

Original Research Article

<https://doi.org/10.20546/ijcmas.2018.704.183>

Estimation of Biochemical Parameters in Different Environments in Upland Cotton (*Gossypium hirsutum* L.)

Pinki*, S.S. Siwach, R.S. Sangwan, Sombir Singh, V.S. Mor,
Shiwani Mandhania, Sunayana and Neha Rohila

CCS Haryana Agricultural University, Hisar, Haryana, India

*Corresponding author

ABSTRACT

Keywords

Cotton, Biochemical
parameters, Correlation,
Seed germination

Article Info

Accepted:

12 March 2018

Available Online:

10 April 2018

The present study was conducted on estimation of biochemical parameters i.e. sugar content, gossypol content, protein content and oil content in 3 genotypes of Upland cotton grown in six environments. The results showed that The early sown condition was best for high seed germination (%), high sugar (%), protein (%), oil (%) and low gossypol (%). Early sown conditions were good for desirable biochemical parameters. Protein (%) was positively correlated with seed germination (%), whereas it was negatively correlated with sugar.

Introduction

Cotton is an important commercial crop of India. It is an important fiber yielding crop of global importance, which is grown in tropical and subtropical regions of more than 80 countries of the world. It provides 65% of the raw material for textile industry, lint, oil and protein rich meal from its seed (Kaliyaperumal *et al.*, 2013). India has a pride place in the global cotton scenario due to several distinct features such as the largest area under cotton (105 lakh ha) representing about one-third of the global cotton area (330 lakh ha) with production of 560 kg/ha in the world (ICAR 2016-17). Cotton is not only our major fiber crop but also main source of edible oil,

however, being ignored as an oilseed crop. Through developing the cotton varieties having both high fiber and oil yield, it would be possible to reduce edible oil imports in the country (Munawar *et al.*, 2013).

A good cotton variety have high sugar, protein and oil content and low gossypol content in the cotton seed. So, the present investigation was planned to find out the environments i.e. sown condition for desirable biochemical traits.

Materials and Methods

The experiment was conducted during *kharif* 2015 & 2016 having three cultivars H 1098-I,

H 1300 and H 1316 of American cotton grown at CCS Haryana Agricultural University, Hisar in randomized block design replicated six times each in eight rows of 6 m length with a spacing of 67.5 x 30 cm. These varieties were grown in six environments that comprises of three sowings periods (Early: first fortnight of April, normal: first fortnight of May and late: end of May/early June) during the year 2015 and 2016.

Data was recorded on the basis of number of effective bolls formed from tagged flower (tagged every week) and the week in which maximum and minimum bolls developed was identified. The seed cotton from these opened bolls was picked separately and ginned. From each seed lot of all the varieties of different environments, biochemical parameters were worked out from the best, normal and poorest performing seed lot to find out the role of these parameters and their correlation was also worked out.

Four biochemical parameters i.e. sugar content, gossypol content, protein content and oil content were estimated in all the three varieties. Total sugar estimation was done as per method of Du Bois *et al.*, (1956). Gossypol content was determined by the method of Bell, 1967. Total nitrogen was estimated by micro-Kjedahl method (AOAC, 1990). The oil content was determined by Soxhelt method.

Results and Discussion

Biochemical parameters (sugar, gossypol, protein and oil (Tables 1, 2, 3 and 4)

In the present study sugar (%), gossypol (%), protein (%) and oil (%) were estimated. These biochemical parameters were of prime importance for cotton oil quality. Cotton seed oil is generally used for human consumption so its superior quality is essential. Good

quality oil should have higher sugar (%), protein (%) and oil (%) whereas, the gossypol (%) should be low as it had anti-nutritional factors and these are harmful for human and animal health.

In the variety H 1098-I mean values of sugar content (%) in E₁ was 4.63, 4.65 in E₂, 4.15 in E₃, 4.58 in E₄, 4.61 in E₅ and 4.21 in E₆. Among the six environments sugar (%) ranges from 2.99 – 5.84. In the variety H 1300 mean sugar (%) in E₁ was 4.97, 4.77 in E₂, 4.58 in E₃, 5.18 in E₄, 5.04 in E₅ and 4.78 in E₆. Among the six environments sugar (%) ranges from 3.87 – 6.03. In the variety H 1316 mean sugar (%) in E₁ was 4.35, 4.43 in E₂, 4.30 in E₃, 4.42 in E₄, 4.56 in E₅ and 4.35 in E₆. Among the six environments sugar (%) ranges from 2.43 – 6.05. Sugar (%) was better in E₁ and E₄ or in early sown condition in all the three varieties.

In the variety H 1098-I mean value of gossypol content (%) in E₁ was 0.42, 0.46 in E₂, 0.46 in E₃, 0.39 in E₄, 0.44 in E₅ and 0.44 in E₆. In the variety H 1098- I gossypol % among the six environments ranges from 0.26 – 0.58. In E₁ and E₄ there were 10 tagging weeks while in other environments there were 8 tagging weeks. In the variety H 1300 mean gossypol (%) in E₁ was 0.44, 0.46 in E₂, 0.46 in E₃, 0.45 in E₄, 0.45 in E₅ and 0.47 in E₆. In the variety H 1300 gossypol (%) among the six environments ranges from 0.32 – 0.62. In the variety H 1316 mean gossypol (%) in E₁ was 0.40, 0.43 in E₂, 0.44 in E₃, 0.39 in E₄, 0.42 in E₅ and 0.44 in E₆. In the variety H 1316 gossypol (%) among the six environments ranges from 0.24 – 0.58. Gossypol (%) was low in E₁ and E₄ or in early sown condition in all the three varieties.

In the variety H 1098-I mean value of protein content (%) in E₁ was 19.81, 18.95 in E₂, 18.48 in E₃, 19.78 in E₄, 19.33 in E₅ and 19.02 in E₆.

Table.1 Biochemical parameter (sugar) of different varieties in different environments

	H 1098- I						H 1300						H1316					
Weak	E ₁	E ₂	E ₃	E ₄	E ₅	E ₆	E ₁	E ₂	E ₃	E ₄	E ₅	E ₆	E ₁	E ₂	E ₃	E ₄	E ₅	E ₆
1	3.68	-	-	3.70	-	-	4.32	-	-	4.38	-	-	4.20			4.69		
2	3.69	-	-	3.65	-	-	4.39	-	-	4.65	-	-	5.77			5.84		
3	4.82	4.49	2.95	4.75	4.49	2.99	5.22	4.17	3.97	5.64	4.14	3.87	5.05	3.94	3.79	5.52	4.63	4.35
4	3.69	3.40	3.12	3.54	3.25	3.14	4.30	4.12	3.94	4.68	4.44	4.17	3.66	5.64	5.46	3.60	5.55	5.28
5	4.54	4.33	4.43	4.62	4.44	4.24	4.50	4.95	4.70	4.83	5.42	5.21	5.93	4.88	4.76	5.60	5.29	5.13
6	5.63	5.43	3.22	5.67	5.56	3.16	5.82	4.07	3.88	5.78	4.58	4.27	2.82	3.30	3.18	2.80	3.43	3.35
7	5.44	5.12	4.20	5.84	5.67	4.26	5.45	4.32	4.16	5.86	4.60	4.34	3.62	5.90	5.69	3.82	5.57	5.31
8	5.36	5.22	5.35	5.54	5.27	5.39	6.09	5.72	5.62	6.03	5.61	5.39	6.05	2.57	2.43	5.83	2.64	2.43
9	3.63	3.54	4.84	3.65	3.44	5.48	4.96	5.13	4.86	5.11	5.70	5.33	2.59	3.44	3.36	2.75	3.69	3.42
10	5.80	5.70	5.08	4.86	4.78	5.02	4.65	5.65	5.51	4.82	5.86	5.65	3.79	5.80	5.70	3.80	5.67	5.51
Mean	4.63	4.65	4.15	4.58	4.61	4.21	4.97	4.77	4.58	5.18	5.04	4.78	4.35	4.43	4.30	4.42	4.56	4.35

Table.2 Biochemical parameter (Gossypol) of different varieties in different environments

	H 1098- I						H 1300						H1316					
Weak	E ₁	E ₂	E ₃	E ₄	E ₅	E ₆	E ₁	E ₂	E ₃	E ₄	E ₅	E ₆	E ₁	E ₂	E ₃	E ₄	E ₅	E ₆
1	0.30	-	-	0.26	-	-	0.52	-	-	0.53	-	-	0.30	-	-	0.32	-	-
2	0.33	-	-	0.34	-	-	0.60	-	-	0.58	-	-	0.54	-	-	0.51	-	-
3	0.49	0.52	0.33	0.43	0.46	0.32	0.41	0.54	0.56	0.43	0.55	0.56	0.53	0.31	0.32	0.52	0.33	0.35
4	0.43	0.45	0.38	0.43	0.45	0.38	0.32	0.62	0.57	0.32	0.59	0.60	0.53	0.54	0.56	0.51	0.54	0.57
5	0.39	0.40	0.54	0.38	0.43	0.48	0.38	0.42	0.44	0.38	0.45	0.47	0.37	0.57	0.58	0.36	0.54	0.57
6	0.50	0.51	0.46	0.46	0.48	0.46	0.37	0.34	0.35	0.37	0.33	0.35	0.23	0.54	0.56	0.24	0.54	0.57
7	0.54	0.57	0.41	0.53	0.55	0.43	0.34	0.39	0.40	0.34	0.38	0.40	0.31	0.38	0.40	0.31	0.36	0.38
8	0.35	0.38	0.53	0.35	0.36	0.49	0.57	0.38	0.39	0.57	0.38	0.39	0.47	0.26	0.26	0.43	0.26	0.28
9	0.47	0.47	0.58	0.43	0.46	0.58	0.44	0.36	0.38	0.44	0.36	0.38	0.37	0.31	0.33	0.36	0.33	0.35
10	0.39	0.40	0.41	0.33	0.36	0.38	0.50	0.59	0.62	0.50	0.59	0.60	0.38	0.49	0.50	0.35	0.45	0.47
Mean	0.42	0.46	0.46	0.39	0.44	0.44	0.44	0.46	0.46	0.45	0.45	0.47	0.40	0.43	0.44	0.39	0.42	0.44

Table.3 Biochemical parameter (protein) of different varieties in different environments

Weak	H 1098- I						H 1300						H1316					
	E ₁	E ₂	E ₃	E ₄	E ₅	E ₆	E ₁	E ₂	E ₃	E ₄	E ₅	E ₆	E ₁	E ₂	E ₃	E ₄	E ₅	E ₆
1	19.80	-	-	19.40	-	-	19.39	-	-	19.63	-	-	20.15	-	-	20.16	-	-
2	22.19	-	-	20.89	-	-	20.51	-	-	20.48	-	-	19.65	-	-	19.93	-	-
3	19.99	19.70	18.56	20.17	19.82	19.01	17.65	18.95	18.14	17.73	19.33	18.89	20.32	19.99	19.70	20.60	20.14	19.29
4	20.06	19.37	19.21	18.31	18.14	18.96	20.17	19.85	19.42	19.17	19.84	19.63	20.32	19.48	18.68	19.86	19.03	18.89
5	21.22	20.50	19.20	21.49	21.38	19.64	21.07	16.55	16.36	21.07	17.33	16.85	20.65	19.32	18.80	20.80	19.51	18.96
6	18.27	17.96	18.68	18.46	18.14	17.86	21.02	19.51	19.06	20.74	19.14	18.88	21.81	19.48	18.92	20.91	18.86	18.70
7	19.93	19.76	20.16	20.73	19.97	21.04	21.59	19.69	19.50	21.59	20.14	19.83	19.81	19.32	18.87	19.50	19.28	19.15
8	17.84	17.59	16.35	19.50	19.16	17.99	17.67	20.70	19.85	18.54	19.72	18.43	22.16	21.00	20.82	21.90	19.30	19.01
9	20.50	19.21	18.40	20.38	20.15	18.72	20.78	20.15	19.26	20.89	20.47	19.67	19.96	19.32	18.77	20.14	19.45	18.78
10	18.29	17.51	17.26	18.44	17.87	18.94	21.62	15.97	15.81	21.72	18.34	17.95	19.92	22.01	21.48	19.94	21.01	20.28
Mean	19.81	18.95	18.48	19.78	19.33	19.02	20.15	18.92	18.42	20.16	19.29	18.77	20.47	19.99	19.51	20.37	19.57	19.13

Table.4 Biochemical parameter (oil) of different varieties in different environments

Weak	H 1098- I						H 1300						H1316					
	E ₁	E ₂	E ₃	E ₄	E ₅	E ₆	E ₁	E ₂	E ₃	E ₄	E ₅	E ₆	E ₁	E ₂	E ₃	E ₄	E ₅	E ₆
1	16.78	-	-	17.45	-	-	13.97	-	-	14.34	-	-	19.16	-	-	19.64	-	-
2	19.43	-	-	18.40	-	-	16.05	-	-	16.04	-	-	16.75	-	-	17.11	-	-
3	18.78	15.66	13.11	18.84	17.28	13.54	17.42	11.74	10.79	17.26	14.24	12.13	16.79	18.02	15.45	16.46	17.66	15.66
4	14.99	13.55	17.20	15.91	15.10	16.70	17.24	14.22	12.26	17.53	14.68	12.92	19.15	14.17	12.92	19.04	14.83	13.36
5	14.60	13.47	13.72	17.68	15.79	14.83	17.55	15.45	14.96	18.43	16.12	15.30	15.97	15.33	13.36	15.44	15.14	13.59
6	17.99	17.08	11.31	17.74	17.06	12.10	17.66	15.24	15.36	18.44	15.90	15.69	17.65	18.17	16.89	17.98	16.61	16.29
7	15.59	14.99	11.33	16.99	16.01	14.35	16.88	15.44	13.20	17.36	16.44	13.64	16.80	14.26	12.88	17.41	14.28	12.66
8	16.34	14.97	15.41	16.57	14.97	16.12	16.47	15.66	13.17	16.87	15.92	13.60	15.13	16.68	14.99	15.44	16.96	15.32
9	16.72	14.98	12.17	16.99	15.68	15.65	18.31	13.88	12.93	18.66	14.55	13.08	16.03	15.58	12.94	15.97	16.22	13.79
10	18.01	15.31	13.18	18.45	17.12	13.18	19.31	14.94	13.76	19.64	15.30	14.20	16.91	15.24	14.48	16.56	15.11	14.46
Mean	16.92	15.00	13.43	17.50	16.13	14.56	17.09	14.57	13.30	17.46	15.39	13.82	17.03	15.93	14.24	17.10	15.85	14.39

Table.5 Correlation between seed germination (%) and biochemical traits and during 2015

	Sugar	Gossypol	Protein	Oil	Germination
Sugar	1				
Gossypol	0.33	1			
Protein	-0.47*	-0.15	1		
Oil	0.25	-0.15	0.16	1	
Germination	-0.18	0.14	0.53**	0.05	1

Table.6 Correlation between germination (%) and biochemical traits and during 2016

	Sugar	Gossypol	Protein	Oil	Germination
Sugar	1				
Gossypol	0.39	1			
Protein	-0.01	-0.02	1		
Oil	0.29	-0.14	0.23	1	
Germination	0.20	0.37	0.26	0.17	1

In the variety H 1098 - I protein (%) among the six environments ranges from 16.35-22.19. In E₁ and E₄ there were 10 tagging weeks while in other environments there were 8 tagging weeks. In the variety H 1300 mean protein (%) in E₁ was 20.15, 18.92 in E₂, 18.42 in E₃, 20.16 in E₄, 19.29 in E₅ and 18.77 in E₆. In the variety H 1300 protein (%) among the six environments ranges from 15.81 – 21.62. In the variety H 1316 mean protein (%) in E₁ was 20.47, 19.99 in E₂, 19.51 in E₃, 20.37 in E₄, 19.57 in E₅ and 19.13 in E₆. In the variety H 1316 protein (%) among the six environments ranges from 18.70 – 22.16. Protein (%) was high in E₁ and E₄ or in early sown condition in all the three varieties.

In the variety H 1098-I mean value of oil content (%) in E₁ was 16.92, 15.00 in E₂, 13.43 in E₃, 17.50 in E₄, 16.13 in E₅ and 14.56 in E₆. In the variety H 1098 - I oil (%) among the six environments ranges from 11.31 – 19.43%. In E₁ and E₄ there were 10 tagging weeks while in other environments there were 8 tagging weeks.

In the variety H 1300 mean oil (%) in E₁ was 17.09, 14.57 in E₂, 13.30 in E₃, 17.46 in E₄,

15.39 in E₅ and 13.52 in E₆. In the variety H 1300 oil (%) among the six environments ranges from 10.79 – 19.64. In H 1316 mean oil (%) in E₁ was 17.03, 15.93 in E₂, 14.24 in E₃, 17.10 in E₄, 15.85 in E₅ and 14.39 in E₆. In the variety H 1316 oil (%) ranges from 12.88 – 19.15 % among the six environments. Oil (%) was high in E₁ and E₄ or in early sown condition in all the three varieties.

In early sown condition sugar (%), protein (%) and oil (%) were high and gossypol (%) was low as compared to normal and late sown condition because the early sown condition had better seed development. Under such conditions plant gets longer period to accumulate the photosynthates resulting in more accumulation of sugar, protein and oil. These biochemical traits go on decreasing in delayed sown condition while gossypol (%) increases.

Warner and Burke (1993) reported that the cool-night inhibition of cotton growth correlates with biochemical limitation on starch mobilization in source leaves, which results in a secondary inhibition of photosynthesis, even under optimal temperatures during the day.

Correlation between seed germination (%) and biochemical traits observed during 2015 is presented in table 5. Seed germination (%) was positively correlated with protein (%), whereas protein content was negatively correlated with sugar.

There was no correlation found between seed germination (%) and biochemical traits during 2016 (Table 6).

References

- A.O.A.C. (1990). Official method of analysis 15th edition, Association of Analytical Communities, Washington, D.C., U.S.A.
- Bell, A.A. (1967). Formation of gossypol in infected or chemically irritated tissues

of *Gossypium* species. *Phytopathology*, 57: 759-764

- DuBois, M., Gilles, K.A. and Hamilton, J.D. (1956). Colorimetric method for determination of sugars and related substances. *Analytical Chemistry*. 28: 350-356.
- ICAR-All India Coordinated Research Project on Cotton Annual Report 2016-2017.
- Kaliyaperumal, A.K., Karuppanasamy S. K. and Rajasekaran R. (2013). Heterosis studies for Fiber quality of upland cotton in line x tester design. *African J. Agri. Res.* 8: 6359-6365.
- Munawar, M. and Malik, T.A. (2013). Correlation and genetic architecture of seed traits and oil content in *Gossypium hirsutum* L. *J. Plant Breed. Genet.* 1(02): 56-61.

How to cite this article:

Pinki, S.S. Siwach, R.S. Sangwan, Sombir Singh, V.S. Mor, Shiwani Mandhania, Sunayana and Neha Rohila. 2018. Estimation of Biochemical Parameters in Different Environments in Upland Cotton (*Gossypium hirsutum* L.). *Int.J.Curr.Microbiol.App.Sci.* 7(04): 1624-1629. doi: <https://doi.org/10.20546/ijcmas.2018.704.183>