RESPONSE OF COTTON TO NITROGEN FERTILIZER AND SPACING BETWEEN HOLES

[1]M. O. Alubaidi [2]M. A. Al-Naqeeb [3]H. K. Saleh*
Prof. Prof. Lecturer
[1,3]Dept. of Field Crop – Coll. of Agric. – Anbar Univ.
[2]Dept. of Field Crops – Coll. of Agric. – Univ. of Baghdad
mohammadalubaidi@yahoo.com

ABSTRACT

This experiment was conducted at the farm of field crop department, College of Agriculture, University of Baghdad during two summer seasons (2010 and 2011) in order to know the response of cotton var. Lashata to nitrogen levels and spacing between holes. A randomized complete block design under arrangement of split plot with four replications was used. The plant spacing; 10, 20 and 30 cm between holes and 75 cm between rows considered as main plots, while three nitrogen levels (150, 200 and 250 Kg N.ha^{-1}) are considered as sub plots. The results showed that using 10 cm between hills were significantly superior in boll weight (3.69 and 4.26) gm.boll^{-1}, seed cotton yield (3.03 and 3.6) t.ha^{-1} and lint yield (1.13 and 1.30) t.ha^{-1} in both seasons 2010 and 2011 respectively. While, 30 cm spacing significantly superior in number of open bolls (12.10 and 13.6) bolls.plant^{-1} and ginning percentage (39.05 and 37.44)% in both seasons respectively. The nitrogen fertilizer 250 kg N ha^{-1} was significantly superior in dehiscence bolls number, seed cotton yield, lint yield and ginning percentage in both seasons 2010 and 2011 respectively. It can be concluded that 'using 10 cm spacing between holes with 250 kg N ha^{-1} to achieve highest seed cotton yield.

Keywords: cotton, nitrogen, planting spacing, lint yield, ginning percentage.
***Part of Ph.D. Dissertation of third author.**

استجابة القطن لمستويات من السماد النتروجيني والمسافة بين الجور

[1]محمد عويد غدير العبيدي [2]موفق عبدالرزاق النقيب [2]حامد خلف صالح*
أستاذ أستاذ مدرس
[1و3]قسم المحاصيل الحقلية – كلية الزراعة – جامعة الانبار
[2]قسم المحاصيل الحقلية – كلية الزراعة – جامعة بغداد
mohammadalubaidi@yahoo.com

المستخلص

طبقت التجربة في حقل تجارب قسم المحاصيل الحقلية–كلية الزراعة–جامعة بغداد–ابو غريب خلال الموسم الصيفي لعامي 2010 و2011 بهدف معرفة استجابة القطن صنف لاشاتا لمستويات النتروجين والمسافة بين الجور. استعمل تصميم القطاعات الكاملة المعشاة بترتيب الالواح المنشقة بأربعة مكررات. كانت المسافة بين الجور داخل المرز الواحد 10 و20 و30 سم مع مسافة 75 سم بين المروز والتي مثلت الألواح الرئيسة، بينما مثلت مستويات السماد النتروجيني (150 و200 و250) كغم N.هـ$^{-1}$ الألواح الثانوية. اظهرت النتائج تفوق المسافة 10 سم بين النباتات معنويا في صفات وزن الجوزة (3.69 و4.26) غم وحاصل القطن الزهر (3.03 و3.6) طن هـ$^{-1}$ وحاصل الالياف (1.13 و1.3) طن هـ$^{-1}$ للموسمين بالتتابع. بينما تفوقت المسافة 30 سم بين الجور معنويا في صفتي عدد الجوز المتفتح ونسبة تصافي الحلج وللموسمين بالتتابع. كما اظهرت النتائج تفوق مستوى التسميد 250 كغم N.هـ$^{-1}$ في في عدد الجوز المتفتح وحاصل القطن الزهر وحاصل الالياف ونسبة تصافي الحلج للموسمين بالتتابع. لذلك نوصي بالزراعة على مسافة 10 سم بين الجور والتسميد بالمستوى 250 كغم N.هـ $^{-1}$ للحصول على اعلى حاصل للقطن. يمكن الاستنتاج أن استعمال المسافة 10 سم بين الجور مع اضافة 250 كغم N.هـ$^{-1}$ اعطى أعلى حاصل للقطن.

كلمات مفتاحية: قطن، نتروجين ، مسافات الزراعة، حاصل الشعر، النسبة المئوية لتصافي الحلج.
***البحث مستل من اطروحة الدكتوراه للباحث الثالث.**

INTRODUCTION

Cotton *Gossypium hirsutum* L. is one of the most important industrial crops, which is planted in order to obtain fiber and oil. The productivity per unit area in Iraq is still low due to insufficient management. Cotton crop is stressful of soil, as it consumes high amounts of nutrients in order to deepen the roots and enlarge of total vegetative growth. Nitrogen is one of the most important of these elements, while the cotton plants need from the beginning of the growth stage to increase plant growth shoots and strengthen the root system, which is necessary for rate, growth, flowering and maturation (2, 4). The availability of nitrogen in the soil will be a limiting factor for cotton production when increasing of plant density. The planting method and distribution of plants in the field are the most important factors affecting the growth and yield of cotton (13). Studies refers that the cotton plants during the stage progresses increases the absorption of nitrogen until they reached their highest after four months from planting and then begging to decrease. Reduced nitrogen with high plant density causes configuration of weak stem and low production. Yellowing of leaves and plant dwarfing are one of the most common symptoms nitrogen deficiencies (5, 17). This research was carried out to investigate the effect of nitrogen fertilizer and plant spacing on cotton yield and its quality.

MATERIALS AND METHODS

This study was carried out during 2010 and 2011 at the field of the College Agriculture – University of Baghdad, in a soil with salt clay loam texture, using RCBD design with split plot arrangement and four replicates. Three nitrogen levels (150, 200 and 250) Kg $N.ha^{-1}$ considered as a sub-plots, while, the hill spacing (10, 20 and 30) cm between hills and 75 cm between rows, which represented plant density 133333.33, 66666.66 and 44444.44 $plant.ha^{-1}$ respectively as main plots. The experimental unit area was 3×3.75 m, Lashata variety was used. Sowing date was at the beginning of April in each year, using 3-4 seeds in each hill with 3-5 cm depth. Phosphorus added as a P_2O_5 at a rate of 100 Kg ha^{-1}, either nitrogen added as a urea (46% N) in two times, the first after emergence and the second after 45 days from the first time. Ten plants were selected randomly from each experimental unit to study the following traits::

1. Number of open $bolls.plant^{-1}$.
2. Boll weight (gm).
3. Seed cotton yield ($Kg.ha^{-1}$).
4. Lint yield ($Kg.ha^{-1}$).
5. Ginning percentage %: using the equation

Ginning percentage (%) = Lint weight (gm) / {Lint weight (gm) + seeds weight (gm)} × 100

Data were analyzed as analysis of variance using a statistical analysis program Genstat, while the means were compared using LSD 0.05.

RESULTS AND DISCUSSION

Number of open $bolls.plant^{-1}$

Table 1 indicates the superiority of 30 cm plant spacing which achieve the highest (12.10 and 13.60 bolls $plant^{-1}$), while the 10 cm spacing gave the lowest (7.12 and 7.99 $bolls.plant^{-1}$) for both years respectively. The reason may be that the plants which cultivated in narrow spacing (10 cm) had highly competition for growth factors in addition to shading (17, 18). The results in Table 1 represent that 250 Kg $N.ha^{-1}$ level achieve the highest rate for this characters (11.19 and 12.07) $boll.plant^{-1}$, while the 150 Kg $N.ha^{-1}$ level produced a lower rate (8.38 and 9.97) $boll.plant^{-1}$ for both years respectively. These results deals that the cotton plants had good response to the N element, which played an important role in the improving of the source size and increasing the rate of net photo-synthesis (6). A significant the inter-action between plant spacing and N levels was revealed, the 30 cm spacing with 250 Kg $N.ha^{-1}$ recorded the highest value (13.43 and 14.25) $boll.plant^{-1}$, while treatment 10 cm with 150 Kg $N.ha^{-1}$ gave the lowest rate (5.12 and 6.26) $boll.plant^{-1}$ for the two years respectively. This

this results revealed that the response of number of open bolls plant^{-1} were different significantly from nitrogen.

Boll weight

Table 2 shows the significant influence of plant spacing on boll weight for 2011 season only, the spacing 10 cm produced highest weight 4.26 gm.boll^{-1} while the lowest 3.36 gm.boll^{-1} for the spacing 30 cm. That's may be due to the compensation principle between yield components, it is found that the plant, which increased the number of dehiscence bolls was in wide distance between plants (Table 1), that's indicated by the results of Ali et al (3) and Clawson et al (8).

Seed cotton yield

According to Table 3 results indicate that was significant difference between plant spacing on seed cotton yield, a spacing 10 cm has produced highest yield (3028.0 and 3551.4) Kg.ha^{-1}, while the spacing 30 cm produced the lowest (1914.2 and 2353.8) Kg.ha^{-1} for both years, respectively (Table3). That's may be due to the increase of the number of plants in unit area in the 10 cm spacing in addition to a significant increase of boll weight (Table 2) that is confirmed by the results of Ali et al (3) and Akhtar et al (1). Significant difference, also found among N levels on cotton yield, where the 250 Kg N.ha^{-1} produced the highest 2817.0 and 3153.4 Kg.ha^{-1} and 150 Kg N.ha^{-1}, produced lowest 2138.6 and 2776.9 Kg.ha^{-1} for both years, respectively. That's may be due to the plants under treatment 250 Kg N. ha^{-1} had the highest rate of open boll.plant^{-1} (Table 1) in addition to the heavy boll weight (Table 2). These results agreed with what achieved by Rashidi and Gholami (19); Ibrahim et al (14) and Khan and Dar (15). A significant interaction was found between planting spacing and N levels, the 10 cm spacing with 250 Kg N.ha^{-1} gave the highest yield (3732.3 and 3821.3) Kg.ha^{-1} and a lower yield between 30 cm with 150 Kg N.ha^{-1} (1735.2 and 2223.7) Kg.ha^{-1} for both years respectively. This interaction was due to difference in response to the spacing plant and nitrogen fertilizer.

Lint yield

Table 4 shows significant difference between plant spacing was revealed in lint yield for both years. The highest was 1135.4 and 1285.5 Kg.ha^{-1} for 10 cm spacing between hill, while the 30 cm produced the lower reached 735.9 and 881.6 Kg. ha^{-1} for the two years, respectively, that is supports by Boquet (7), Akhtar et al (1) and Demastro (9). Also, a significant difference were revealed between N fertilizer in lint yield (Table 4), The highest yield was 1078.0 and 1185.6 Kg. ha^{-1} for 250 Kg N. ha^{-1}, while, the lowest 800.8 and 999.6 Kg. ha^{-1} for 150 Kg N. ha^{-1} for the two years, respectively. This may be due to the N, which increased the total cotton yield (Table 3), (14, 16). A significant interaction between N levels and plant spacing was obtained in the lint yield. The level 250 Kg N.ha^{-1} with 10 cm spacing produced highest 1418.4 and 1423.0 Kg.ha^{-1}, while the level 150 Kg N.ha^{-1} with 30 cm the lowest produced (664.3 and 825.1) Kg.ha^{-1} for two years respectively.

Ginning percentage

Table 5 shows significant difference among N levels and plant spacing in ginning percentage. The spacing 30 cm between hills had significantly superior to other ginning% highest ginning% that reached 39.05 and 37.44%, while 10 cm produced the lowest percentage (37.73 and 36.67)% for both years respectively. This could be due to the lack of competition at the growth factors between plant, which are planted in wider spacing and provided more cellulose in secondary wall of lint (10, 11, 18). As for N levels, the highest ginning percentage was 38.97 and 37.44% produced from 250 Kg N.ha^{-1} while 150 Kg N. ha^{-1} produced the lowest 37.52 and 36.69% for both years respectively. This may be due to the fact that N increasing photosynthesis and provide more carbohydrates which are de-posited in the secondary wall and formation of cellulose, which increase lint weight (12, 20).

Table 1. Effect of spacing between hills and nitrogen levels on number of open bolls.plant^{-1} in years 2010 and 2011

Spacing between hill (cm)	2010				2011			
	Nitrogen levels (Kg N.ha^{-1})				Nitrogen levels (Kg N.ha^{-1})			
	150	200	250	Mean	150	200	250	Mean
10	5.12	7.55	8.68	7.12	6.76	8.26	8.97	7.99
20	9.53	10.80	11.47	10.60	10.34	11.63	12.99	11.65
30	10.48	12.40	13.43	12.10	12.81	13.74	14.25	13.60
LSD 0.05	0.71			0.48	0.57			0.40
Mean	8.38	10.25	11.19		9.97	11.21	12.07	
LSD 0.05	0.41				0.33			

Table 2. Effect of spacing between hills and nitrogen levels on boll weight (gm.boll^{-1}) in years 2010 and 2011

Spacing between hill (cm)	2010				2011			
	Nitrogen levels (Kg N.ha^{-1})				Nitrogen levels (Kg N.ha^{-1})			
	150	200	250	Mean	150	200	250	Mean
10	3.81	3.61	3.65	3.69	4.33	4.26	4.20	4.26
20	3.76	3.51	3.33	3.53	4.18	3.84	3.60	4.89
30	3.77	3.11	3.19	3.36	3.74	3.52	3.43	3.56
LSD 0.05	N.S			N.S	N.S			0.54
Mean	3.78	3.41	3.39		4.08	3.89	3.74	
LSD 0.05	N.S				N.S			

Table 3. Effect of spacing between hills and nitrogen levels on seed cotton yield (Kg. ha^{-1}) in years 2010 and 2011

Spacing between hill (cm)	2010				2011			
	Nitrogen levels (Kg N.ha^{-1})				Nitrogen levels (Kg N.ha^{-1})			
	150	200	250	Mean	150	200	250	Mean
10	2249.4	3102.3	3732.3	3028.0	3241.4	3591.5	3821.4	3551.4
20	2431.2	2587.7	2643.3	2554.1	2865.7	3010.0	3164.4	3013.4
30	1735.2	1932.1	2075.3	1914.2	2223.7	2363.2	2474.5	2353.8
LSD 0.05	72.4			44.6	88.7			54.7
Mean	2138.6	2540.7	2817.0		2776.9	2988.2	3153.4	
LSD 0.05	44.5				54.6			

Table 4. Effect of spacing between hills and nitrogen levels on lint yield (Kg.ha^{-1}) in years 2010 and 2011

Spacing between hill (cm)	2010				2011			
	Nitrogen levels (Kg N.ha^{-1})				Nitrogen levels (Kg N.ha^{-1})			
	150	200	250	Mean	150	200	250	Mean
10	826.5	1161.4	1418.4	1135.4	1117.2	1316.3	1423.0	1285.5
20	911.7	982.1	1014.5	969.5	1056.6	1113.7	1193.6	1121.3
30	664.3	742.3	801.1	735.9	825.1	879.7	940.1	881.6
LSD 0.05	54.1			33.1	59.4			36.3
Mean	800.8	961.9	1078.0		999.6	1103.2	1185.6	
LSD 0.05	33.3				36.6			

Table 5. Effect of spacing between hills and nitrogen levels on ginning percentage (%) in years 2010 and 2011

Spacing between hill (cm)	2010				2011			
	Nitrogen levels (Kg N.ha^{-1})				Nitrogen levels (Kg N.ha^{-1})			
	150	200	250	Mean	150	200	250	Mean
10	36.75	38.40	38.00	37.72	36.10	36.66	37.24	36.67
20	37.50	38.80	39.19	38.50	36.87	37.00	37.72	37.20
30	38.32	39.10	39.72	39.05	37.10	37.23	38.00	37.44
LSD 0.05	N.S			0.79	N.S			0.58
Mean	37.52	38.77	38.97		36.69	36.69	37.65	
LSD 0.05	0.66				0.58			

REFERENCES

1. Akhtar, M., M.S. Cheema, M. Jamil, M.R. Farooq and M. Asiam. 2002. Effect of plant density on four statured cotton varieties. Assian J. of Plant Sci. 1 (6): 644-645.
2. Ali, H. and R. A. Hameed.2011. Growth, yield and yield components of American cotton (*Gossypium hirsutum* L.) as affected by cultivars and nitrogen fertilizer. International. J. of Sci. & Engineering. Res. 2(7): 1-11.
3. Ali, A.; M. Tahir, M. Ayub, I. Ali, A. Wasaya and F. Khalid. 2009. Studies on the effect of plant spacing on the yield recently approved varieties of cotton. Pak. J. Sci. 7 (1): 25-30.
4. Barker, A. V. and D. J. Pilbeam. 2007. Handbook of Plant Nutrition. Taylor & Francis Group. New York. PP: 613.
5. Bibi, Z., N. U. Khan, M. Mussarat, M. J. Khan, R. Ahmed, I. U. Khan and S. Shaheen. 2011. Response of *Gossypium hirsutum* L. genotypes to various nitrogen levels. Pak. J. Bot. 43(5): 2403-2409.
6. Boquet, D. J., E. B. Moser and G. A. Breitenbeck. 1994. Boll weight and with in plant yield distribution in field grown cotton given different levels of nitrogen. Agron. J. 86: 20-26.
7. Boquet, D.J. 2005. Cotton in ultra-narrow row spacing, plant density and nitrogen fertilizer rates. Agron. J. 97: 279-287.
8. Clawson, E.L., J.T. Cothren and D.C. Blouin. 2006. Nitrogen fertilization and yield of cotton in ultra-narrow and conventional row spacings. Agron. J. 92: 72-79.
9. Demastro, G. 1998. Influence of the irrigation timing and plant density on the cotton yield in south Italy. World Cotton Research Conference. 2. 6-12 September. Athens, Greece: 153.
10. Fatihkilli, Y.K., A. Tufekci, O.S. Uslu and S. Karraltine. 1998. Row space X nitrogen interaction in cotton (*Gossypium hirsutum* L.), Turkey. World Cotton Research Conference. 2. 6-12 September. 1998. Athens, Greece: 145.
11. Feng, L., V. B. Bufon, C. I. Mills, E. Hequet, J. P. Bordovsky, W. Keeling, R. Boman and C. W. Bednarz. 2010. Effects of irrigation, cultivar and plant density on cotton within-boll fiber quality. Agron. J. 103 (2): 297-303.
12. Gormus, O. 2005. Interactive Effect of Nitrogen and Boron on Cotton Yield and Fiber Quality. Cukurova University. Faculty of Agriculture, Department of Field Crops. Adama, Turkey.PP:781.
13. Gwathmey, C. O., L. E. Steckel and J. A. Larson. 2008. Soil and skip-row spacings for irrigated and non-irrigated upland cotton. Agron. J. 100: 672-680.
14. Ibrahim, M.A.S., K.E. Ahmed, S. Osman, E.S. Ali and A.A. Hamada. 2010. Response of new cotton varieties to nitrogen fertilization in Sudan gezira. African. J. Agric. 5 (11): 1213-1219.
15. Khan, M.B. and J.S. Dar. 2006. Response of cotton (*Gossypium hirsutum* L.) cultivars to different levels of nitrogen. J. Res. Sci. 17 (4): 257-261.
16. Kumbhar, A.M., U.A. Buriro, S. Junejo, F.C. Oad, G.H. Jamro, B.A. Kumbhar and S.A. Kumbhar. 2008. Impact of different nitrogen levels on cotton growth, yield and N-uptake planted in legume rotation. Pak. J. Bot., 40(2): 767-778.

17. Nadeem, M.A., A. Ali, M. Tahir, M. Naeem, A.R. Chadhar and S. Ahmed. 2010. Effect of nitrogen levels and plant spacing on growth and yield of cotton. Pak. J. Sci. 8 (2): 121-124.

18. Ram, M and A.N. Giri. 2006. Response of newly released cotton (*Gossypium hirsutum* L.) varieties to plant densities and fertilizer levels. Cotton Res. J. 20 (1): 85-86.

19. Rashidi, M and M. Gholami. 2011. Nitrogen and boron effects on yield and quality of cotton (*Gossypium hirsutum* L.). Agric & Soil. Sci. J. 1 (4): 118-125.

20. Saleem, M.F., M.F. Bilal, M. Awais, M.Q. Shahid and S.A. Anjum. 2010. Effect of nitrogen on seed cotton yield and fiber qualities of cotton (*Gossypium hirsutum* L.) cultivars. Animal & Plant. Sci. J. 20 (1): 23-27.