ISSN : 1812-5379 (Print)
ISSN : 1812-5417 (Online)
http://ansijournals.com/ja

JOURNAL OF AGRONOMY

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Journal of Agronomy 12 (2): 78-85, 2013
ISSN 1812-5379 / DOI: 10.3923/ja.2013.78.85

Evaluation of the Technological Properties of the Bio-organic Colored Cotton

[1]Abeer S. Arafa and [2]A.M. Azza Abd El-All
[1]Cotton Research Institute, Agriculture Research Center, Giza, Egypt
[2]Soils, Water and Environ. Research Institute, Agriculture Research Center, Giza, Egypt

Abstract: Reducing the use of the chemical pollutants become necessary for save environment. Cotton is a crop needs extensive use of fertilizers during growing and a lot of chemical during processing. Thus, alternative sources of non chemical fertilizers in addition to, use less chemical in bleaching and dyeing is very important to cotton producer and manufacturer. Our study was performed at Cotton Res. Inst., Agric. Res. Center, Egypt, during 2011 and 2012 seasons to study the effect of using cyanobacteria strain (*Spirulina platensis*) (*Azolla pinnata*) as biofertilizers and Humic acid as an organic fertilizer on the technological properties of the colored cotton. Split plot design with three replicates was used in this study. The cotton Type (T) was occupied the main plot as a main factor with two levels (green cotton, brown cotton), while; the fertilizers treatments (F) were distributed randomly in the sub plots. The effect of all factors under study and their interaction were significant for all characters under study except for the effect of the main factor and the interaction on the soil biological characters, the effect of the sub main factor and the interaction on fiber upper half mean (mm), fiber elongation%, the effect of all factors and their interaction on fiber uniformity index and the effect of the interaction on the color parameters on both years. The green cotton surpassed the brown cotton on fiber upper half mean (mm), fiber strength (g/tex), fiber maturity ratio and fiber color strength (K/S). On the other hand, the brown cotton exhibited the highest value for micronaire value, fiber fineness (millitex), fiber elongation (%), fiber yellowness/blueness% (b*) and fiber redness/greenness% (a*). The treatment *Spirulina platensis* suspension+*Azolla pinnata* suspension+Humic acid (F4) generally enhanced all the fiber characters (except upper half mean) as well as, the soil biological activity in terms of increasing the total bacterial, total cyanobacterial counts, CO_2 evolution. On the contrary, the treatment containing spirulina platensis suspension only (F2) was the least one. So, it is save for environment to fertilize the colored cotton with bio-organic fertilizers, which enhanced the soil activates without affecting its fiber properties.

Key words: Cotton, fiber, biofertilizer, organic fertilizer, humic acid, bio organic, *Azolla* cyanobacteria, green cottonl, brown cotton

INTRODUCTION

World is suffering from the chemical pollution due to extensive use of soil chemical fertilizers. Egypt as part of the world is suffering too, especially after building the high dam which deprived the Egyptian soil from the silt. This causes a lot of biological problems such as, under ground water pollution, decrease the number and the activity of the soil microorganisms, effects plant, animal and human health. So, effort should coordinate to decrease the consequences of the soil chemical pollution. Using eco-friendly fertilizer became the save solution to provide plant with nutrient. Also, the final product is strongly needed to meet the market requires as stated by Elhassan *et al.* (2010).

Cotton expose to harmful chemical treatments beginning with fertilization, weed and pest control, ending with finishing and dyeing processing which had a bad effect on soil, water and the ecosystem. Naturally colored cottons have many applications for textile products consumer, because of their safeness on the human skin and environmentally friendly aspects make them an attractive alternative to conventionally dyed cottons. Combination between colored cotton and bioorganic framing increase the importance and value of the final product specially if it reported by several workers like Apodaca (1993), May *et al.* (1994) and Lee (1996) they found that naturally colored cotton have a poor fiber properties in term of fiber strength, length, micronaire as compared to the conventional cotton.

Also, Mohamed (2001) stated that the micronaire reading ranged from 3.1 for dark brown cotton to 3.3 for brown cottons. The maturity% ranged from 67% for dark brown cotton to 68% for brown cottons. Reflectance (Rd%) ranged from 31.2 for dark brown cotton to 38.5 for brown cottons. The yellowness (+b) ranged from 18.5 for

Corresponding Author: Abeer S. Arafa, Cotton Research Institute, Agriculture Research Center, Giza, Egypt

dark brown cotton to 19.8 for brown cottons. However, Dutt *et al.* (2004) and Mohamed *et al.* (2010) indicated that the physical properties of brown cotton i.e., fiber strength, elongation, length, micronaire reading and fineness are on average. Green cotton is longer and stronger than brown cotton. In contrast, the brown cotton is better in maturity ratio and micronaire value while the color cotton in general is lower than those of the white cotton. Although, the colored cotton has poor fiber quality but it naturally has an extremely soft hand or "feel." and combined with its lake of harmful chemical in finishing and dyeing which increase their need globally. These benefits are maximized by using safe environmentally field practices such as using blue green algae or cyanobacteria. They are photosynthetic microorganisms. That mean that they capture the sun light to make their own food and used in agriculture as biofertilizer and stabilization of soil as stated by Abdel-Raouf *et al.* (2012) cyanobacteria can promote plant cell division and elongation. So, increase growth rate by producing growth promoting regulators, such as gibberellic and auxinic (Haroun and Hussein, 2003; Rodriguez *et al.*, 2006). Also can fix N_2 from air into ammonia then amino acids (Raja *et al.*, 2012). Also, cyanobacteria can secrete polypeptides and hydrogen cyanide which play an important role as antibacterial and antifungal substances and exhibit phytopathogen biocontrol. Also, cyanobacteria secrete exopolysaccharides that help in soil aggregation and increase its porosity (Gupta and Sen, 2012; Ibraheem, 2007; Hamed, 2007).

These facts excited us to make combination between the natural fertilizer and the eco friendly crop for an environmentally safe raw material for textile industry. Also, evaluate colored cotton quality and soil properties under using these fertilizers.

MATERIALS AND METHODS

This investigation was conducted at Cotton Research Institute, Agric. Res. Center, Egypt, during 2011 and 2012 seasons to study the technological properties of the colored cotton fertilized using Cyanobacteria strain (*Spirulina platensis*) (*Azolla pinnata*) and the organic fertilizer (Humic acid).

Split plot design with three replicates was used in this study. The cotton type (T) was occupied the main plot as a main factor with two types (green cotton, brown cotton) while, the Fertilizers treatments (F) were distributed randomly in the sub plots. Net plot size was 3×3.6 m with proper irrigation channels.

Moreover, for all data collected LSD was used as a mean separation test to calculate the separation of means at 0.05% Level.

Analysis of variance was done according to the methods described by Snedecor and Cochran (1982).

The biofertilizer treatments were used in this study
Cyanobacteria strain and *Azolla*: Cyanobacteria strain (*Spirulina platensis*) and (*Azolla pinnata*) were kindly provided Agric. Res. Microbiol. Dept. Soils, water and Environ. Res. Inst., ARC Giza, Egypt. *Azolla* was grown in the greenhouse up to log. phase on Yoshida medium (Yoshida *et al.*, 1976), while cyanobacteria strain *Spirulina platensis* was grown on Zarrouk medium (Zarrouk, 1966).The culture was incubated for 30 days in growth chamber under continuous illumination (5000 Lux) and a temperature of 35°C±2°C.

Cyanobacteria suspension: Cyanobacteria strain *Spirulina platensis* (Fig. 1) was grown in the Lab. and after 30 days blended with a mixer to have a homogenized suspension (Fig. 2). The obtained suspension was then used as soil drench treatment.

***Azolla* suspension:** Fresh *Azolla* (Fig. 3) was hardly crushed and blended in a mixer till obtaining a

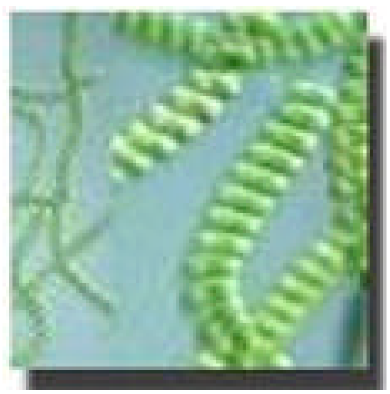

Fig. 1: Cyanobacteria cells under microscope

Fig. 2: Cyanobacteria prepared as a fertilizer

Fig. 3: Fresh *Azolla* as found in nature floating on the water

Fig. 4: Green and brown colored cotton

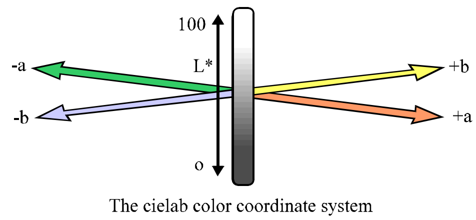

Fig. 5: Color coordinate system

homogeneous suspension. The obtained suspension was used as soil drench treatment. However, the obtained suspensions for both *Azolla* and cyanobacteria were also mixed together with Humic acid in a plastic bag to be used as soil drench in mix treatment.

Organic fertilizer used

Humic acid: Commercial Humic acid purchased from the local market was used in the study.

All the previous fertilizers treatments were applied in the same time as the recommended mineral fertilizer. Weed and best control were performed manually without adding chemicals.

Treatments

Main factors (colored cotton T): As shown in Fig. 4 colored cotton is:

- Green cotton
- Brown cotton

Sub main factors(fertilizer treatments F):

- 100% mineral fertilizer (recommended dose 60 kg N/feddan, 30 kg K/feddan, 15 kg P_2O_5/feddan)………………… control (F1)
- *Spirulina platensis* suspension (50 L/fed)……(F2)
- (Mix) *Spirulina platensis* suspension+*Azolla pinnata* suspension……………………(F3)
- (Mix) *Spirulina platensis* suspension+*Azolla pinnata* suspension+Humic acid………………(F4)

Fiber physical properties: Fiber Upper Half Mean (UHM) mm, fiber uniformity index (UI), fiber strength (g/tex) and fiber elongation percentage were determined using HVI instrument system according to (ASTM, 1986). Micronaire value, maturity ratio and fineness (millitex) was tested using micromat instrument according to (ASTM, 1986).

Table 1: Physio-chemical of the experimental soil

Properties	Season 2011	Season 2012
Particle size distillation (%) coarse sand	4.4	3.8
Fine sand	25.6	24.3
Silt	27.8	29.1
Clay	Clay	Clay
Texture clay	1.42	1.33
$CaCO_3$	1.41	1.36
PH (1:2.5) soil solution	7.35	7.1
EC dS m^{-1} (soil paste)	1.9	1.84
Total N (%)	0.09	0.04
Organic C (%)	0.86	0.78
Cations (mg L^{-1})		
Ca^{++}	7.51	7.02
Mg^{++}	4.56	7.89
Na^{+}	10.49	10.37
K^{+}	0.45	0.63
Anions (mg L^{-1})		
CO_3^{-2}	0	0
HCO_3^{-1}	2.11	2.29
Cl^{-}	9.16	9.04
SO_4^{-2}	11.74	14.58

Color measurements characters: The color strength (K/S) and the color parameters, a* = (+) redness (-) greenness, b* = (+) yellowness (-) blueness (Fig. 5) were measured by using the Win lab Software of the Perkin Elmer, Lambda 35 Spectrophotometer using integrated sphere.

Soil analysis: The experimental field soil was sampled initially before conducting the experiment to determine its physical and chemical analyses according to Jackson (1976). The results of these analyses are shown in (Table 1).

Soil biological activity: Soil biological activity was evaluated in terms of total microbial counts (Allen, 1959), total counts of cyanobacteria (Allen and Stanier, 1968), CO_2 evolution (Gaur *et al*., 1971).

RESULTS AND DISCUSSION

It's obvious from Table 2, that the effect of the main factor was significant in both seasons while the effect of the sub main factor and the interaction were not significant in 2011 and 2012 seasons. The green cotton surpassed the brown cotton in fiber length (29.32 and 28.89 mm for green cotton vs. 28.30 and 28.22 mm for brown cotton) in both seasons, respectively. This result may be due to that the environmental effect is limited on the fiber length because it is associated with genetic factor. Also, the effect of all factor under study and their interaction on fiber uniformity index were not significant on both years. These results are in a harmony with the results of Mohamed *et al*. (2010).

From data shown in Table 3, we can deduce that generally green colored cotton was stronger than brown cotton as indicated from the fiber strength general means (33.85 g/tex and 33.57 g/tex for green cotton versus 30.58 g/tex and 29.69 g/tex for brown cotton) in the two seasons under study, respectively. The best fertilizer treatment gave (32.59 g/tex and 32.36 g/tex) in 2011 and 2012 seasons respectively, it was obtained from the complex between the two organisms and Humic acid (F4). In addition, the best interaction was obtained from the treatment *Spirulina platensis*+*Azolla pinnata*+Humic acid (F4) and the green cotton, which gave the values (34.12 and 33.84 g/tex) in both seasons, correspondingly. These results are in a harmony with (Dutt *et al*., 2004; Mohamed *et al*., 2010). This may be due to that the mixture of the cyanobacteria, *Azolla* and Humic acid enhanced the plant metabolism, which leaded to morphs and uniform deposition of the cellulose layers of the secondary cell wall that made the fiber able to bear the tension load.

Concerning the fiber elongation, the effects were not significant except for the main factor (cotton type).Whereas, the brown cotton was more elongated than the green cotton (5.12 and 5.11% vs. 5.0 and 4.93%) for brown cotton and green cotton in both seasons in that order.

Data aforementioned in Table 4, clarified that, micronaire values for all the factors under the study and their interaction were significant in both seasons. Concerning the main factor (genotype), the green cotton gave the lowest micronaire values (3.50 and 3.45) for both seasons, comparing to the brown cotton, which was greater in micronaire (4.53 and 4.48) for both seasons as stated by Dutt *et al*. (2004) and Mohamed *et al*. (2010). With reference to the sub-main factor (fertilizer), the treatment containing the mix of *Spirulina platensis* suspension, *Azolla pinnata* suspension and Humic acid (F4) usually surpassed the other fertilizer treatments in micronaire values (4.10 and 4.05) in 2011 and 2012 seasons, correspondingly. As to, the interaction between the factors, the interaction between brown cotton and (F4) gave the highest micronaire values (4.6 and 4.5) in 2011

Table 2: Effect of Cyanobacteria, *Azolla* and Humic acid on upper half mean (mm) and uniformity index characters

	2011			2012		
Fiber character	Green cotton	Brown cotton	F means	Green cotton	Brown cotton	F means
Upper half mean (mm)						
F 1	29.83	28.16	29.00	29.71	28.11	28.91
F 2	28.58	28.19	28.39	28.43	28.11	28.27
F 3	28.96	28.36	28.66	28.63	28.24	28.44
F 4	29.89	28.47	29.18	28.80	28.41	28.61
T means	29.32	28.30		28.89	28.22	
LSD 5(%)						
T	0.03	0.02				
F	n.s	n.s				
FxT	n.s	n.s				
Uniformity index						
F 1	84.28	83.01	83.65	83.95	82.69	83.32
F 2	83.97	83.15	83.56	83.63	83.11	83.37
F 3	84.09	83.45	83.77	83.70	83.25	83.48
F 4	85.37	84.21	84.79	85.00	84.40	84.70
T means	84.43	83.46		84.07	83.36	
LSD 5(%)						
T	n.s	n.s				
F	n.s	n.s				
FxT	n.s	n.s				

Table 3: Effect of cyanobacteria, *Azolla* and Humic acid on fiber strength (g/tex) and the percentage of fiber elongation

	2011			2012		
Fiber character	Green cotton	Brown cotton	F means	Green cotton	Brown cotton	F means
Fiber strength (g/tex)						
F 1	33.77	30.30	32.04	33.61	29.56	31.59
F 2	33.77	30.14	31.96	33.12	28.55	30.84
F 3	33.72	30.84	32.28	33.69	29.78	31.74
F 4	34.12	31.05	32.59	33.84	30.87	32.36
T means	33.85	30.58		33.57	29.69	
LSD 5%						
T	0.07	0.06				
F	0.09	0.08				
FxT	0.12	0.09				
Fiber elongation (%)						
F 1	4.810	5.110	4.960	4.600	5.110	4.860
F 2	5.000	5.110	5.060	4.910	5.110	5.010
F 3	5.100	5.120	5.110	5.100	5.100	5.100
F 4	5.101	5.130	5.120	5.110	5.110	5.110
T means	5.000	5.120		4.930	5.110	
LSD 5%						
T	0.014	0.012				
F	n.s	n.s				
FxT	n.s	n.s				

Table 4: Effect of cyanobacteria, *Azolla* and Humic acid on micronaire value and maturity ratio

	2011			2012		
Fiber character	Green cotton	Brown cotton	F Means	Green cotton	Brown cotton	F means
Micronaire						
F 1	3.410	4.510	3.950	3.410	4.410	3.900
F 2	3.410	4.510	3.950	3.300	4.500	3.900
F 3	3.600	4.500	4.050	3.500	4.500	4.000
F 4	3.610	4.610	4.100	3.600	4.500	4.050
T means	3.500	4.530		3.450	4.480	
LSD 5%						
T	0.013	0.013				
F	0.014	0.013				
FxT	0.019	0.016				
Maturity ratio						
F 1	0.770	0.740	0.760	0.760	0.720	0.740
F 2	0.750	0.720	0.740	0.730	0.730	0.730
F 3	0.800	0.750	0.780	0.760	0.730	0.750
F 4	0.820	0.790	0.810	0.800	0.750	0.780
T means	0.790	0.750		0.760	0.730	
LSD 5%						
T	0.0035	0.0029				
F	0.0041	0.0038				
FxT	0.0094	0.0062				

and 2012 seasons likewise. On the contrary, the interaction between green cotton and the *Spirulina platensis* suspension only gave the lowest values (3.4 and 3.3) in 2011 and 2012 seasons. It is worthy to refer to that micronaire value incorporate both of fineness and maturity fineness is a genetic factors so, it influences by the genotype while, maturity is affected by environment. So, the variation between the two cotton types expresses fineness while the variation between the fertilizer treatments inside the type expresses maturity.

As regard to maturity ratio, the green cotton is more matured than brown cotton (0.79 and 0.76 vs. 0.75 and 0.73) for both seasons, respectively. With reference to the fertilizer factor, the treatment containing the mix of *Spirulina platensis* suspension, *Azolla pinnata* suspension and Humic acid (F4) exceeded the other fertilizer treatments in both seasons (0.81 and 0.78). Thus, these results indicated the above results of the micronaire value. As to, the interaction between the colored cotton and the fertilizer treatments, the interaction between green cotton and (F4) gave the highest maturity ratio (0.82 and 0.80) in both seasons. This may be due to that Humic acids play an important role in nitrogen cycle, because it encourage the n fixing bacteria to fix the air nitrogen into ammonia, then amino acids which reflected positively in plant growth and maturity. Dong *et al*. (2012) in addition to, cynobacteria effect as mentioned before. As to, the interaction between the colored cotton and the fertilizer treatments, the interaction between green cotton and (F4) gave the highest maturity ratio (0.82 and 0.80) in both seasons.

Data shown in Table 5, illuminating that, the effect of all the factors under the study and their interaction on fiber fineness (millitex) were significant in both seasons.

Concerning the main factor (genotype), the green cotton fineness values were (141.23 and 138.30 millitex) for both seasons comparing to the brown cotton which, was coarser (145.28 and 143.30 millitex) for both seasons, respectively. These results are congruent to the micronaire results (Table 2). With reference to the sub-main factor (fertilizer), the (F4) treatment usually exceeded the other fertilizer treatments in fiber fineness (millitex) (146.20 and 143.10) in 2011 and 2012 seasons correspondingly. As to, the interaction between the factors, the interaction between brown cotton and (F4) gave the highest fineness (148.3 and 145.6 millitex) in 2011 and 2012 seasons correspondingly. On the contrary, the interaction between green cotton and the *Spirulina platensis* suspension only gave the lowest values (138.3 millitex and 136.0 millitex) in 2011 and 2012 seasons. According to the color parameter (a*) the brown cotton exhibited the highest value of (a*) this is logic because, as the (a*) decreased the color redness (%) decreased and the greenness (%) increased as detected from Color coordinate system Fig. 4. The difference between the fertilizer treatments values were not great but it were significant the highest value was obtained from the mix between the organic and biofertilizer (F4), this may be explained later by the K/S values as mentioned in Table 6.

It's clear from Table 6, that the yellowness values of the brown cotton (23.17 and 22.70) were greater than green cotton (20.29 and 19.93) in2011 and 2012 respectively. In contrast the, K/S values of the brown cotton (1.87 and 1.97) is less than the green cotton (2.29 and 1.94) in 2011 and 2012, respectively. F4 treatment usually gave the highest values of both of the yellowness% (22.75 and 22.32) and color strength values (22.25 and 22.10) in both seasons these results are in agreement with the results obtained by Mohamed (2001) and Mohamed *et al*. (2010).

Its obvious from Table 7, that the effect of the main factor genotype had no effect on all the soil biological characters in both seasons. This is logic because both the genotypes grown in the same soil and the same environment. This also, is true in case of the interaction. As to the sub main factor (the fertilizer treatment).The treatment containing Cyanobacteria, *Azolla* and Humic acid (F4) generally enhanced the soil biological activity in terms of increasing the total bacteria (37.0 and 35.5), total cyanobacterial counts (31.5 and 27.5) and (288 and 286) for CO_2 evolution in seasons. On the contrary, the treatment containing *Spirulina platensis* suspension only (F2) gave the lowest values for all the soil biological characters. Indicated by Singh and Singh (1990) they found that adding *Azolla* to the soil in reaching

Table 5: Effect of cyanobacteria, *Azolla* and Humic acid on fiber fineness (millitex) and fiber redness/greenness % (a *)

	2011			2012		
Fiber character	Green cotton	Brown cotton	F means	Green cotton	Brown cotton	F means
Fineness millitex						
F 1	140.50	144.50	142.50	138.00	144.00	141.00
F 2	138.30	142.30	140.30	136.00	140.00	138.00
F 3	142.00	146.00	144.00	138.60	143.60	141.10
F 4	144.11	148.30	146.20	140.60	145.60	143.10
T means	141.23	145.28		138.30	143.30	
LSD 5%						
T	0.03	0.02				
F	0.04	0.03				
FxT	0.06	0.06				
a*						
F 1	4.260	6.010	5.140	4.250	6.080	5.170
F 2	4.110	5.800	4.960	4.130	6.030	5.080
F 3	4.260	5.990	5.130	4.290	6.040	5.170
F 4	4.830	6.110	5.470	4.570	6.130	5.350
T means	4.370	5.980		4.310	6.070	
LSD 5%						
T	0.016	0.013				
F	0.032	0.018				
FxT	n.s	n.s				

Table 6: Effect of cyanobacteria, *Azolla* and Humic acid on fiber yellowness/blueness % (b*) and fiber K/S

	2011			2012		
Fiber character	Green cotton	Brown cotton	F means	Green cotton	Brown cotton	F means
b*						
F 1	20.020	23.940	21.980	19.680	21.770	20.730
F 2	18.700	22.030	20.370	19.030	22.240	20.640
F 3	21.100	22.570	21.840	20.220	22.940	21.580
F 4	21.350	24.150	22.750	20.790	23.850	22.320
T means	20.290	23.170		19.930	22.700	
LSD 5%						
T	0.013	0.011				
F	0.029	0.022				
FxT	n.s	n.s				
K/S						
F 1	2.421	1.891	2.161	1.980	2.170	2.080
F 2	1.952	1.802	1.882	1.900	1.750	1.830
F 3	2.210	1.870	2.040	1.940	1.830	1.890
F 4	2.581	1.921	2.251	2.070	2.002	2.100
T means	2.291	1.871		1.970	1.940	
LSD 5%						
T	0.013	0.010				
F	0.012	0.011				
FxT	0.014	0.014				

Table 7: Effect of cyanobacteria, *Azolla* and Humic acid on soil biological characters after cotton harvesting

	2011			2012		
Fiber character	Green cotton	Brown cotton	F means	Green cotton	Brown cotton	F means
Total Bact. counts (10^6cfu g^{-1} soil)						
F 1	37.00	35.00	36.00	33.00	35.00	34.00
F 2	5.00	6.00	5.50	4.00	4.00	4.00
F 3	13.00	14.00	13.50	10.00	9.00	9.50
F 4	38.00	36.00	37.00	36.00	35.00	35.50
T means	23.20	22.80		20.80	20.80	
LSD 5%						
T	n.s	n.s				
F	0.015	0.011				
FxT	n.s	n.s				
Total Cyano. counts (10^3 cfu g^{-1} soil)						
F 1	32.00	31.00	32.50	28.00	27.00	30.00
F 2	19.00	20.00	19.50	17.00	14.00	15.50
F 3	25.00	27.00	26.00	24.00	22.00	23.00
F 4	33.00	32.00	31.50	31.00	30.00	27.50
T means	27.20	27.50		24.75	23.25	
LSD 5%						
T	n.s	n.s				
F	0.02	0.01				
FxT	n.s	n.s				
CO_2 evolution (mg 100 g $soil^{-1}$)						
F 1	286.00	279.00	282.50	283.00	278.00	280.50
F 2	182.00	179	180.50	175.00	170.00	172.50
F 3	253.00	249.00	251.00	255.00	240.00	247.50
F 4	290.00	286.00	288.00	287.00	285.00	286.00
T means	252.80	248.30		250.00	243.30	
LSD 5%						
T	n.s	n.s				
F	0.04	0.03				
FxT	n.s	n.s				

the soil amount of organic matter, protein and other important mineral Ibraheem (2007) and Hamed (2007).

CONCLUSION

Using either *Spirulina platensis* suspension or *Azolla pinnata* suspension separately is not enough for enrichment the soil chemicals and biological activities, consequently the fiber properties, but using the mixture of both of them in addition to, the organic fertilizer humic acid gave the best results for all soil characteristics. Also, its save to use bio-organic fertilizers for colored cotton without affecting the colored fiber properties.

REFERENCES

Abdel-Raouf, N., A.A. Al-Homaidan and I.B.M. Ibraheem, 2012. Agricultural importance of algae. Afr. J. Biotechnol., 11: 11648-11658.

Allen, M.M. and R.Y. Stanier, 1968. Selective isolation of blue-green algae from water and soil. J. G. Microbiol., 51: 203-209.

Allen, O.M., 1959. Experiments in Soil Bacteriology. 1st Edn., Burgess Publishing Co., USA.

ASTM, 1986. D-3818, D- 4605-1986 and D: 2288-93. American Stander for Testing Materials, USA.

Apodaca, J., 1993. Economic potential of naturally colored and organically grown cotton for the Texas natural fibers industry. Natural Fibers Research and Information Center, Bureau of Business Research, University of Texas at Austin, pp: 14.

Dong, L., L.C. Ana, J.Y. Hongli and M.S. Kate, 2012. Humic acids buffer the effects of urea on soil ammonia oxidizers and potential nitrification. Soil Biol. Biochem.,

Dutt, Y., X.D. Wang, Y.G. Zhu and Y.Y. Li, 2004. Breeding for high yield and fiber quality in colored cotton. Plant Breed., 123: 145-151.

Elhassan G.A., M.E. Abdelgani, A.G. Osman, S.S. Mohamed and B.S. Abdelgadir, 2010. Potential production and application of biofertilizers in Sudan. Proceedings of the International Conference on Organic Farming, April 6-7, 2010, Sudan.

Gaur, A.C., K.V. Sadasivan, O.P. Vimal and R.S. Mathur, 1971. A study of decomposition of organic matter in an alluvial soil: CO_2 evolution microbiological and chemical transformation. Plant Soil, 34: 17-28.

Gupta, A. and S. Sen, 2012. Role of biofertilizers and biopesticides for sustainable agriculture. http://www.icbb2012.in/download/A-42.pdf.

Hamed, S.M.M., 2007. Studies on nitrogen fixing Cyanobacteria. M.Sc. Thesis, Botany Department, Faculty of Science, Beni-Suef University, Beni-Suef, Egypt.

Haroun S.A. and M.H. Hussein, 2003. The promotive effect of algal biofertilizers on growth, protein pattern and some metabolic activities of *Lupinus termis* plants grown in siliceous soil. Asian J. Plant Sci., 2: 944-951.

Ibraheem, I.B.M., 2007. Cyanobacteria as alternative biological conditioners for bioremediation of barren soil. Egyp. J. Phycol., 8: 99-116.

Jackson, M.L., 1976. Soil Chemical Analysis. Prentice Hall, Inc., Englewood Cliffs, New Jersey, USA., pp: 498.

Lee, J., 1996. A new spin on naturally colored cottons. Agric. Res. Mag., 44: 20-21.

May, O.L., C.C. Green, B.U. Kittrell and S.H. Roach, 1994. Registration of PD 93001, PD 93001, PD 93002, PD 93003 and PD 93004 germplasm lines of upland cotton with brown lint and high fiber quality. Crop Sci., 34: 542-542.

Mohamed, A.S., 2001. The chemical and physical properties of white and colored Egyptian cottons and their response to dyeing with some natural dyes. Ph.D. Thesis, Biochemistry Department, Faculty of Agriculture, Cairo University.

Mohamed, A.S., A.M.R. Abd El Bary and R.M. Hassan, 2010. Studies on Egyptian naturally colored cotton compared with some conventional uncolored cotton. J. Bio. Chm. Environ. Sci., 5: 269-288.

Raja, W., P. Rathaur, S.A. John and P.W. Ramtek, 2012. *Azolla*-anabaena association and its significance in supportable agriculture. Hacettepe J. Biol. Chem., 40: 1-6.

Rodriguez, A.A., A.M. Stella, M.M. Storni, G. Zulpa and M.C. Zaccaro, 2006. Effects of cyanobacterial extracellular products and gibberellic acid on salinity tolerance in *Oryza sativa* L. Saline Syst., Vol. 2. 10.1186/1746-1448-2-7

Singh, A.L. and P.K. Singh, 1990. Intercropping of *Azolla* bio fertilizer with rice at different crop geometry. Trop. Agric., 67: 350-354.

Snedecor, G.W. and G.W. Cochran, 1982. Statistical Method. 6th Edn., The Iowa State University Press, USA.

Yoshida, S., D.A. Forno, J.H. Cock and K.A. Gomez, 1976. Laboratory Manual for Physiology Studies of Rice. 3rd Edn., The International Rice Research Institute, LoS Banos, Manila, Phlippines, pp: 61-65.

Zarrouk, C., 1966. Contribution a letude dune cyanophycee-influence de divers facteurs physiques et chimiques sur la croissance et la photosynthese de la spirulina maxima (Setch et Garder). Geitler. Ph.D Thesis, University of Paris, France.