The Bioscan 11(2): 1219-1222, 2016 (Supplement on Agronomy)
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.com

INFLUENCES OF IRRIGATION SCHEDULE AND NITROGEN ON YIELD ATTRIBUTES, YIELDS AND N UPTAKE IN *BT*. COTTON (*GOSSYPIUM* SPP.)

J. M. MODHVADIA*, R. M. SOLANKI, B. S. GOHIL AND R. B. THANKI
Engineering Department,
College of Agril. Engg. And technology, Junagadh Agricultural University, Junagadh-362001, Gujarat
e-mail: jmmodhvadia@jau.in

KEYWORDS
Gossypium
IW:CPE
N uptake
WUE

Received on :
11.12.2013

Accepted on :
26.03.2014

***Corresponding author**

ABSTRACT
A field experiment was conducted at Cotton Research Station, Junagadh Agricultural University, Junagadh (Gujarat) during *kharif* season of 2009-10, 2010-11 and 2011-12 on medium black clayey soil to study the effect of irrigation schedule and nitrogen on *Bt*. Cotton. The experiment laid out in Split Plot Design. The treatments comprised *viz*., three irrigation levels based of IW: CPE ratios, I_1-0.8, I_2-1.0 and I_3-1.2 were assigned to main plot and four levels of nitrogen *i.e.* N_1-160, N_2-200, N_3-240 and N_4-280 kg ha^{-1} in sub plots which replicated four times. The results revealed that significantly higher seed cotton (3652 kg ha^{-1}) and stalk (5057 kg ha^{-1}) yields as well as plant height (128.59 cm), no. of monopodial (2.53 plant^{-1}) and sympodial (18.30 plant^{-1}) branches/plant, no. of bolls/plant (47.76), boll weight (3.59 g) and lint yield (1281 kg ha^{-1}) were recorded with crop was irrigated at an IW: CPE ratios of 1.2. Application of nitrogen 280 kg ha^{-1} produced significantly higher seed cotton yield (3592 kg ha^{-1}) and stalk yield (4776 kg ha^{-1}), growth and yield attributes. So, it can be concluded that the application of nitrogen 240 kg ha^{-1} and crop was irrigated with IW: CPE ratios of 1.2 gave higher yields.

INTRODUCTION

Cotton, the king of fibre, is one of the momentous and an important cash crop exercising profound influence on economics and social affairs of the world. Any other fibre crop cannot compare with cotton for its fibre quality. It is also called as "White Gold".Cotton is grown in 75 countries across the world out of which United States, China and India contribute 80% of total yield in the world. India ranks first in area and second in production of cotton in the world. Gujarat, Maharashtra, Haryana, Punjab, Rajasthan, Madhya Pradesh, Andhra Pradesh, Karnataka and Tamil Nadu are the major cotton growing states in India.*Bt* cotton varieties are high yielding, fertilizer and irrigation responsive and hence famers are attempting to grow more and more cotton in this region. Cotton is the most important non-food cash crop in Gujarat, covering more than 27 lakh hectares area with production of about 110 lakh bales of lint. Area under cotton in Saurashtra is about 18 lakh hectares and contributes around 65 per cent total production in the state.Water and nitrogen are the key input for improving cotton productivity, which must be used in most efficient manner to sustain the cotton productivity at higher level.Nitrogen play very important role in crop productivity and is an important determinant of the growth and yield of irrigated cotton (Gadhiya*et al.,* 2009; Reddy and Kumar, 2010). Nitrogen, an integral component of many plant compounds such as aminoacids, that are the building blocks of proteins, is a vital nutrient for the growth anddevelopment of cotton. As N is a mobile element, its deficiency during the early andmid season results in the chlorosis of older leaves. Its deficiency also leads to reducedplant height, fruiting branches and increased boll shed (Hodges, 1995). The yieldresponse of *Bt*cotton (Pettigrew and Adamczyk, 2006) and increases in *Bt*protein content with N fertilization (Yang Chang Qin *et al*., 2005) demands adequateN fertilization. Since, both irrigation and nitrogen are costly inputs, efficient utilization of these resources through optimum synergistic combination is essential for higher productivity and input-use efficiency of *Bt* cotton. Hence, the study was taken up to find out optimum water and nitrogen requirement for *Bt* cotton.

MATERIALS AND METHODS

A field experiment was conducted at Cotton Research Station, Junagadh Agricultural University, Junagadh (Gujarat) during *kharif* season of 2009-10, 2010-11 and 2011-12 to study the effect of irrigation schedule and nitrogen management in *Bt*. cotton. The soil of the experiment site was clayey in texture and has organic carbon 3.9 g kg^{-1}, nitrogen 212 kg ha^{-1}, available phosphorus 25.5 kg ha^{-1}, and available potassium 297 kg ha^{-1} with $pH_{2.5}$ 7.6. The experiment was laid out in SPD. The treatments *viz*., three irrigation levels based of IW: CPE ratios viz., I_1-0.8, I_2-1.0 and I_3-1.2 IW: CPE ratios were assigned to main plot and four levels of nitrogen (i.e. N_1-160, N_2-200, N_3-240 and N_4-280 kg ha^{-1}) in sub plots. Nitrogen as per treatments was applied in four split, each of 25 % at basal and remaining at 30, 60 and 90 days after sowing (DAS). A common irrigation was given immediately after sowing the crop for satisfactory seed germination and proper establishment of crop. Remaining irrigations each of 50mm

depth were given as per treatments. The quantity of irrigation water was measured with 7.5cm throat Parshall Flume installed under free flow condition in the water channel. Cotton variety NHH-44 *Bt.* was sown at spacing of 120 x 45 cm at 29th June 2009, 09th June 2010 and 11th July 2011, respectively and harvested at 03rd January 2010, 22nd January 2011 and 06th January 2012, respectively. The experimental data recorded for growth parameters, yield attributes, yield, and economics were statistically analyzed for level of significance and pooled of the season.

Nitrogen content and uptake

The nitrogen content was determined with micro Kjeldhal's method (Jackson, 1974). The uptake of nitrogen by seed cotton and cotton stalk were calculated by using the formula as under:

$$\text{N uptake/Seed cotton (Kg/ha)} = \frac{\text{N content in seed cotton (\%)} \times \text{Seed cotton yield (Kg/ha)}}{100}$$

$$\text{N uptake by cotton stalk (kg/ha)} = \frac{\text{N content in stalk (\%) X Stalk Yield (kg/ha)}}{100}$$

Total N uptake (kg/ha) = N uptake by seed cotton (kg/ha) + N uptake by cotton stalk (kg/ha)

RESULTS AND DISCUSSION

Effect of irrigation on growth, yield attributes and yields

Irrigation levels had significant effect on growth and yield attributing characters. Significantly, higher plant height (128.59 cm), numbers of monopodial and sympodial branches per plant (2.53 and 18.30), number of bolls per plant (47.76), boll weight (3.59) and lint yield (1281kg/ha) were recorded when crop received irrigation at 1.2 IW/CPE ratio on pooled data basis (Table 2). The results showed the significant effect of irrigation levels on seed cotton and stalk yields. Significantly maximum seed cotton yield of 4612, 3952, 2393 and 3652 kg/ha was recorded when crop was irrigated at 1.2 IW/CPE ratio during 2009-10, 2010-11, 2011-12 and in pooled results, respectively. Significantly lower seed cotton yield recorded when crop was irrigated at 0.8 IW/CPE ratios during individual's years and in pooled. The per cent increased due to 1.2 IW/CPE ratios over 0.8 IW/CPE ratio was, 19.14, 23.73, 54.59 and 27.20% corresponding. Similarly, stalk yield was also significantly influenced by irrigation levels and significantly higher yield of 7480, 5017, 2674 and 5057 kg/ha was produced when crop was irrigated at1.2 IW/CPE ratio during 2009-10, 2010-11, 2011-12 and in pooled data, respectively (Table 1). The increase in stalk yield due to 1.2 IW/CPE ratios over 0.8 IW/CPE ratios was, 28.59, 24.89, 33.83 and 28.22% correspondingly. Similar results were obtained by Adarsha*et al*. (2004),Sankarnarayan, *et al*. (2004), Yudhveer *et al*. (2010) and Ughade and Mahadkar (2015).

Effect of nitrogen levels on growth, yield attributes and yields

Nitrogen management treatments significantly affect the growth and yield attributing parameters. Significantly higher plant height (128.53cm), numbers of monopodial and sympodial branches per plant (2.60 and 18.73), number of bolls per plant (48.18), boll weight (3.53) and lint yield (1256 kg/ha) were recorded when crop was fertilized with application of nitrogen 280 kg/ha (Table 2). Seed cotton and stalk yields were significantly influenced by nitrogen management practice during individual years and in pooled results. Fertilizing the crop with 280 kg N/ha produced significantly maximum seed cotton yield of 4597, 3917, 2261 and 3592 kg/ha during 2009-10, 2010-11, 2011-12 and on pooled data basis. The respective increase in seed cotton yield with fertilized 280 kg N/ha over lower levels of nitrogen was to tune of 18.97, 19.90, 27.67 and 21.02% (Table 1). Similar trend was also observed in stalk yield, wherein application of 280 kg N/ha produced significantly maximum stalk yield with fertilized 280 kg N/ha during individual years and in pooled results and remained statistically at par with fertilized 240 kg N/ha in 2011-12 individual year. Similar positive response on growth and yield attributes was observed by Basavanneppa (2005), Meena *et al*. (2007) and Shukla *et al*. (2013).

Interaction effect of irrigation and nitrogen

The interaction effect found non-significant for yields, growth and yield attribute characters.

Effect of different treatments on N content and uptake by seed cotton and stalk

Effect of irrigation

Significantly the higher N content and uptake in seed cotton (1.88% and 68.64 kg/ha) and stalk (0.93% and 47.02 kg/ha) is found with irrigated at 1.2 IW/CPE ratios over lower level (Table 2).

Table 1: Effect of different treatments on seed cotton yield of *Bt.* cotton.

Treatments	Seed cotton yields (kg/ha)				Stalk yields (kg/ha)			
	2009-10	2010-11	2011-12	pooled	2009-10	2010-11	2011-12	pooled
Irrigation levels (IW/CPE)								
I_1:0.8	3871	3194	1548	2871	5817	4017	1998	3944
I_2:1.0	4122	3537	2051	3237	6875	4537	2382	4598
I_3:1.2	4612	3952	2393	3652	7480	5017	2674	5057
S.Em.±	128	105	89	62	300.97	179.86	112.15	122.71
C.D. at 5 %	444	363	308	186	1041.51	622.42	388.12	364.59
Nitrogen (kg/ha)								
N_1:160	3864	3267	1771	2968	6308	4327	2101	4245
N_2:200	4024	3400	1910	3112	6707	4503	2246	4485
N_3:240	4322	3659	2046	3342	6822	4526	2529	4626
N_4:280	4597	3917	2261	3592	7059	4729	2530	4776
S.Em.±	108	99	71	54	150.15	72.65	78.74	61.48
C.D. at 5 %	314	289	208	153	435.76	210.80	228.51	173.28

Table 2: Effect of different treatments on growth and yield attributing characters (Average of three years)

Treatment	Plant height at harvest (cm)	Numberof monopodia branches / plant	Number of sympodia branches / plant	Number of bolls / plant	Boll weight (g)	Lint yield (kg/ha) Seed cotton	Cotton stalk	N content (%) Seed cotton	Cotton stalk	N uptake (kg/ha)
Irrigation levels (IW/CPE)										
I_1:0.8	117.68	1.99	16.12	40.69	3.16	1014	1.82	0.82	52.65	32.23
I_2:1.0	123.58	2.44	17.35	44.61	3.30	1131	1.85	0.85	60.28	38.58
I_3:1.2	128.59	2.53	18.30	47.76	3.59	1281	1.88	0.93	68.64	47.02
S.Em.±	1.44	0.07	0.19	0.92	0.05	23.31	0.012	0.014	1.38	1.32
C.D. at 5 %	4.28	0.20	0.55	2.72	0.16	69.26	0.036	0.043	4.11	3.92
Nitrogen (kg/ha)										
N_1:160	117.40	2.07	15.81	42.01	3.16	1048	1.77	0.78	53.05	33.54
N_2:200	122.60	2.30	16.67	42.23	3.27	1095	1.85	0.86	57.87	38.04
N_3:240	124.59	2.30	17.83	45.00	3.45	1168	1.88	0.91	62.59	41.90
N_4:280	128.53	2.60	18.73	48.18	3.53	1256	1.90	0.92	68.59	43.62
S.Em.±	1.09	0.07	0.25	0.74	0.05	21.52	0.01	0.014	1.12	0.81
C.D. at 5 %	3.07	0.20	0.70	20.7	0.14	60.65	0.03	0.039	3.16	2.27

Table 3: Water use efficiency (kg/ha-mm) as influenced by different irrigation levels (Average three years).

Irrigation levels (IW/CPE)	Number of irrigation	Quantity of water (mm)	WUE(kg/ha-mm)	% saving of water over I_3
I_1:0.8	7	350	8.20	22.22
I_2:1.0	8	400	8.09	11.11
I_3:1.2	9	450	8.12	-

Effect of nitrogen levels

Significantly the higher N content and uptake in seed cotton (1.90 % and 68.59 kg/ha) and stalk (0.92% and 43.62 kg/ha) were observed with application of nitrogen 280 kg/ha and on stalk remained statistically at par with fertilized 240 kg N/ha in pooled data (Table 2).

Interaction effect

The interaction effect was not found significant on nitrogen uptakeon seed cotton and stalk. These findings are in close agreement with Kote *et al*. (2005). Gadhiya *et al*. (2009) indicated increase in *Bt* cotton yield by increasing nitrogen levels from 160 to 240 kg/ha under irrigated condition.

Effect of different treatments on total nitrogen uptake (kg/ha) by crop

The data showed that different total nitrogen uptake by *Bt*. cotton crop was significantly affected due to irrigation and nitrogen levels. Significantly higher N total uptake (115.66 kg/ha) was observed with irrigated 1.2 IW/CPE ratio and higher total N uptake (112.20 kg/ha) was observed with 280kgN/ha.

Water Use efficiency and water saving

Among the irrigation ratios, the $I_{0.8}$ and $I_{1.0}$ recorded higher WUE (2.73 kg/ha-mm) and also saved 22.22 and 11.11 per cent water, respectively over $I_{1.2}$ (Table 3).

REFERENCES

Adarsha, T. S., Patil, B. C., Vanaja, M. and Srinivas, K. 2004. Nitrogen and phosphorus management of cotton under different moisture regimes. Paper presented in International Symposium Strategies for Sustainable Cotton Production. *Int. Symp. Strat. Sust. CottonProd., A Global Vision, Univ. Agric. Sci., Dharwad, November,* pp. 23-25.

Basavanneppa, M. A. 2005. Productivity and profitability of cotton influenced by fertilizer management under Tungabhadra project area of *Karnataka. J. Cotton Res. Dev.* **19:** 66-68.

Gadhiya, S. S., Patel, B. B., Jadav, N. J., Patel, M. V. and Patel, V. R. 2009. Effect of different level of nitrogen phosphorus and potassium on growth, yield and quality of *Bt*. cotton. *An. Asian. J. Soil Science.* **4(1):** 37-42.

Hodges, C. S. 1995. Cotton Fertilization. *North Carolina Cooperative Extension Services.*

Jackson, M. L. 1974. "Soil chemical analysis". *Printice Hall India Pvt.* Ltd., New Delhi. pp. 327-350.

Kote, J. M., Giri, A. N. and Kausale, S. P. 2005. Nutrient concentration and uptake of different cotton (*Gossypium hirsutum* L.) genotypes as influenced by intercrops and fertilizer level under rainfed conditions. *J. Cotton Res. Dev.* **19:** 188-190.

Meena, R. L., Babu, V. R. and Nath, A. 2007. Effect of fertilizer management on cotton under saline soils of Gujarat. *Bhartiya Krishi Annusandhan Patrika*. **22:** 206-210.

Pettigrew, W. T. and Adamczyk Jr, J. J. 2006. Nitrogen fertility and planting date effects onlint yield and *cryl ac* (*bt*) endotoxin production. *Agronomy J.* **98:** 691-697.

Reddy, P. R. R. and Kumar, B. D. 2010. Fertilizer response studies in *Bt* cotton hybrid. *J. Cotton Res. and Development.* **24(1):** 76-77.

Sankarnarayana, K., Nalayini, P. and Praharaj, C. S. 2004. Agronomic requirements of *Bt* cotton hybrid in relation to plant densities and fertilizer requirements. *Int. Symp. Strat.Sust. Cotton Prod., A Global Vision, Univ. Agric. Sci.*, Dharwad, November. p. 149.

Shukla, U. N., Khakare, M. S., Srivastava, V. K., Rakesh Kumar, Smita Singh, Kumar, V. and Kumar, K. 2013. Effect of spacing and fertilitylevels on growth, yield and quality of cotton hybrids under rainfedcondition of vidarbha. *The Bioscan*. **8(2):** 561-567.

Ughade, S. R. and Mahadkar, U. V. 2015. Effect of different planting density, irrigation and fertigation levels on growth and yield of brinjal (*Solanum melongena* L.).*The Bioscan.***10(3):** 1205-1211.

Yang Chang Qin, Xu LiHua and Yang DeYin. 2005. Effects of nitrogen

fertilizer on the *Bt* protein content in transgenic cotton and the mechanism of nitrogen metabolism. *Cotton Science*. **17(4):** 227-231.

Yudhveer Singh, Sajjan Singh Rao and Panna Lal Regar. 2010. Deficit irrigation and nitrogen effects on seed cotton yield, water productivity and yield response factor in shallowsoils of semi-arid environment. *Agricultural Water Management*. **97(7):** 965-970.