient status (available NPK, uptake NPK and Nutrient use efficiency) of soil on *Bt* cotton was not influenced significantly due to the interaction effect between *Bt* cotton hybrids, fertigation levels and different canopy management practices during 2021-22 and 2022-23.

Conclusion

PDKV JKAL-116 *Bt* hybrids had significantly highest upake of NPK, also reflect significantly highest nutrient use efficiency. Application of 125% recommended dose of N and K in four unequal splits observed significantly highest available NPK, uptake of NPK, but NUE was significantly highest in application of 100% recommended dose of N and K in four unequal splits. In canopy management practices monopodia removal at 60 DAS and detopping at 75-80 DAS (C_2) observed significantly highest available NPK, uptake of NPK and NUE.

Acknowledgement

Authors are thankful to Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, all faculty of Agriculture, Government of India for supporting this research project to carry out this work. An expression of gratitude to Prof. Dr. Narsing Parlawar and Asso. Prof. Dr Sanjay Kakade for their assistance and support, as well as gave advice and suggestions.

References

Ayyadurai, P. and Manickasundaram P. (2014). Growth, nutrient uptake and seed cotton yield as influenced by foliar nutrition and drip fertigation in cotton hybrid. *Int. J. Agric. Sci.*, **10(1)**, 276-279.

Balasubramanian, V.S., Palaniappan S.P. and Chelliah S. (2000). Increasing water and fertilizer use efficiency through fertigation in cotton. *J. Indian Society for Cotton Improvement*, **25(2)**, 91-95.

Bhalerao, P.D., Gaikwad G.S. and Imade S.R. (2011). Productivity and nutrient uptake of Bt-cotton (*Gossypium hirsutum*) as influenced by precision in application of irrigation and fertilizer. *Indian J. Agron.*, **56(2)**, 150-153.

Gokila, J. (2012). Optimizing irrigation and fertigation schedule under drip fertigation system in *Bt* cotton. *Ph.D. (Agri.) Thesis* (Unpublished), Tamil Nadu Agricultural University, Coimbatore.

Hallikeri, S.S., Halemani H.L., Patil V.C., Palled Y.B., Patil B.C. and Katageri I.S. (2010). Effect of nitrogen levels, split application of nitrogen and detopping on seed cotton yield and fibre quality in *Bt* cotton. *Karnataka J. Agric. Sci.*, **23**, 418-422.

ICAC (International cotton advisory committee) (2023). Committee on Cotton Production and Consumption (COCPE) meeting held on 01.06.2023.

Kakade, S.U. (2014). Studies on fertigation in cotton- crop sequence. *Ph.D. Thesis* (Unpub.), Dr. PDKV, Akola.

Kakade, S.U., Bhale V.M., Deshmukh J.P. and Thakur V.R. (2017). Soil Moisture Distribution, Nutrient Dynamics and Yield of *Bt* Cotton as influenced by Split Application of Nutrients through Fertigation. *Int. J. Pure App. Biosci*., **5(2)**, 1081-1088.

Norton, L.J., Clark H., Borrego and Bryan Ellsworth (2005). Evaluation of two plant growth regulators from LT Biosyn. Arizona Cot. Rep., May 2005, p. 142.

Pawar, D.D., Dingre S.K., Bhakre B.D. and Surve U.S. (2013). Nutrient and water use by *Bt*. cotton (*Gossypium hirsutum*) under drip fertigation. *Indian J. Agron..*, **58(2)**,

237-242.

Sathyaprakash, D. (2007). Drip fertigation and bio fertigation studies on cotton hybrid. *M.Sc. (Agri.) Thesis* (Unpub.) Tamil Nadu Agricultural University, Coimbatore.

Sattelmacher, Burkhard, Walter, Horst J. and Becker C. Heiko (2007). Factors that contribute to genetic variation for nutrient efficiency of crop plants. *Zeitschrift fur Pflanzenernahrung and Bodenkunde*, **157(3)**, 215-224.

Suganya, S., Anitha A. and Appavu K. (2007). Moisture and nutrient distribution system under drip fertigation systems. In: Third International Ground Water Conference on "*Water, Environment and Agriculture - Present problems and future challenges*". February 7-10. 2007.

Veeraputhiran, R. (2000). Drip fertigation studies in hybrid cotton. *Ph.D. Thesis* (Unpub.), TNAU, Coimbatore.

Veeraputhiran, R., Kandasamy O.S., Sundar Singh S.D. and Chinnusamy C. (2004). Effect of nitrogen application through drip irrigation on yield, nitrogen use efficiency and quality of hybrid cotton. National symposium on changing world under cotton Research, Development and Policy in context, August 10-12, ANGRAU, Hyderabad.