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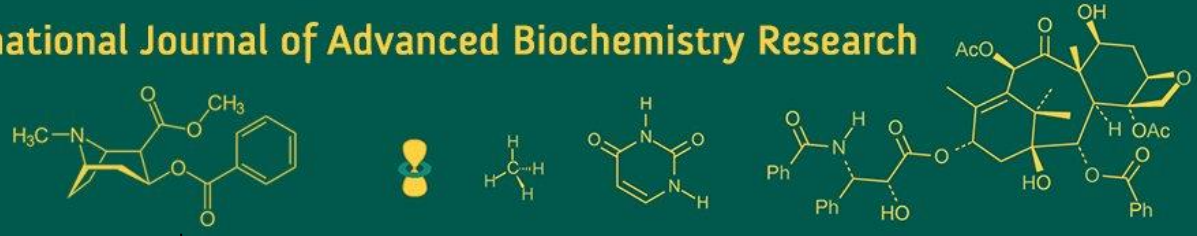

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Assessment of nitrogen response in promising cotton cultivars in Vidarbha region of Maharashtra

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Abstract
Cotton (*Gossypium* spp.) stands as the primary fiber-producing crop globally, with India leading in both cultivation area and raw cotton production. However, Maharashtra, despite being a leading state in cotton cultivation, faces challenges with comparatively low productivity. Soil nitrogen plays a crucial role in crop yield and quality, affecting various physiological processes essential for plant growth. This study examines the nitrogen response of promising cotton cultivars in Maharashtra's Vidarbha region. Through field experiments conducted over two years, we evaluated the impact of nitrogen levels and irrigation on cotton growth and yield. Results indicate significant differences in seed cotton, lint, cotton stalk, and biological yield between cultivars and nitrogen levels. Notably, cotton cultivar Bt hybrid PKV-Hy-2-BG-II exhibited higher seed cotton and lint yields compared to improved cotton cultivar AKH-9916. Additionally, nitrogen application positively influenced yield parameters up to a certain threshold, beyond which diminishing returns were observed. Economic analysis revealed higher gross and net monetary returns for Bt hybrid PKV-Hy-2-BG-II, attributed to its superior yield performance. These findings underscore the importance of nitrogen management strategies in optimizing cotton productivity in Maharashtra's cotton-growing regions.

Keywords: Cotton cultivars, nitrogen response, Maharashtra, Vidarbha region, yield parameters, nitrogen fertilization, crop productivity, agronomic traits, field experiment, economic analysis

Introduction
Cotton (*Gossypium* spp.) is the world's most important fiber producing crop. The commercially grown species of *Gossypium* includes *G. hirsutum*, *G. barbedense*, *G. arboreium* and *G. herbaceum*. India remains the leading country in terms of area under cotton cultivation and raw cotton production in the world. During 2021-22, cotton production in India was 311.18 lakh bales (170 kg) from 123.72 lakh hectares with productivity of 428 kg lint ha^{-1}. While, Maharashtra ranks first in case of area (44.10 lakh ha) and production (82.49 lakh bales) among cotton growing states of India. The productivity of cotton in Maharashtra is only 318 kg lint ha^{-1} which is lowest as compare to other states of India. (Anonymous, 2023) [1]. Cotton accounts for more than 75 percent of the annual fiber consumption in spinning mills, about 58 percent of the total fiber consumption in textile sector and 30-35 percent of total export earnings in India (Gumber, *et al.*, 2008) [9].
Soil nitrogen amount is among the most important criteria that affect crop yields and quality. Plant growth and development need nitrogen in greater quantity, since it is involved in various physiological processes. Nitrogen is a part of many components of plant cells, including amino acids, nucleic acids (Bernard and Habash, 2009) [3] proteins, and chlorophyll in plant leaves. Likewise, nitrogen availability produces rapid and early crops' growth, increases protein content of crops, facilitates the uptake and utilization of other nutrients as potassium and phosphorous, improves fruit quality, and controls overall growth of plant (Hemerly, 2016) [10]. However, nitrogen deficiency rapidly inhibits the growth of plants and alters many metabolic processes. The lack of nitrogen decreases photosynthesis (Brix, 1983) [5] causes appearances of chlorosis (Fernandes and Rossiello, 1995) [6], reduces chloroplast size (Laza *et al.*, 1993) [13], and provokes a high decrease in crop quality and yields. Hence, nitrogen fertilization management is an important issue in cotton production systems. It is more difficult to balance demand and supply of cotton plant N nutrition compared with other nutrient fertilizers because of the complexity of N cycling in the soil and the indeterminate growth habit of cotton (Gerik, *et al*., 1998) [7].

Materials and Methods

A field experiment entitled "Assessment of nitrogen and water response in promising cotton cultivars through aerial multispectral remote sensing" was conducted in *Kharif* season during the year 2019-20 and 2020-21 at the Research Farm of Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (Maharashtra).

The experiment was laid in main-main-sub split plot design with two main (i) factors, two main (ii) factors and six sub factors with three replications. The main (i) plot factor consists of two cotton cultivars 1) V_1: Bt hybrid PKV-Hy-2-BG-II and 2) V_2: Improved AKH-9916, main (ii) plot factor comprises of two irrigation levels 1) I_1: Need based irrigation (at 50% soil moisture depletion) and 2) I_2: No Irrigation, whereas sub plot factor encompasses of seven nitrogen levels *viz*; N_1: Control (No Nitrogen), N_2: FYM 5.00 t ha^{-1}, N_3: N_2 + 30 kg N ha^{-1}, N_4: N_2 + 60 kg N ha^{-1}, N_5: N_2 + 90 kg N ha^{-1}, N_6: N_2 + 120 kg N ha^{-1}, N_7: N_2 + 150 kg N ha^{-1}. The sowing of research trial was done on 29th June, 2019 and 21st June, 2020. Cotton cultivar Bt hybrid PKV-Hy-2-BG-II was sown at 90 x 60 cm and improved cotton cultivar AKH-9916 was sown at 60 x 30 cm. N was applied in splits as per the treatment and full dose of P and K was applied as a basal dose as per the RDF (NPK kg ha^{-1}). The need-based irrigation will have to be applied when soil available moisture reaches below 50% during crop growth period. But during both years of investigation soil available moisture was not depleted to 50% in crop growth period as the soil available moisture was recorded at 15 days interval. Hence, during the course of investigation the treatment of need-based irrigation was not implemented. Necessary intercultural operations and plant protection measures were taken timely as per the need.

The observations on growth parameters were recorded at 30, 60, 90, 120, 150, 180 DAS and at harvest. Seed cotton yield, lint yield, cotton stalk yield, biological yield recorded at harvest and calculated based on the yield obtained from each net plot and converted to kg ha^{-1} and cost benefit ratio was calculated by using gross returns and total cost of cultivation. The data were statistically analyzed by following the method given by Gomez and Gomez, 1984. The results have been presented and discussed based on pooled data of two years.

Results and Discussion

Seed cotton, lint, cotton stalk and biological yield

The data presented in Table 1 revealed that, the yield of kg ha^{-1} was statically influenced by cotton cultivars under study during both years of investigation and in pooled over two years. Cotton cultivar Bt hybrid PKV-Hy-2-BG-II sown on wider spacing (90 x 60 cm) produced significantly highest 2042, 1767 and 1904 kg ha^{-1} seed cotton yield than improved cotton cultivar AKH-9916 sown on closer spacing (60 x 30 cm) achieved 1723, 1523 and 1623 kg ha^{-1} seed cotton yield during 2019-20, 2020-21 and in pooled, respectively. The rate of increase in seed cotton yield with cotton cultivar Bt hybrid PKV-Hy-2-BG-II was 18.51, 16.02 and 17.31% during 2019-20, 2020-21 and in pooled over improved cotton cultivar AKH-9916, respectively. There is a strong positive correlation between lint yield and seed cotton yield, hence, similar trend was observed in lint yield. In pooled the increase in lint yield was to the tune of 25.19% in cotton cultivar Bt hybrid PKV-Hy-2-BG-II over improved cotton cultivar AKH-9916. The results might be due to the genetic makeup of the cotton cultivars and utilization of more photosynthates for the nourishment to bolls favouring reproductive growth could be the key physiological phenomenon in Bt cotton resulted into more seed cotton yield (Patel *et al.*, 2015) [20]. Secondly, higher plant density of improved cotton cultivar AKH-9916 failed to compensate loss in seed cotton yield plant^{-1} hence recorded lower seed cotton and lint yield as compare to lower plant density of cotton cultivar Bt hybrid PKV-Hy-2-BG-II. The results of present investigation were in line with the results of Waqas *et al.* (2018) [26] and Sparlangue *et al.* (2007) [25]. Whereas, Manjunatha *et al.* (2010) [16] and Brar *et al.* (2013) [4] found divergent results as higher plant density at closer spacing recorded significantly higher seed cotton yield than lower plant density at wider spacing.

In case of cotton stalk and biological yield the trend was totally reverse, improved cotton cultivar AKH-9916 planted on closer spacing (60 x30 cm) produced significantly highest cotton stalk yield (4950, 4310 and 4630 kg ha^{-1}) and biological yield (6673, 5833 and 5733 kg ha^{-1}) than cotton cultivar Bt hybrid PKV-Hy-2-BG-II planted on wider spacing (90 x 60 cm) which yielded cotton stalk (4123, 3514 and 3819 kg ha^{-1}) and biological yield (6165, 5281 and 5723 kg ha^{-1}), during 2019-20, 2020-21 and in pooled, respectively. This could be due to increased plant population per unit area in improved cotton cultivar AKH-9916 (55556 plants ha^{-1}) as compare to cotton cultivar Bt hybrid PKV-Hy-2-BG-II (18519 plants ha^{-1}). These results were in close agreement with findings of Patel *et al.* (2023) [19], Hiwale *et al.* (2018) [11].

Each increased dose of nitrogen linearly increased seed cotton, lint, cotton stalk and biological yield from 0 kg N ha^{-1} (N_1) to application of 5.00 t FYM + 90 kg ha^{-1} (N_5) afterwards it declined at application of 5.00 t FYM + 120 kg ha^{-1} (N_6) and at 5.00 t FYM + 150 kg ha^{-1} (N_7). Application of 5.00 t FYM + 90 kg ha^{-1} (N_5) yielded significantly highest seed cotton yield (2183, 1876 and 2029 kg ha^{-1}), lint yield (737, 633 and 685 kg ha^{-1}), cotton stalk yield (5401, 4578 and 4990 kg ha^{-1}) and biological yield (7584, 6454 and 7019 kg ha^{-1}) followed by application of 5.00 t FYM + 120 kg ha^{-1} (N_6) in case of seed cotton, lint and biological yield whereas in respect of cotton stalk it was followed by application of 5.00 t FYM + 150 kg ha^{-1} (N_7) and found on par with each other, while, absolute control recorded significantly lowest seed cotton yield (1516, 1364 and 1440 kg ha^{-1}), lint yield (509, 457 and 483 kg ha^{-1}), cotton stalk yield (3305, 2940 and 3122 kg ha^{-1}) and biological yield (4821, 4304 and 4562 kg ha^{-1}) during 2019-20, 2020-21 and in pooled, respectively. The substantial increase in seed cotton yield due to application of higher levels of nitrogen might be due to favorable effect of nitrogen on growth attributes like plant height, increased number of bolls plant^{-1}, dry matter accumulation plant^{-1} and its subsequent translocation towards sink improved the seed cotton and lint yield (Mahadevappa *et al.*, 2018) [14]. Similar positive response of nitrogen on seed cotton yield was observed by Basavanneppa (2005) [2] and Meena *et al.*, (2007) [17]. Beside this, S. Krishnaprabu, (2015), found that, the increase in seed cotton yield (kg ha^{-1}) was observed higher upto 80 kg N ha^{-1} and decrease further at 100 kg N ha^{-1}. Similar results were reported by Sharma *et al.* (2001) [24] and Rawal *et al.* (2015) [22].

Cotton cultivars under investigation responded differently to the nitrogen levels throughout the investigation and in

pooled also. The seed cotton yield of cotton cultivar Bt hybrid PKV-Hy-2-BG-II was markedly increased up to application of 5.00 t FYM + 120 kg ha^{-1} (N_6) afterward the yield was declined with the application of 5.00 t FYM + 150 kg ha^{-1} (N_7) while seed cotton yield of improved cotton cultivar AKH-9916 was distinctly increased with increase in nitrogen level up to application of 5.00 t FYM + 90 kg ha^{-1} (N_5) and decrease was observed in higher doses N_6 and N_7. From the said results it can be concluded that the optimum dose of nitrogen for cotton cultivar Bt hybrid PKV-Hy-2-BG-II was application of 5.00 t FYM + 120 kg ha^{-1} and for improved cotton cultivar AKH-9916 it was application of 5.00 t FYM + 90 kg ha^{-1} (N_5).

Whereas, integration of improved cotton cultivar AKH-9916 and the application of 5.00 t FYM + 90 kg N ha^{-1} (V_2N_5) produced significantly highest cotton stalk yield (6095, 5190 and 5642 kg ha^{-1}) and biological yield (8175, 6988 and 7582 kg ha^{-1}) than all other union of cotton cultivars and nitrogen levels, but it was found at par with combination V_2N_7 during 2019-20, while combination of cotton cultivar Bt hybrid PKV-Hy-2-BG-II and application of 0 kg N ha^{-1} (V_1N_1) yielded significantly lowest cotton stalk yield (2993, 2626 and 2810 kg ha^{-1}) and biological yield (4641, 4089 and 4365 kg ha^{-1}) during 2019-20, 2020-21 and in pooled, respectively.

Economics

Cotton cultivar Bt hybrid PKV-Hy-2-BG-II obtained significantly highest GMR (₹ 121555, ₹ 109958 and ₹ 115756 ha^{-1}) and NMR (₹ 74310, ₹ 62974 and ₹ 68642 ha^{-1}) than GMR (₹ 105501, ₹ 97345 and ₹ 101423 ha^{-1}) and NMR (₹ 60120, ₹ 52206 and ₹ 56154 ha^{-1}) in improved cotton cultivar AKH-9916 during 2019-20, 2020-21 and pooled over two years, respectively. Higher GMR and NMR evidently due to the higher seed cotton yield obtained in cotton cultivar Bt hybrid PKV-Hy-2-BG-II than in improved cotton cultivar AKH-9916. The present results were in conformity with results of Nagender *et al.* (2017) [18] as he reported higher cotton seed yield in MRC 7201 BGII Bt cotton cultivar than in non Bt WGCV-48 cotton cultivar. Similar trend was observed with benefit: cost ratio.

Table 1: Yield of cotton as influenced by different treatments

Treatments	Seed cotton yield (kg ha^{-1})			Lint yield (kg ha^{-1})			Cotton stalk yield (kg ha^{-1})			Biological yield (kg ha^{-1})		
	19-20	20-21	Pooled	19-20	20-21	Pooled	19-20	20-21	Pooled	19-20	20-21	Pooled
Main Plot (Cotton cultivars & Irrigation levels)												
Cotton Cultivars												
V_1: PKV-Hy-2-BG-II	2042	1767	1904	708	613	661	4123	3514	3819	6165	5281	5723
V_2: AKH-9916	1723	1523	1623	561	496	528	4950	4310	4630	6673	5833	6253
SE(m)±	44	30	25	15	11	8	114	83	65	156	112	88
CD at 5%	153	104	86	52	37	28	395	286	225	541	387	306
Irrigation levels												
I_1: NB Irrigation	1889	1638	1764	637	552	595	4552	3904	4228	6441	5542	5992
I_2: No Irrigation	1875	1652	1764	632	556	594	4522	3920	4221	6397	5572	5984
SE(m)±	44	30	25	15	11	8	114	83	65	156	112	88
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Sub Plot (Nitrogen Levels)												
N_1: Control	1516	1364	1440	509	457	483	3305	2940	3122	4821	4304	4562
N_2: FYM @ 5.0 t ha^{-1}	1645	1464	1555	554	494	524	3661	3219	3440	5306	4683	4995
N_3: N_2 + 30 kg ha^{-1}	1793	1576	1685	603	530	566	4110	3563	3836	5903	5139	5521
N_4: N_2 + 60 kg ha^{-1}	1943	1692	1817	654	569	612	4598	3954	4276	6541	5646	6093
N_5: N_2 + 90 kg ha^{-1}	2183	1876	2029	737	633	685	5401	4578	4990	7584	6454	7019
N_6: N_2 + 120 kg ha^{-1}	2110	1819	1964	714	615	664	5312	4524	4918	7421	6343	6882
N_7: N_2 + 150 kg ha^{-1}	1985	1724	1854	671	583	627	5371	4606	4988	7355	6330	6843
SE(m)±	35	28	25	13	11	9	84	70	61	117	97	86
CD at 5%	99	79	71	37	31	26	238	199	175	334	275	243
Interactions												
Cultivar x Irrigation												
SE(m)±	63	42	35	21	15	11	161	117	92	221	158	125
D at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Cultivar x Nitrogen												
E(m)±	49	39	35	19	16	13	119	99	87	166	137	121
D at 5%	140	111	100	NS	NS	NS	337	281	247	472	389	344
Irrigation x Nitrogen												
E(m)±	49	39	35	19	16	13	119	99	87	166	137	121
D at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Cultivar x Irrigation x Nitrogen												
E(m)±	70	55	50	26	22	18	168	140	123	235	193	171
D at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 2: Seed cotton yield (kg ha^{-1}) as influenced by interaction of cotton cultivars and nitrogen levels during 2019-20, 2020-21 and pooled.

Treatments	Seed cotton yield (kg ha^{-1})						
	N_1	N_2	N_3	N_4	N_5	N_6	N_7
2019-20							
V_1	1647	1785	1945	2070	2285	2371	2188
V_2	1385	1505	1642	1816	2080	1848	1781
SE(m)±	49						
CD at 5%	140						
2020-21							
V_1	1464	1570	1692	1789	1954	2020	1881
V_2	1265	1358	1461	1594	1798	1619	1567
SE(m)±	39						
CD at 5%	112						
Pooled							
V_1	1556	1678	1818	1930	2120	2195	2034
V_2	1325	1432	1551	1705	1939	1734	1674
SE(m)±	35						
CD at 5%	100						

Table 3: Cotton stalk yield (kg ha^{-1}) as influenced by interaction of cotton cultivars and nitrogen levels during 2019-20, 2020-21 and pooled.

Treatments	Cotton stalk yield (kg ha^{-1})						
	N_1	N_2	N_3	N_4	N_5	N_6	N_7
2019-20							
V_1	2993	3314	3736	4098	4707	5026	4988
V_2	3616	4008	4484	5098	6095	5598	5753
SE(m)±	119						
CD at 5%	337						
2020-21							
V_1	2626	2877	3198	3490	3967	4216	4224
V_2	3254	3561	3928	4419	5190	4832	4989
SE(m)±	99						
CD at 5%	281						
Pooled							
V_1	2810	3096	3467	3794	4337	4621	4606
V_2	3435	3784	4206	4758	5642	5215	5371
SE(m)±	87						
CD at 5%	247						

Table 4: Cotton biological yield (kg ha^{-1}) as influenced by interaction of cotton cultivars and nitrogen levels during 2019-20, 2020-21 and pooled.

Treatments	Cotton biological yield (kg ha^{-1})						
	N_1	N_2	N_3	N_4	N_5	N_6	N_7
2019-20							
V_1	4641	5099	5680	6168	6992	7397	7176
V_2	5001	5513	6125	6914	8175	7446	7535
SE(m)±	166						
CD at 5%	472						
2020-21							
V_1	4089	4448	4890	5279	5921	6236	6104
V_2	4519	4919	5388	6013	6988	6451	6556
SE(m)±	137						
CD at 5%	389						
Pooled							
V_1	4365	4773	5285	5723	6456	6816	6640
V_2	4760	5216	5757	6463	7582	6949	7046
SE(m)±	121						
CD at 5%	344						

Gross monetary and net monetary returns were significantly increased with each successive increment of nitrogen dose up to application of 5.00 t FYM + 90 kg N ha^{-1} (N_5) but beyond this decrease was observed throughout the course of investigation and in pooled. Application of 5.00 t FYM + 90 kg N ha^{-1} (N_5) fetched significantly highest GMR and NMR but found statistically similar with application of 5.00 t FYM + 120 kg N ha^{-1} (N_6), while markedly lowest GMR and NMR were registered in absolute control (N_1), during 2019-20, 2020-21 and in pooled over two years. The rate of increase in GMR with N_5 was 45.38, 38.77 and 42.18% and in NMR was 48.26, 37.23 and 43.01% over absolute control (N_1) during 2019-20, 2020-21 and in pooled, respectively. The increase in GMR and NMR with application of 5.00 t FYM + 90 kg N ha^{-1} (N_5) was mainly due to the increased seed cotton yield in this treatment. These results are in line with the findings of Honnappa *et al.* (2019) [12], Prakash (2017) [21], Manjunatha *et al.* (2017) 15[].

Table 5: Economics of cotton as influenced by different treatments

Treatments	Gross monetary returns (₹ ha^{-1})			Net monetary returns (₹ ha^{-1})			Benefit: Cost ratio		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
Main Plot (Cotton cultivars & Irrigation levels)									
Cotton Cultivar									
V_1: PKV-Hy-2-BG-II	121555	109958	115756	74310	62974	68642	2.58	2.35	2.46
V_2: AKH-9916	105501	97345	101423	60102	52206	56154	2.33	2.16	2.24
SE(m)±	2669	1965	1516	2669	1965	1516	--	--	--
CD at 5%	9238	6801	5247	9238	6801	5247	--	--	--
Irrigation levels									
I_1: NB Irrigation	113933	103240	108586	67611	57178	62395	2.46	2.25	2.35
I_2: No Irrigation	113124	104063	108593	66802	58001	62402	2.44	2.26	2.35
SE(m)±	2669	1906	1516	2669	1906	1516	--	--	--
CD at 5%	NS	NS	NS	NS	NS	NS	--	--	--
Sub Plot (Nitrogen Levels)									
N_1: 0 kg ha^{-1} (Control)	90754	85348	88051	55979	50833	53406	2.61	2.47	2.54
N_2: FYM @ 5.0 t ha^{-1}	98623	91730	95177	53848	47215	50532	2.20	2.06	2.13
N_3: N_2 + 30 kg ha^{-1}	107748	98936	103342	59540	50989	55264	2.23	2.06	2.15
N_4: N_2 + 60 kg ha^{-1}	117025	106454	111740	68451	58140	63296	2.41	2.20	2.30
N_5: N_2 + 90 kg ha^{-1}	131938	118441	125189	82997	69760	76379	2.70	2.43	2.56
N_6: N_2 + 120 kg ha^{-1}	127707	115016	121362	78401	65969	72185	2.58	2.34	2.46
N_7: N_2 + 150 kg ha^{-1}	120901	109637	115269	71227	60223	65725	2.43	2.22	2.32
SE(m)±	2097	1749	1533	2097	1749	1533	--	--	--
CD at 5%	5962	4974	4358	5962	4974	4358	--	--	--
Interactions									
Cultivars x Irrigation									
SE(m)±	3775	2695	2144	3775	2695	2144	--	--	--
CD at 5%	NS	NS	NS	NS	NS	NS	--	--	--
Cultivars x Nitrogen									
SE(m)±	2965	2474	2167	2965	2474	2167	--	--	--
CD at 5%	8432	7034	6163	NS	NS	NS	--	--	--
Irrigation x Nitrogen									
SE(m)±	2965	2474	2167	2965	2474	2167	--	--	--
CD at 5%	NS	NS	NS	NS	NS	NS	--	--	--
Cultivars x Irrigation x Nitrogen									
SE(m)±	4194	3498	3065	4194	3498	3065	--	--	--
CD at 5%	NS	NS	NS	NS	NS	NS	--	--	--

Table 6: Gross monetary returns of cotton as influenced by interaction of cotton cultivars and Nitrogen levels

Treatments	Gross monetary returns (₹ ha^{-1})						
	N_1	N_2	N_3	N_4	N_5	N_6	N_7
2019-20							
V_1	97404	105682	115409	123086	136239	141640	131422
V_2	84105	91564	100086	110964	127636	113775	110379
SE(m)±	2965						
CD at 5%	8432						
2020-21							
V_1	90522	97233	104935	111196	121759	126070	117993
V_2	80174	86227	92937	101712	115123	103962	101280
SE(m)±	2474						
CD at 5%	7034						
Pooled							
V_1	93963	101457	110172	117141	128999	133855	124708
V_2	82140	88896	96512	106338	121379	108868	105830
SE(m)±	2056						
CD at 5%	5845						

Conclusions

Higher seed cotton yield can be obtained from cotton cultivar Bt hybrid PKV-Hy-2-BG-II with the application of 5.0 t FYM + 120 kg N ha^{-1}, whereas from improved cotton cultivar AKH-9916 it was with the application of 5.0 t FYM + 90 kg N ha^{-1}. Higher cotton stalk and biological yields were obtained in AKH-9916 with the application of 5.0 t FYM + 90 kg N ha^{-1}.

Cotton cultivar PKV-Hy-2-BG-II gained higher gross monetary returns, net monetary returns and benefit: cost ratio with the application of 5.0 t FYM + 120 kg N ha^{-1} which was statistically at par with the application of 5.0 t FYM + 90 kg N ha^{-1}.

References

1. Anonymous. Annu. Rep., ICAR – All India Coordinated Research Project (Cotton). Coimbatore. A-1 and A-2. 2023.
2. Basavanneppa MA, Angadi VV, Biradar DP. Productivity and endotoxin expression as influenced by nutrient levels and nitrogen doses application in Bt cotton under irrigation. J Cotton Res Dev. 2015;29(1):39-44.
3. Bernard SM, Habash DZ. The importance of cytosolic glutamine synthetase in nitrogen assimilation and recycling. New Phytol. 2009;182:608-620.
4. Brar AS, Sarlach RS, Sohu RS, Rathore P. Response of American cotton (*Gossypium hirsutum* L.) genotypes to varying plant densities and graded levels of fertilizers. Soc Plant Res. 2013; 26(2):145-147.
5. Brix H. Effects of thinning and nitrogen fertilization on growth of Douglas-fir: relative contribution of foliage quantity and efficiency. Can J For Res. 1983;13:167-175.
6. Fernandes MS, Rossiello R. Mineral nitrogen in plant physiology and plant nutrition. Plant Sci. 1995;14:111-148.
7. Gerik TJ, Oosterhuis DM, Torbert HA. Managing cotton nitrogen supply. Adv Agron. 1998;64:115-147.
8. Gomez KA, Gomez AA. Statistical Procedure for Agricultural Research. John Wiley and Sons; c1984. p. 241-266.
9. Gumber RK, Gill MS, Pathak D, Gill JS, Sarlach RS. Cotton research in Punjab. Cotton Section, Department of Plant Breeding, Genetics and Biotechnology, Punjab Agricultural University, Ludhiana; c2008. p. 1-12.
10. Hemerly A. Genetic controls of biomass increase in sugarcane by association with beneficial nitrogen fixing bacteria. In: Plant and Animal Genome XXIV Conference; Plant and Animal Genome; c2016.
11. Hiwale SD, Khargakharate VK, Patil SS, Nichal AD. Effect of hirsutum cotton to high plant density and fertilizer doses on yield and nutrient uptake under rainfed condition. Int. J Curr Microbiol App Sci. 2018;6:2653-2658.
12. Honnappa HM, Shekara BG, Sannagoudar MS, Patil L, Hamsa N. Effect of Nitrogen, Phosphorus and Potassium Levels on Yield and Economics of Interspecific Hybrid Cotton (*Gossypium* spp.) under Southern Dry Zone of Karnataka. JEAI. 2019;30(6):1-8.
13. Laza RC, Bergman B, Vergara BS. Cultivar differences in growth and chloroplast ultrastructure in rice as affected by nitrogen. J Exp Bot. 1993; 44: 1643-1648.
14. Mahadevappa SG, Sreenivas G, Reddy DR, Madhavi A, Rao SS. Effect of Different Levels of Irrigation and Nitrogen on Growth and Yield Bt Cotton. Int. J Curr. Microbiol App Sci. 2018;7(8):4599-4604.
15. Manjunatha SB, Biradar DP, Aladakatti YR. Effect of nitrogen levels and K ratios on growth, yield and economics of Bt cotton. J Farm Sci. 2017;30(3):338-342.
16. Manjunatha MJ, Halepyati AS, Koppalkar BG, Pujari BT. Yield and yield components, uptake of nutrients, quality parameters and economics of Bt cotton (*Gossypium hirsutum* L.) genotypes as influenced by different plant densities. Karnataka J Agric Sci. 2010;23(2):423-425.
17. Meena RL, Babu VR, Nath A. Effect of fertilizer management on cotton under saline soils of Gujarat. Bharatiya Krishi Anusandhan Patrika. 2007;22:206-210.
18. Nagender T, Reddy DR, Rani PL, Sreenivas G, Surekha K, Gupta A, *et al*. Response of Nitrogen Fertilization and Plant Densities on Bt and Non-Bt Cotton (*Gossypium hirsutum* L.) Hybrids. Int. J Curr Microbiol App Sci. 2017;6(9):3199-3207.
19. Patel PM, Patel KK, Patel CK. Sowing Time and Spacing Influenced Yield, Quality and Economics of Bt Cotton (*Gossypium hirsutum* L.). Int. J Environ Clim. Change. 2023;13(11):148-155.
20. Patel P, Patel JC, Mehta RS, Vyas KG. Response of Bt and non Bt cotton (*Gossypium hirsutum* L.) hybrids to varying sowing time. J Cotton Res Dev. 2015;29(2):273-276.
21. Prakash BH. Response of cotton (*Gossypium* spp.) to nutrient and irrigation levels in Southern Dry Zone of Karnataka [M.Sc. thesis]. Univ. Agric Sci. Bengaluru, Karnataka; c2017.
22. Rawal S, Mehta AK, Thakral SK, Kumar M. Effect of nitrogen and phosphorus levels on growth, yield attributes and yield of Bt cotton. J Cotton Res Dev. 2015;29(1):76-78.
23. Krishnaprabu S. Sustaining Productivity of Deshi Cotton Hybrid to Different Plant Spacings and Nitrogen Levels. Eurasian J Anal Chem. 2015;10(3):205-207.
24. Sharma JK, Upadhyay A, Khamparia SK, Mishra US, Mandloi KC. Effect of spacing and fertility levels on growth and yield of hirsutum genotypes. J Cotton Res Dev. 2001;15(2):151-153.
25. Sparlangue T, Andrade FH, Calvino PA, Larry C. Why do maize hybrids respond differently to variations in plant density? Agron J. 2007;99:984-991.
26. Liaqat W, Jan MF, Ahmadzai MD, Ahmad H, Rehan W. Plant spacing and nitrogen affects growth and yield of cotton. J Pharmacogn Phytochem. 2018;7(2):2107-2110.