Egypt. J. Agron. The 15th Int. Conf. Crop Science, pp. 125 - 137 (2018)

Effect of Nano-Fertilizer and N-Fertilization Levels on Productivity of Egyptian Cotton under Different Sowing Dates

M.A.A. Emara[(1)#], S.A.F. Hamoda[(1)] and Maha M.A. Hamada[(2)]

[(1)]Cotton Research Institute, Agricultural Research Center (ARC), Giza, Egypt; [(2)]Agronomy Department, Faculty of Agriculture, Ain Shams University, Cairo, Egypt.

TWO FIELD experiments were carried out on clay soil in El-Gemmeiza Agric. Res. St., ARC, El-Gharbiya Governorate, during 2016 and 2017 to study the effect of nano-fertilizer and N-fertilization levels on productivity of cotton Giza 86 under two sowing dates. The experiment design was a split split-plot. The main plots involved two sowing dates; (Early at 8th April and Late at 8th May). While, the sub plots were allocated to three treatment of nano-fertilizer (without, Lithovit 2.5g/L and Lithovit 5g/L). Application three times (at squaring, initiation of flowering and two weeks after flowering). While, the sub sub-plots were allocated to three N-fertilization levels, (50%, 75% and 100% recommended dose). The most important results obtained could be summarized as follows: Sowing date had a significant effect on growth, yield and its components. Where, the early sowing date surpassed the late sowing date. The levels of N had significant effect on growth, seed cotton yield and its components in both seasons. The rate of N (75%) gave the good averages in this respect. The Nano-fertilizer by Lithovit had significant effect on growth, seed cotton yield and it compounds. All treatments had a not significant effect on fiber properties. Early sowing date in combination with the N fertilizer (45kg N/fad) and foliar application with Lithovit (5g/L water) for obtaining gave the high productivity of Egyptian cotton variety Giza 86.

Keywords: Cotton, Sowing dates, N-fertilizer, Lithovit, Growth, Yield, Earliness and Fiber Quality.

Introduction

The suitable sowing date and nutrients play a vital role in cotton production, where the early sowing date is one of the most important management factors involved in producing high yielding and quality (Dong et al., 2006). In Egypt, planting cotton before end of March leads to the formation of vegetative growth, earliness and fruiting capacity therefore, increasing the yield and quality. Early sowing appears higher yield potential and alternately, late planting of cotton shows high vegetative growth and difficult to resulting lower yield (Ali et al., 2009). Boquet et al. (2003) showed that the excessive plant height at late planting was partly responsible for lower yield as crop used a larger portion of its energy budget for vegetative growth yield was significantly decreased with delayed planting.

Early sowing produced 23% more open bolls and 18% more cotton yield (Arshad et al., 2007). However, several reports indicated that early sown cotton produces taller plants with higher number of branches, number of bolls and yield (Bange et al., 2008). These findings are also supported by other researchers (Emara et al., 2006 and Emara et al., 2015 b), where they found that early planting date significantly increased seed cotton yield/fad. Due to the increase of number of open bolls/plant, boll weight and seed cotton yield/plant. Planting date did not exhibit significant effect on lint percentage. However, Deshish et al. (2015) indicated that all fiber properties studied were improved due to early planting of cotton. Emara (2012) reported that sowing date produced significant effects on upper half mean length and micronaire reading in favour of early planting, while no significant on fiber strength.

Nutrition manner is considering one of the most important factors that affecting cotton growth. Furthermore, N forms are the most important plant nutrients limiting plant growth and consequently yield. Through cotton agronomy programs, many traits are usually

#Corresponding author email: mostafacotton@yahoo.com

DOI: 10.21608/agro.2019.5682.1129

assigned to determine the optimum N fertilization levels for commercial varieties (Srinivasan, 2007). In this respect, Policepatil et al. (2009) revealed that increasing N fertilization to cotton may result in more accumulation of photosynthetic assimilate that resulted higher fruit weight. Also, several studies were done to evaluate the response of cotton to different N levels, Hamoda et al. (2014) found that the final plant height, number of fruiting branches/plant, number of bolls/plant, boll weight, seed index, lint percentage and seed cotton yield//fad increased with increasing rates of N applied. Emara et al. (2015 a), Emara et al. (2016) and Emara & Abdel-Aal (2017 b) revealed that the high N fertilizer level did not exhibit significant effect on seed index, lint presenting and fiber properties. Elhamamsey et al. (2016) and Emara & Abdel-Aal (2017 a) found that maximum number of bolls/plant, boll weight and yield/fad. were recorded with using high fertilizer.

Nanotechnology opens a large scope of novel application in the fields of biotechnology and agricultural industries, because nanoparticles have unique physicochemical properties, i.e., high surface area, high reactivity, tunable pore size and particle morphology (Siddiqui et al., 2015). Lithovit is naturally occurring CO_2 fertilizer, which will be used at four rates. Lithovit (a Nano $CaCO_3$) has been given much attention as a natural safety fertilizer, which releases CO_2 which reflected in improving net photosynthesis and causes various promoted effect on plants. Reddy & Zhao (2005) found that plants grown in elevated had significantly greater leaf area than plants in ambient. Hamoda et al. (2016) found that foliar spraying CO_2 fertilizer (in the form of Lithovit) at the rate of 7.5g/L in two times at 45 and 60 days after planting increased significantly number of open bolls/plant, boll weight, seed cotton yield/plant, lint % and seed cotton yield/fad. Seed cotton yield of late plantings could be increased by foliar spray with Potasin-P at 7.5cm^3/L twice (at 46 and 61 days after planting) in combined with two foliar sprays with CO_2 as a nano fertilizer in the form of Lithovit at the rate of 7.5g/L (at 45 and 60 days after planting). The main objective of this investigation was to study the effect of nano-fertilizer and N-fertilization levels on productivity of Egyptian cotton under two sowing date.

Materials and Methods

Two field experiments were carried out at El-Gemmeiza Agric. Res. St., ARC, El-Gharbiya Governorate, during 2016 and 2017 to study the effect of nano-fertilizer and N-fertilization levels on productivity of Egyptian cotton variety Giza 86 under two sowing dates. The experiment design was a split split-plot with four replications. The main plots were assigned to the two sowing dates (Early at 8th April and Late at 8th May), while, the sub-plots were allocated to three treatment of nano-fertilizer (without, Lithovit 2.5g/L and Lithovit 5g/L). Application three times (at squaring, initiation of flowering and two weeks after flowering). Natural CO_2 as a nano-foliar fertilizer in the form of Lithovit®. The different constituents of Lithovit® were illustrated in Table 1.

TABLE 1. Main characteristics of Lithovit® used in the study.

Components	(%)	Components	(%)
Calcium carbonate	79.19	Sulphate	0.3300
Nitrogen	0.060	Iron	1.3100
Phosphate	0.010	Zinc	0.0050
Potassium oxide	0.210	Manganese	0.0140
Magnesium carbonate	4.620	Copper	0.0020
Selisium dioxide	11.41		

While, the sub sub-plots were allocated to three N-fertilization levels treatments: (1- 50%, 2- 75% and 3- 100%) soil application traditional recommended N firtilizer dose. The sub sub-plot size was 19.5m^2 including (Six ridges, 5m long and 0.65cm width). The distance between hills was 25cm. Soil samples were taken in the two seasons before planting cotton to estimate the soil characters. The results are shown in Table 2.

TABLE 2. Chemical analysis of the soil in 2016 and 2017 seasons.

Season	Texture	pH	Organic matter (%)	EC (m mhos/cm)	Bicarbonate (%)	Available elements (ppm)			
						N	P	K	B
2016	Clay loam	8.0	1.42	0.54	1.81	28.7	11.1	306	0.34
2017	Clay loam	8.2	1.56	0.67	1.62	29.2	14.7	250	0.27

In both seasons, the soil texture was clay loam, low content of organic matter, low calcium carbonate and non-saline (Chapman & Parker, 1981).

The soils of the two seasons were low in total N, Extractable-P, and low to medium in available K and B.

Phosphorus in the form of superphosphate (15.5% P_20_5) was applied during land preparation at the rate of 22.5kg P_20_5/fad. Nitrogen fertilizer in the form of ammonium nitrate (33.5% N) at the tested levels was applied in two equal portions, the 1st portion was applied after thinning and the 2nd portion was added at the following irrigation. Potassium was added to soil in the form of potassium sulphate (48% K_2O) at the rate of 24kg K_2O/fad in one dose after thinning. The other agricultural practices were followed throughout the two growing seasons. The other cultural collected out as recommended for the conventional cotton planting. In both seasons, ten representative plants were from the ridge within each plot to determine the following traits: Growth characters; plant height at harvest from the cotyledonary node to the apex of the main stem (cm) and number of sympodia/plant. Yield and yield components; number of open bolls/plant, boll weight (g), lint % and seed index (g). The yield of seed cotton in kentars/fad was estimated from the three inner ridges of each plot. Fiber quality; fiber length, fiber fineness and fiber strength were determined on digital, Fibrograph instrument 630, Micronaire instrument 675 and Pressley instrument, respectively, according to A.S.T.M. (2012) at the C.R.I. laboratories. Statistical analysis was done according to the procedures outlined by Snedecor & Cochran (1980) using M Stat-C microcomputer program for a split split-plot. The treatments means were compared by LSD and T test at 5% level of probability

Results and Discussion

The results of growth traits, yield, its components, and fiber parameters as affected by nano-fertilizer and N-fertilization levels under two sowing dates and their interactions on Egyptian cotton (Giza 86) during 2016 and 2017 seasons are shown in Tables 3 to 8.

Effect of planting dates

Data in Table 3 showed that planting date had a significant effect on plant height at harvest, number of sympodia/plant, number of open bolls/plant, boll weight and seed cotton yield/fad, while it did not exhibit any significant effect on fiber parameters (upper half mean length, fiber strength and micronaire reading) in both seasons. Late sowing date as significantly increased plant height compared with early sowing. However, early sowing date as significantly increased number of sympodia/plant, number of open bolls/plant and boll weight compared with late sowing. This could be attributed to increase in number of sympodia/plant and the well-built plants, which were shorter and had lower fruiting node than the late sown plants, which were etiolated. This intern might have had increased the amounts of available photosynthates for boll development and hence increased number of open bolls/plant and boll weight. Earlier sowing date surpassed late sowing date in the increase of seed cotton yield/fad., owing to early sowing date were 21.03% and 14.30% for first and second seasons, respectively. The seed cotton yield/fad. was increased in favor of early sowing as a result of increasing number of open bolls/plant and boll weight. Seed index and lint percentage insignificantly affected by treatments. This effect may be due to the balance between vegetative and fruiting growth, which occurred under the earlier date, than late one. These results are in harmony with those obtained by Emara et al. (2006), Emara (2012), Emara et al. (2015 b) and Deshish et al. (2015).

Effect of nano-fertilizer

Results presented in Table 3 indicate that levels of nano-fertilizer had significant effect on growth traits (plant height and number of sympodia/plant), number of bolls/plant, boll weight and seed cotton yield/feddan while, it did not exhibit any significant effect on seed index, lint percentage and fiber parameters (upper half mean length, fiber strength and micronaire reading) in both seasons.

The highest values of plant height, number of sympodia/ plant, number of bolls/plant and boll weight produced from nano-fertilizer 5g Lithovit/L. While, the lowest values produced from without Lithovit in. Highest values of seed cotton yield/fad (9.64 and 9.91kentar) was produced from nano-fertilizer 5g Lithovit/L. While, the lowest values was (8.52 and 8.45kentar) produced from without lithovit in 2016 and 2017 seasons, respectively.

TABLE 3. Effect of planting dates, nano applications and N-fertilizer on growth, yield and yield components and fiber properties of cotton during 2016 and 2017 seasons.

Season	Treatments		Growth characters			Yield and yield components				Fiber properties		
			Plant height (cm)	No. of fruiting branches/ plant	No. of open bolls/ plant	Boll weight (g)	Seed index (g)	Lint %	Seed cotton yield (ken/fad)	Length U.H.M	Strength g/tex.	Mic. value
2016	Planting dates	Early	162	14.82	16.45	2.70	10.18	40.22	10.00	33.17	10.05	4.24
		Late	167	14.46	13.73	2.67	10.22	40.16	8.27	32.90	10.19	4.32
	F Test		**	*	**	*	-	-	**	-	-	-
	Nano	Without Lithovit	164.01	14.11	14.28	2.64	10.08	39.99	8.52	32.89	10.04	4.34
		Lithovit 2.5g/L	164.88	14.77	15.29	2.69	10.20	40.52	9.24	33.06	10.10	4.29
		Lithovit 5g/L	166.82	15.04	15.69	2.73	10.31	40.05	9.64	33.16	10.22	4.22
	LSD at 0.05		**0.92**	**0.26**	**0.22**	**0.01**	**N.S.**	**N.S.**	**0.16**	**N.S.**	**N.S.**	**N.S.**
	N-fertilizer	50% N	156.86	14.29	14.46	2.64	10.24	40.31	8.63	33.28	10.16	4.18
		75% N	165.55	15.00	15.94	2.73	10.12	40.20	9.70	32.79	10.04	4.32
		100% N	173.29	14.63	14.86	2.70	10.23	40.05	9.07	33.03	10.16	4.34
	LSD at 0.05		**1.04**	**0.16**	**0.18**	**0.02**	**N.S.**	**N.S.**	**0.11**	**N.S.**	**N.S.**	**N.S.**
2017	Planting dates	Early	165.08	15.16	14.80	2.64	9.98	39.87	9.83	33.33	10.19	4.21
		Late	170.26	14.10	13.67	2.52	10.06	39.97	8.60	33.25	10.23	4.24
	F Test		**	**	**	**	-	-	**	-	-	-
	Nano	Without Lithovit	166.64	13.67	13.77	2.46	10.03	39.84	8.45	33.36	10.25	4.14
		Lithovit 2.5g/L	167.18	14.54	14.21	2.61	10.02	39.96	9.28	33.43	10.18	4.27
		Lithovit 5g/L	169.20	15.68	14.72	2.67	10.01	40.00	9.91	33.08	10.20	4.27
	LSD at 0.05		**0.32**	**0.28**	**0.18**	**0.02**	**N.S.**	**N.S.**	**0.10**	**N.S.**	**N.S.**	**N.S.**
	N-fertilizer	50% N	162.38	14.32	13.94	2.52	10.02	39.87	8.99	33.39	10.27	4.13
		75% N	167.41	15.02	14.60	2.64	10.05	39.90	9.51	33.34	10.17	4.21
		100% N	173.22	14.55	14.17	2.58	9.97	40.03	9.14	33.13	10.19	4.28
	LSD at 0.05		**0.52**	**0.17**	**0.18**	**0.02**	**N.S.**	**N.S.**	**0.08**	**N.S.**	**N.S.**	**N.S.**

TABLE 4. Effect of the interaction between planting dates and nano applications on growth, yield and yield components and fiber properties of cotton during 2016 and 2017 seasons.

Season	Treatments		Growth characters		Yield and yield components					Fiber properties		
	Planting dates	Nano applications	Plant height (cm)	No. of fruiting branches/ plant	No. of open bolls/plant	Boll weight (g)	Seed index (g)	Lint %	Seed cotton yield (ken/fad)	length U.H.M	Strength (g/tex.)	Mic. value
2016	Early	Without Lithovit	161.93	14.43	15.54	2.67	10.15	40.07	9.34	33.33	10.04	4.30
		Lithovit 2.5 g/L	162.43	14.84	16.63	2.70	10.20	40.72	10.09	33.06	10.00	4.26
		Lithovit 5 g/L	163.56	15.19	17.17	2.73	10.18	39.85	10.57	33.11	10.11	4.18
	Late	Without Lithovit	164.47	13.80	13.02	2.62	10.02	39.93	7.70	32.44	10.04	4.38
		Lithovit 2.5 g/L	167.82	14.70	13.95	2.68	10.20	40.30	8.40	33.06	10.20	4.32
		Lithovit 5 g/L	171.21	14.89	14.21	2.72	10.44	40.25	8.71	33.20	10.32	4.27
	LSD at 0.05		**1.30**	**N.S.**	**N.S.**	**0.02**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**
2017	Early	Without Lithovit	164.00	14.13	14.62	2.47	10.20	39.69	9.06	33.26	10.17	4.13
		Lithovit 2.5 g/L	165.06	15.01	14.68	2.69	9.92	39.91	9.92	33.46	10.30	4.21
		Lithovit 5 g/L	166.19	16.35	15.10	2.76	9.82	40.00	10.50	33.27	10.11	4.28
	Late	Without Lithovit	169.27	13.22	12.91	2.45	9.87	39.98	7.83	33.46	10.33	4.14
		Lithovit 2.5 g/L	169.29	14.07	13.75	2.53	10.11	40.01	8.64	33.40	10.07	4.32
		Lithovit 5 g/L	172.21	15.00	14.35	2.57	10.19	40.00	9.32	32.90	10.29	4.27
	LSD at 0.05		**0.45**	**0.40**	**0.25**	**0.02**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**

TABLE 5. Effect of the interaction between planting dates and N-fertilizer on growth, yield and yield components and fiber properties of cotton during 2016 and 2017 seasons.

Season	Treatments		Growth characters			Yield and yield components				Fiber properties		
	Planting dates	N-fertilizer	Plant height (cm)	No. of fruiting branches/ plant	No. of open bolls/plant	Boll weight (g)	Seed index (g)	Lint %	Seed cotton yield (ken/fad)	Length U.H.M	Strength (g/tex.)	Mic. value
2016	Early	50% N	154.44	14.42	15.49	2.64	10.04	40.58	9.21	33.14	10.12	4.11
		75% N	162.75	15.30	17.81	2.75	10.16	40.03	10.91	32.82	9.84	4.33
		100% N	170.73	14.73	16.04	2.72	10.34	40.04	9.88	33.53	10.19	4.29
	Late	50% N	159.27	14.16	13.43	2.63	10.43	40.05	8.05	33.41	10.20	4.26
		75% N	168.36	14.69	14.06	2.71	10.10	40.37	8.50	32.76	10.24	4.31
		100% N	175.86	14.54	13.69	2.68	10.12	40.06	8.26	32.53	10.12	4.40
	LSD at 0.05		**1.47**	**0.22**	**0.26**	**N.S.**	**N.S.**	**N.S.**	**0.16**	**N.S.**	**N.S.**	**N.S.**
2017	Early	50% N	159.04	14.69	14.31	2.55	9.94	39.97	9.53	33.57	10.20	4.20
		75% N	165.70	15.62	15.22	2.72	10.05	39.98	10.17	33.29	10.33	4.26
		100% N	170.51	15.19	14.86	2.65	9.95	39.65	9.77	33.12	10.04	4.17
	Late	50% N	165.73	13.95	13.56	2.48	10.11	39.76	8.45	33.22	10.33	4.21
		75% N	169.12	14.42	13.98	2.55	10.07	39.82	8.84	33.39	10.01	4.31
		100% N	175.93	13.92	13.47	2.52	9.99	40.41	8.51	33.14	10.34	4.21
	LSD at 0.05		**0.73**	**0.25**	**0.26**	**0.03**	**N.S.**	**N.S.**	**0.11**	**N.S.**	**N.S.**	**N.S.**

TABLE 6. Effect of the interaction between nano applications and N-fertilizer on growth, yield and yield components and fiber properties of cotton during 2016 and 2017 seasons.

Season	Treatments		Growth characters		Yield and yield components					Fiber properties		
	Nano application	N-fertilizer	Plant height (cm)	No. of fruiting branches/ plant	No. of open bolls/plant	Boll weight (g)	Seed index (g)	Lint %	Seed cotton yield (ken/fad)	length U.H.M	Strength (g/tex.)	Mic. Value
2016	Without Lithovit	50% N	156.71	13.78	13.43	2.58	9.96	39.96	7.96	33.23	10.15	4.20
		75% N	166.18	14.52	15.32	2.69	10.14	39.88	9.17	32.48	9.80	4.52
		100% N	172.56	14.03	14.08	2.66	10.16	40.15	8.42	32.95	10.18	4.30
	Lithovit 2.5g/L	50% N	157.54	14.40	14.61	2.66	10.53	40.66	8.70	33.90	10.20	4.25
		75% N	164.54	15.16	16.05	2.72	10.06	40.55	9.74	32.62	9.98	4.27
		100% N	169.96	14.76	15.21	2.70	10.00	40.33	9.29	32.65	10.11	4.35
	Lithovit 5g/L	50% N	156.32	14.70	15.33	2.67	10.22	40.32	8.23	32.70	10.13	4.10
		75% N	165.95	15.31	16.45	2.77	10.19	40.17	10.19	33.27	10.35	4.18
		100% N	177.35	15.11	15.30	2.74	10.54	39.66	9.50	33.50	10.17	4.38
	LSD at 0.05		**1.80**	**N.S.**	**0.32**	**N.S.**	**N.S.**	**N.S.**	**0.20**	**N.S.**	**N.S.**	**N.S.**
2017	Without Lithovit	50% N	160.25	13.78	13.36	2.38	10.14	39.76	8.49	33.45	10.27	4.10
		75% N	166.79	13.91	14.33	2.53	10.04	39.69	8.66	33.70	10.38	4.07
		100% N	172.88	13.33	13.61	2.47	9.91	40.06	8.20	32.92	10.10	4.25
	Lithovit 2.5g/L	50% N	162.45	14.18	13.95	2.55	10.10	40.01	8.92	33.82	10.25	4.28
		75% N	166.88	14.87	14.51	2.68	10.04	40.04	9.66	33.15	10.05	4.38
		100% N	172.20	14.57	14.18	2.60	9.91	39.82	9.27	33.32	10.25	4.13
	Lithovit 5g/L	50% N	164.45	15.00	14.51	2.61	9.83	39.82	9.56	32.92	10.28	4.23
		75% N	168.56	16.28	14.96	2.71	9.09	39.97	10.20	33.17	10.08	4.40
		100% N	174.59	15.76	14.71	2.69	10.10	40.21	9.96	33.17	10.23	4.18
	LSD at 0.05		**0.90**	**0.30**	**0.32**	**0.04**	**N.S.**	**N.S.**	**0.14**	**N.S.**	**N.S.**	**N.S.**

TABLE 7. Effect of the interaction among planting dates, nano applications and N-fertilizer on growth, yield and yield components and fiber properties of cotton in 2016 season.

Planting dates	Treatments		Growth characters		Yield and yield components					Fiber properties		
	Nano applications	N-fertilizer	Plant height (cm)	No. of fruiting branches/ plant	No. of open bolls/plant	Boll weight (g)	Seed index (g)	Lint %	Seed cotton yield (ken/fad)	length U.H.M	Strength (g/tex.)	Mic. Value
Early	Without Lithovit	50% N	151.85	14.05	14.47	2.60	9.81	40.23	8.46	33.53	10.13	4.10
		75% N	161.60	14.95	17.20	2.71	10.22	39.61	10.41	32.83	9.70	4.43
		100% N	173.82	14.30	14.95	2.68	10.42	40.37	9.14	33.63	10.30	4.37
	Lithovit 2.5g/L	50% N	157.65	14.37	15.45	2.67	10.36	41.10	9.26	33.67	10.03	4.27
		75% N	164.43	15.37	17.90	2.73	10.12	40.71	10.88	32.30	9.73	4.30
		100% N	168.60	14.77	16.55	2.71	10.11	40.37	10.13	33.20	10.23	4.20
	Lithovit 5g/L	50% N	153.82	14.85	16.55	2.64	9.93	40.41	9.90	32.23	10.20	3.97
		75% N	162.23	15.60	18.35	2.80	10.13	39.75	11.43	33.33	10.10	4.27
		100% N	169.75	15.12	16.62	2.77	10.48	39.38	10.37	33.77	10.03	4.30
Late	Without Lithovit	50% N	161.57	13.52	12.40	2.56	10.10	39.69	7.46	32.93	10.17	4.30
		75% N	170.75	14.10	13.45	2.67	10.07	40.15	7.94	32.13	9.90	4.60
		100% N	181.30	13.77	13.22	2.64	9.89	39.93	7.71	32.27	10.07	4.23
	Lithovit 2.5g/L	50% N	157.43	14.42	13.77	2.64	10.71	40.22	8.14	34.13	10.37	4.23
		75% N	164.65	14.95	14.20	2.71	9.99	40.38	8.61	32.93	10.23	4.23
		100% N	171.32	14.75	13.87	2.69	9.89	40.31	8.45	32.10	10.00	4.50
	Lithovit 5g/L	50% N	158.82	14.55	14.12	2.70	10.49	40.24	8.55	33.17	10.07	4.23
		75% N	169.68	15.02	14.55	2.74	10.24	40.58	8.95	33.20	10.60	4.10
		100% N	174.95	15.10	13.97	2.72	10.60	39.93	8.62	33.23	10.30	4.47
LSD at 0.05			**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**	**N.S.**

TABLE 8. Effect of the interaction among planting dates, nano applications and N-fertilizer on growth, yield and yield components and fiber properties of cotton in 2017 season.

Planting dates	Treatments		Growth characters		Yield and yield components					Fiber properties		
	Nano application	N-fertilizer	Plant height (cm)	No. of fruiting branches/ plant	No. of open bolls/plant	Boll weight (g)	Seed index (g)	Lint %	Seed cotton yield (ken/fad)	Length U.H.M	Strength (g/tex.)	Mic. value
Early	Without Lithovit	50% N	156.75	14.22	13.62	2.35	10.14	39.90	9.07	33.60	10.27	40.00
		75% N	164.65	14.32	15.35	2.58	10.32	39.42	9.28	33.37	10.50	4.07
		100% N	170.60	13.85	14.85	2.49	10.12	39.75	8.84	32.80	9.73	4.33
	Lithovit 2.5g/L	50% N	160.07	14.42	14.55	2.60	9.98	40.21	9.51	33.80	10.17	4.37
		75% N	16.82	15.47	14.90	2.78	9.88	40.12	10.42	33.43	10.30	4.40
		100% N	169.27	15.15	14.60	2.68	9.91	39.40	9.82	33.13	10.43	3.87
	Lithovit 5g/L	50% N	160.30	15.42	14.77	2.70	9.70	39.80	10.02	33.30	10.17	4.23
		75% N	166.63	17.07	15.40	2.81	9.94	40.40	10.82	33.07	10.20	4.30
		100% N	171.65	16.57	15.15	2.79	9.83	39.81	10.65	33.43	9.97	4.30
Late	Without Lithovit	50% N	163.75	13.35	13.10	2.41	10.14	39.62	7.91	33.30	10.27	4.20
		75% N	168.93	13.50	13.27	2.48	9.78	39.97	8.04	34.03	10.27	4.07
		100% N	175.15	12.82	12.37	2.45	9.70	40.37	7.55	33.03	10.47	4.17
	Lithovit 2.5g/L	50% N	164.82	13.95	13.35	2.50	10.22	39.82	8.33	33.83	10.33	4.20
		75% N	167.93	14.27	14.12	2.58	10.19	39.96	8.89	32.87	9.80	4.37
		100% N	175.13	14.00	13.77	2.51	9.92	40.23	8.71	33.50	10.07	4.40
	Lithovit 5g/L	50% N	168.60	14.57	14.25	2.53	9.96	39.85	9.10	32.53	10.40	4.23
		75% N	170.50	15.50	14.55	2.61	10.24	39.54	9.59	33.27	9.97	4.50
		100% N	177.52	14.95	14.27	2.59	10.38	40.62	9.57	32.90	10.50	4.07
LSD at 0.05			**1.27**	**N.S.**	**0.45**	**0.05**	**N.S.**	**N.S.**	**0.20**	**N.S.**	**N.S.**	**N.S.**

Generally, Lithovit fed cotton plant leaves with CO_2 gas from inside the leaves at a much higher rate than in the air, thus enhancing the basic process of photosynthesis and plant growth. Reddy & Zhao (2005) found that plants grown in elevated had significantly greater leaf area than plants in ambient. Increasing Lithavit rates from zero (without Lithovit) to 5g/L significantly increased plant height at harvest and number of fruiting branches/plant in both seasons owing to the increase in number of fruiting branches/plant significant distinctions were detected amongst of CO_2 nano-fertilizer as for number of open bolls/plant, boll weight and seed cotton yield/faddan in both seasons, in favor of applying CO_2 fertilizer as foliar spraying at the high rate of 5g/L three times followed in ranking by the medium rate (2.5g/L) and untreated plants (without Lithovit).

Effect of N levels fertilizer

Results presented in Table 3 indicate that levels of N had significant effect on plant height, number of sympodia/plant, number of bolls/plant, boll weight and seed cotton yield/faddan. While, it did not exhibit any significant effect on fiber parameters (upper half mean length, fiber strength and micronaire reading) in both seasons. The high level of N (100%) significantly increased plant height (173.29 and 173.22cm) in 2016 and 2017 seasons, respectively, as compared with the other two rates. The positive response due to the high N rate on growth is mainly related to the followings; N play an important role in synthesis, distributing and accumulating the important substances responsible for growth and reflected greatly on dry weight plant (Hearn, 1981).

N fertilizer treatments had a significant effect on number of open bolls/plant, boll weight, seed cotton yield/fad. However, the insignificant effect on seed index and lint percentage in both seasons. The highest values of number of sympodia/plant, number of bolls/plant, boll weight and seed cotton yield/faddan were produced from the medium level of N 75% (45kg N/fad), while the lowest values were obtained from the low level of 50% N (30kg N/fad) in 2016 and 2017 seasons, respectively.

The positive response to the N level (75%) with regard to seed cotton yield and its components might be due to the improvement nutrient availability and increases in nutrients uptake, the role of these two concentrations to increase leaf N content and consequently increase photosynthesis, assimilates accumulation and plant dry weight and the higher number of open bolls/plant and heavier bolls. Boll weight increases due to the N level was mainly attributed to increase photosynthetic activity of cotton plants and consequently increase accumulation of metabolites with direct impact on boll weight. These results are in accordance with those outlined by overall plant growth, fruit retention, seed cotton yield and its components, **(**Hamoda et al., 2014; Emara et al., 2015 a, 2016 and Emara & Abdel-Aal, 2017 a, b).

Effect of interaction between planting dates and nano-fertilizer

Data in Table 4 showed that interaction between planting dates and nano-fertilizer had a significant effect on plant height at harvest and boll weight in 2016 and 2017 seasons. While, had a significant effect on number of sympodia/plant and number of open bolls/plant in 2017 seasons only while, it did not exhibit any significant effect on fiber parameters (upper half mean length, fiber strength and micronaire reading) in both seasons.

Late sowing date and nano-fertilizer 5g Lithovit/L had significantly increased plant height as compared with the other treatments. However, early sowing date and nano-fertilizer 5g Lithovit/L had significantly increased boll weight in both seasons and number of sympodia/plant and number of open bolls/plant in 2017 seasons only as compared with the other treatments.

Effect of interaction between planting dates and N-fertilization levels

Data in Table 5 showed that interaction between planting dates and N-fertilizer had a significant effect on plant height at harvest, number of sympodia/plant, number of open bolls/plant and seed cotton yield in 2016 and 2017 seasons. While, had a significant effect on boll weight in 2017 seasons only. While, it did not exhibit any significant effect on seed index, lint % and fiber parameters (upper half mean length, fiber strength and micronaire reading) in both seasons.

The highest value of plant height at harvest (175.86 and 175.93cm) were obtained from late sowing date + N-fertilizer (100%), number of sympodia/plant (15.30 and 15.62), number of open bolls/plant (17.81 and 15.22) and seed cotton yield (10.91 and 10.17ken/fad) were obtained

from early sowing date + N-fertilizer (75%) in 2016 and 2017 seasons, respectively.

Effect of interaction between nano-fertilizer and N-fertilization levels

Data in Table 6 showed that interaction between nano-fertilizer and N-fertilizer had a significant effect on plant height at harvest, number of open bolls/plant and seed cotton yield in 2016 and 2017 seasons. While, had a significant effect on number of sympodia/plant and boll weight in 2017 season only, while it did not exhibit any significant effect on seed index, lint %. and fiber parameters (upper half mean length, fiber strength and micronaire reading) in both seasons.

The highest value of plant height at harvest obtained from nano-fertilizer 5g Lithovit/L + N-fertilizer (100%), number of open bolls/plant and seed cotton yield were obtained from nano-fertilizer 5g Lithovit/L + N-fertilizer (75%) in 2016 and 2017 seasons. While, number of sympodia/plant and boll weight in 2017 season only.

Effects of interaction between planting dates, nano-fertilizer and N levels fertilizer

Data in Tables 7 and 8 showed that interaction between planting dates, nano-fertilizer and N-fertilizer had a significant effect on plant height at harvest, number of open bolls/plant, boll weight and seed cotton yield in 2017 season only. While, had insignificant effect on number of sympodia/plant, seed index, lint % and fiber parameters (upper haif mean length, fiber strength and micronaire reading) in 2016 and 2017 seasons.

The highest value of plant height at harvest obtained from late sowing date + nano-fertilizer 5g Lithovit/L + N-fertilizer (100%) in 2017 season only. While, the highest value of number of open bolls/plant, boll weight and seed cotton yield were obtained from early sowing date + nano-fertilizer 5g Lithovit/L + N-fertilizer (75%).

Conclusion

Results obtained in this study could lead us to a package of recommendations, which seemed to be useful for increasing cotton yield production and best fiber quality. It could be concluded the early planting in combination with the N-fertilizer level (45kg N/fad) and foliar apllication with nano-fertilizer Lithovit Boron (5g from each nano/L water) three times at squaring, initiation of flowering and two weeks after flowering to give the high productivity of Egyptian cotton (Giza 86) under El-Gharbiya Governorate.

References

A.S.T.M. (2012) *American Society for Testing and Materials.* Designation, (D1447-07), (D1448-97), (D1445-67).

Ali, H., Afzal, M., Ahmad, S. and Muhammad, D. (2009) Effect of cultivars and sowing dates on yield and quality of (*Gossypium hirsutum* L.). *Crop. J. Food Agri. Environ.* **7**, 244-247.

Arshad, M., Wajid, A., Maqsood, M., Hussain, K. and Aslam, M. (2007) Response of growth, yield and quality of different cotton cultivars to sowing dates. *Pak. J. Agric.* **44**(2), 208-212.

Bange, M., Caton S. and Milroy, S. (2008) Managing yields of high fruit retention in transgenic cotton (*Gossypium hirsutum* L.) using sowing date. *Austr. J. Agric. Res.* **59**(8), 733-741.

Boquet, D., Caylor, J. and Shivers, C. (2003) No-till cotton response to planting date. *Proc., Beltwide Cotton Conf.,* Nashville TN. U.S.A., (Jan. 6-10), 2, pp. 2045-2047.

Chapman, H.D. and Parker, F.P. (1981) "*Methods of Analysis of Soil, Plants and Water*". Univ. California, August, 1981. Second Printing.

Deshish, El-D., Hamoda, S.A.F. and Emara, M.A. (2015) Study of new irrigation systems under planting dates to increasing productivity of cotton. *Egypt J. Appl. Sci.* **30**(12), 564-573.

Dong, H., Li, W., Tang, W., Li, Z. and Zhang, D. (2006) Yield, quality and leaf senescence of cotton grown at varying sowing dates and plant densities. *Field Crops Res.* **98**, 106-115.

Elhamamsey, M.H., Ali, E.A. and Emara, M.A. (2016) Effect of some cultural practices on shedding and yield of Egyptian cotton. *Assiut J. Agric. Sci.* **47**(4), 41-51.

Emara, M.A. (2012) Response of cotton growth and productivity to application of potassium and zinc under normal and late sowing dates. *J. Plant Prod., Mansoura Univ.* **3**(3), 509-514.

Emara, M.A. and Addel Aal, Amal S. (2017 a) Effect of nano-fertilizer on productivity of cotton under N-fertilization levels conditions. *Egypt. J. Appl. Sci.* **32**(12B), 445-458.

Emara, M.A. and Addel Aal, Amal S. (2017 b) Effect of foliar application with seaweed extract and micronutrients under different NPK fertilization levels on growth and productivity of promising hybrid cotton Giza (86 x 10229). *Egypt. J. Appl. Sci.* **32**(12B), 459-473.

Emara, M.A., El-Bagoury, Olfat H., El-Marakby, A.M. and Makram, E.A. (2006) The effect of planting date in relation to heat unit requirements on growth, yield and some fiber properties of cotton. *Research Bulletin, Ain Shams Univ.* **1**(1), 1-17.

Emara, M.A., Addel Aal, Amal S. and Hamoda, S.A. (2015 a) Effect of water stress and foliar feeding with boron and zinc under NPK fertilizer levels on growth and yield of the new promising cotton genotype (Giza 86 x 10229). *Fayoum J. Agric. Res. Dev.* 30(1), 27-48.

Emara, M.A., Addel Aal, Amal S. and Hamoda, S.A. (2015 b) Effect of times and methods of potassium fertilizer on yield and yield components of new hybrid cotton (Giza 86 x 10229) under early and late sowing. *Fayoum J. Agric. Res. Dev.* **30**(1), 17-26.

Emara, M.A., Addel Aal, Amal S. and El-Gabiery, A.E. (2016) Effect of sowing dates and bio-fertilizer under different NPK fertile levels on growth, yield and fiber of promising hybrid cotton Giza (86X 10229). *Egypt. J. Appl. Sci.* **31**(12), 357-376.

Hamoda, S.A., Ibrahim, M.A. and Emara, M.A. (2014) Effect of irrigation intervals and NPK fertilizers on growth, yield and quality for new hybrid cotton [Giza 83 (Giza 75 x 5844)] x Giza 80]. *The 1st International Cotton Conference* "Challenges to Sustainable Cotton Production & Guality". *Special Issue of Egypt. J. Agric. Res.* **92**(1), 111-123.

Hamoda, S.A., Attia, A.N., El-Hendi, E.H. and El-Sayed, Shiamaa O. (2016) Effect of nano-fertilizer (Lithovit) and potassium on growth, fruiting and yield of Egyptian cotton under different planting dates. *Int. J. Adv. Res. Biol. Sci.* **3**(12), 29-49.

Hearn, A.B. (1981) Cotton nutrition. *Field Crop Abst.* **34**(1), 11-34.

Policepatil, A., Chittapur, B. and Paramesh, V. (2009) Response of Bt cotton hybrids for targeted yield under Northern transitional zone of Karnataka. *Journal of Crop and Weed,* **5**(1), 313-315.

Reddy, K. and Zhao, D. (2005) Interactive effects of elevated CO_2 and potassium deficiency on photosynthesis, growth, and biomass partitioning of cotton. *Field Crops Res.* **94**, 201-213.

Siddiqui, M.H., Al–Whaibi, M.H., Firoz, M. and Al–Khaishany, M.Y. (2015) Role of nanoparticles in plants.In: "*Nanotechnology and Plant Sciences*", Chapter 2, pp. 19-35.

Snedecor, G.W. and Cochran, W.G. (1980) "*Statistical Methods*", pp. 225- 269. Iowa State Univ.

Srinivasan, G. (2007) Response of summer irrigated cotton (*Gossypium hirsutum L.*) to reduced level of nutrients and time of application. *Madras Agric. J.* **90**(7-9), 528-529.

(Received 21/10/2018;
accepted 20/ 1/2019)

تأثير التسميد النانو ومستويات التسميد الأزوتي على إنتاجية القطن المصرى تحت مواعيد زراعة مختلفة

مصطفي عطية أحمد عمارة[1]، سعيد عبد التواب فرج حمودة [1] و مها متولي عباس حمادة [2]
معهد بحوث القطن – مركز البحوث الزراعية – الجيزة – مصر و[2] قسم المحاصيل – كلية الزراعة – جامعة عين شمس – القاهرة – مصر.

أجريت تجربتان حقليتان بمحطة البحوث الزراعية بالجميزة، محافظة الغربية في أرض طينية خلال موسمي 2016، 2017 وذلك بهدف دراسة تأثير التسميد النانو ومستويات التسميد الأزوتي على إنتاجية القطن المصرى جيزة 86 تحت مواعيد زراعة مختلفة. أجريت التجربة في تصميم القطع المنشقة مرتين فى أربع مكررات حيث وضعت مواعيد الزراعة (المبكرة 25 أبريل و المتأخرة 25 مايو) فى القطع الرئيسية وضع التسميد النانو في القطع الشقية الأولى وكان كالاتي: (بدون تسميد نانو، 2.5 جم/لتر ماء ليثوفيت،5 جم/لتر ماء ليثوفيت)، ووضعت مستويات التسميد الأزوتي في القطع الشقية الثانية وكانت كالاتي:(50% من الموصي به من النتروجين)، (75% من الموصي به من النتروجين)، (100% من الموصي به من النتروجين).

وتتلخص أهم النتائج المتحصل عليها فيما يلى:
1- هناك تأثير معنوي لمواعيد الزراعة على النمو والمحصول ومكوناته، حيث تفوقت الزراعة المبكرة على الزراعة المتأخرة في كلا الموسمين.
2- هناك تأثير معنوي لمستويات التسميد بالأزوت على النمو والمحصول ومكوناته في كلا الموسمين، حيث تفوق المعدل المتوسط من التسميد بالأزوت (45 كجم أزوت/فدان) على باقي المعاملات.
3- هناك تأثير معنوي للتسميد برش اليثوفيت 5 جم/لتر ماء على النمو ومحصول القطن ومكوناته في كلا الموسمين تحت الدراسة.
4- لم تظهر أية تأثيرات معنوية لمعاملات الدارسة على جميع صفات جودة التيلة.

أدت الزراعة المبكرة مع التسميد بالازوت بالمعدل (45 كجم أزوت/فدان) والرش الورقي بمادة الليثوفيت بمعدل 5 جم/لتر ماء ثلاث مرات عند مرحلة الوسواس وبداية التزهير وبعدها بأسبوعين لزيادة إنتاجية محصول القطن المصري للصنف جيزة 86.