

Original Research Article

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Meteorological Parameters: Effect of Different Environments on Seed Germination in Upland Cotton (*Gossypium hirsutum* L.)

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ABSTRACT

Keywords

meteorological parameters, Seed germination, Different environments

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The present study was conducted to find out the effect and correlation of meteorological parameters on seed germination in three varieties H 1098 – I, H 1300 and H 1316 under six environments (three sowing periods i.e. early, normal and late sown conditions in year 2015 & 2016). Observations were recorded for seed germination and meteorological parameters as maximum and minimum temperature (°C), relative humidity (%) morning as well as evening, sunshine hours, rainfall (mm) & number of rainy days. Tagging period started from June end when there were sizable amount of flowers. Seed germination (%) was high in early sown condition as compared to normal sown conditions. The period from 2nd week of July to mid August was better of seed germination. So the sowing period should be adjusted in such a way peak flowering appear between 2nd week of July to mid August for better seed development resulting in better seed germination.

Introduction

Environmental factors for optimum seed germination plays a vital role in realizing crop growth and yields. The time of sowings as varied growth condition for various crops differs depending on climate and varieties. Knowledge on effects of various elements of environment on crop growth, development and yield is important to harness good crop yield with better quality of seed and fiber. Seed quality aspects mainly seed vigor and viability plays an important role in seed germination. Seed germination in cotton is a big problem under North Indian conditions. It remains much below the standard germination because

of poor seed development and its quality is very much affected by environment. Sometimes seed germination in cotton may be reduced as low as 10% due to adverse environmental conditions and exact reasons for poor development of seed are not known. To overcome this problem present investigation was planned.

Materials and Method

experiment was conducted during *kharif* 2015 and 2016 having three cultivars H 1098-I, H 1300 and H 1316 of upland 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 (Table 1).

Data was recorded as in all the three replications in every week flowers were tagged and number of effective bolls formed from these flowers was counted and the week in which maximum and minimum bolls developed was identified. The seed cotton from these opened bolls was picked separately and ginned. This seed was used to test the seed quality parameters. These seed quality traits were correlated with different weather parameters to pin point the reasons for good or poor seed developments. The data on meteorological aspects was recorded from tagging period i.e. June, 24 to till the last picking of the experimental plots.

Meteorological data was recorded as:

Maximum and minimum temperature (°C)

Maximum and minimum temperature was calculated as the average temperature of different weeks and then averaged.

Relative humidity (%) morning as well as evening

Relative humidity morning as well as evening was calculated as the average relative humidity of morning and evening of different tagging weeks and the averaged.

Sunshine hours

Sunshine hours were calculated as the average sunshine hours of different tagging weeks and the averaged.

Rainfall (mm) & number of rainy days

Rainfall and rainy days were calculated as the total rainfall and number of rainy days of different weeks and then finally total all the rainfall and number of rainy days of the tagging weeks.

Results and Discussion

Weakly meteorological data for seed development period in 2015 is presented in table 2. During 2015 flowering started from 28th June and it continued up to August 29. The fresh opened flowers were tagged daily and their number was recorded on weekly basis for 10 weeks. The number of tagged flowers maturing in to well develop opened bolls were the number of retained bolls. These bolls were picked weekly and their number was counted, ginned and same were used for further tests like germination and biochemicals. These results were correlated with different weather parameters. Data on weather parameters i.e. Temperature (Max. and Min.) or (T_{max} and T_{min}), Relative humidity (morning and evening) or (RH_m and RH_e), sunshine hours (SS), rainfall (RF) and rainy days (RD) were recorded for these 10 weeks (Table 2). Range for T_{max} during these 10 weeks was 33.0 – 37.8, for T_{min} it was 23.9 – 26.8, for RH_m was 72.4 – 92.7, for RH_e was 40.3 – 75.0, for sunshine hours was 2.6 – 9.5, for rainfall was 0- 77.3 and for rainy days was 0 – 4 during these weeks. Mean T_{max} for these 10 weeks was 34.9°C T_{min} was 25.8 °C, RH_m was 85.4%, RH_e was 60.7%, sunshine hours were 6.4 hours, rainfall was 220.6mm and rainy days were 16.

Weakly meteorological data for seed development period in 2016 is presented in table 3. During the year 2016 also data were

recorded in similar way as that of 2015 starting from June 24 to Sept. 1. Temperature (Max. and Min.) or (T_{max} and T_{min}), Relative humidity (morning and evening) or (RH_m and RH_e), sunshine hours (SS), rainfall (RF) and rainy days (RD) were recorded for these 10 weeks (Table 3). Range for T_{max} during these 10 weeks was 32.5 – 38, for T_{min} it was 24.7 – 28.0, for RH_m was 74.7 – 94.4, for RH_e was 58.3 – 77.7, for sunshine hours was 4.2 – 8.0, for rainfall was 4 - 95.5 and 1 – 5 rainy days for these weeks. Mean T_{max} for these 10 weeks was 34.9°C, T_{min} was 26.1 °C, RH_m was 88.6%, RH_e was 69.3%, sunshine hours were 6 hours, rainfall was 338.2 mm and rainy days were 18.

Better seed germination (%) was the direct outcome of better seed development. The seed germination (%) during in the year 2015 was higher in the period ranging from July, 12 - Aug, 15 and in the year 2016 it was from July, 8 – Aug, 11 indicating that period of

second week of July to middle of August is most appropriate for seed development under Haryana condition. When we compare the seed germination (%) during 2015 and 2016, it was lower in the year 2016 and simultaneous comparison of environmental factors during these years indicated the there were large differences in mean values of the year 2015 and 2016 in RH_e (67.1 and 72.8) and sunshine hours (5.4 and 6.0), where as rest of the environmental factors were almost similar. These results indicated that role of evening humidity is very crucial and persistence of higher RH_e may adversely effect the seed development resulting low seed germination (%). Longer sun shine hours during 2016 may have adversely affected the seed germination as the distribution of rainfall was erratic and longer sun shine hours may have resulted in moisture deficiency during that period. Similar findings of effect of environmental factors on seed germination (%) were reported by Ratnam *et al.*, (2014).

Table.1 Sowing dates and different environments in 2015 and 2016

Environment		Date of Sowing	Environment Designation
Year	Sowing period		
2015	Early	10 April	E ₁
	Normal	15 May	E ₂
	Late	5 June	E ₃
2016	Early	26 April	E ₄
	Normal	5 May	E ₅
	Late	2 June	E ₆

Table.2 Weekly meteorological data for seed development period during 2015

2015	Tagging period	Picking	Temperature (°C)		Relative humidity %		SS (hrs)	Rainfall (mm)	Rainy days
			T _{max}	T _{min}	Morning	Evening			
1	28-June-4 July	1-Sep	37.8	25.8	80.1	48.1	8.3	15.8	2.0
2	5-July- 11july	7-Sep	34.0	26.1	86.1	70.7	2.8	46.7	1.0
3	12-July- 18 July	13-Sep	33.5	26.3	86.0	63.7	6.0	24.7	2.0
4	19-July- 25 July	20-Sep	35.6	26.7	87.3	63.0	7.3	77.3	1.0
5	26-July- 1 Aug	25-Sep	33.0	25.4	88.9	71.0	7.0	2.9	1.0
6	2-Aug- 8 Aug	2-Oct	33.7	26.0	90.0	62.7	4.2	7.4	2.0
7	9-Aug-15 Aug	9-Oct	34.3	26.8	92.7	75.0	2.6	29.2	4.0
8	16-Aug-22 Aug	13-Oct	34.2	26.1	88.1	57.7	6.9	7.8	2.0
9	23-Aug-29 Aug	20-Oct	36.2	25.6	82.0	55.0	9.3	8.8	1.0
10	30-Aug-6Oct	27-Oct	37.0	23.9	72.4	40.3	9.5	0.0	0.0
			34.9	25.8	85.4	60.7	6.4	220.6	16.0

T_{max}=Maximam Temperature T_{min}= Minimum Temperature SS= Sunshine

Table.3 Weekly meteorological data for seed development during period 2016

2016	Tagging Period	Picking	Temperature (°C)		Relative humidity %		SS (hrs)	Rainfall (mm)	Rainy days
			T _{max}	T _{min}	Morning	Evening			
1	24-June- 30 June	28-Aug	38.0	28.0	74.7	58.3	6.7	13.0	1.0
2	1-July- 7 July	4-Sep	35.1	26.5	90.4	71.3	5.8	93.5	3.0
3	8-July- 14 July	11-Sep	36.3	27.2	86.6	72.3	7.3	4.0	1.0
4	15-July- 21 July	18-Sep	33.9	25.3	91.9	71.3	4.5	73.3	5.0
5	22-July- 28 July	23-Sep	36.7	26.0	89.4	70.4	8.0	27.0	1.0
6	29-July- 4 Aug	30-Sep	32.5	25.2	93.4	74.4	4.2	47.0	1.0
7	5-Aug- 11 Aug	7-Oct	34.6	26.1	91.6	75.7	6.0	4.3	1.0
8	12-Aug- 18 Aug	11-Oct	34.8	24.7	85.7	60.3	6.5	4.5	1.0
9	19-Aug-25 Aug	15-Oct	34.0	26.4	88.1	61.1	5.1	8.4	2.0
10	26-Aug- 1 Sept	19-Oct	32.8	25.3	94.4	77.7	6.0	63.2	2.0
			34.9	26.1	88.6	69.3	6.0	338.2	18.0

T_{max}=Maximam Temperature T_{min}= Minimum Temperature SS= Sunshine

Table.4 Seed germination (%) of different varieties in different environments

Week	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	37	---	---	12	---	---	28			11			21			8		
2	67	---	---	16	---	---	58			16			52			12		
3	72	60	52	42	32	23	61	53	45	32	23	14	56	50	40	31	18	10
4	76	65	58	46	36	25	64	56	50	35	24	17	58	54	42	32	19	12
5	77	68	62	48	40	27	68	59	52	38	26	20	60	58	46	35	21	16
6	79	72	69	51	41	30	72	62	55	43	30	25	62	60	49	36	24	18
7	78	75	72	53	43	32	75	63	60	43	33	28	65	63	51	39	27	21
8	49	34	28	25	21	16	31	28	22	21	19	18	28	26	20	20	18	12
9	25	22	18	19	11	9	20	15	12	16	15	14	18	16	10	15	11	6
10	15	12	9	12	10	5	9	8	6	10	6	3	9	8	5	9	4	3
Mean	57	51	46	32	29	21	49	43	38	26	22	17	43	42	33	24	18	12

Table.5 Environmental factors for proper seed germination and their optimum range in 2015 and 2016

Environmental factors	2015 (12 July- 15 Aug)	2016 (8 July- 11 Aug)	2015 & 2016
	Mean	Mean	Mean
T _{max}	34.0	34.8	34.4
T _{min}	26.2	26.0	26.1
RH _m	89.0	90.6	89.8
RH _e	67.1	72.8	70.0
SS	5.4	6.0	5.7
RF	28.3	31.12	29.71
RD	2	1.8	1.9

T_{max} =Maximum Temperature T_{min}= Minimum Temperature RH_m= Morning Relative Humidity RH_e = Evening Relative Humidity SS= Sunshine
 RF = Rainfall RD= Rainy Days

Seed germination (%) of different varieties in different environments is given in table 4. In the variety H 1098- I, average seed germination of 10 weeks had wide differences in different environments i.e.57, 51, 46, 32, 29 and 21 in E₁, E₂, E₃, E₄, E₅ and E₆ respectively. Range of seed germination in H

1098- I was 5% – 79 % across all the six environments. It was observed that seed germination was high in E₁ and E₄ when we compare the environments of both the years. In the variety H 1300 average seed germination of 10 weeks was 49, 43, 38, 26, 22 and 17 respectively. Range of seed

germination in H 1300 was 3 %- 75 % across all the six environments. Seed germination was high in E₁ and E₄ when we compare all the environments of 2015 and 2016. In the variety H 1316 average seed germination was 43, 42, 33, 24, 18 and 12 respectively. It was high in E₁ and E₄. Range of seed germination in the variety H 1316 was 3 % - 65 % across all the six environments. So seed germination was higher environments in E₁ and E₄ i.e. in early sown conditions of both the years. These findings indicated that environmental factors were favorable for seed development in early sown conditions during both the years. These results confirm the earlier findings of Bange and Milroy, 2004.

Seed germination was higher in the seed development period from July, 12- Aug, 15 in 2015 and July, 8 – Aug, 11 in the year 2016 (Table 5). There were differences in some environmental factors such as RH_e, sunshine hours and rainfall in year 2015 and 2016 leading to differences of mean of these environmental factors. During 2015 mean value of T_{max} was 34°C, T_{min} was 26.2, RH_m was 89%, RH_e was 67.1, sunshine hours were 5.4, rainfall was 28.3 and rainy days were 2. During 2016 mean value of T_{max} was 34.8°C, T_{min} was 26.0, RH_m was 90.6%, RH_e was 72.8, sunshine hours were 6, rainfall was 31.12 and rainy days were 1.8. Pooled mean of environmental factors during 2015 and 2016 for T_{max} was 34.4°C, T_{min} was 26.1°C, RH_m was 89.8 %, RH_e was 70 %, for SS was 5.7 hours, rainy days was 29.71 and rainy days were 1.9. Benefits of temperature were also documented by Sankaranarayanan *et*

al., (2010) and Reddy *et al.*, (1991). These results indicate that although the environmental factors are beyond our control but by adjusting sowing period it is possible to obtain higher yield with better seed quality.

References

- Bange, M.P. and Milroy, S.P. (2004). Growth and dry matter partitioning of diverse cotton genotypes. *Field Crops Res.* 87(1): 73-87.
- Blanc, E., Quirion, P., and Strobl, E. (2008). The climatic determinants of cotton yields: Evidence from a plot in West Africa. *Agric. Forest Meteorology.*
- ICAR-All India Coordinated Research Project on Cotton Annual Report 2016-2017.
- Malagouda, P. Khadi, B.M. Basamma, K. and I.S. Katageri (2014). Genetic Variability and Correlation Analysis for Fibre Quality Traits in Diploid Cotton (*Gossypium* spp). *J. Agric. & Environ. Sci.* 14 (5): 392-395.
- Ratnam, M., Reddy, S.K., Bharathi, S. (2014). Influence of weather parameters on growth and yield of Bt cotton under kishina agro climatic zone of Andhra Pradesh. *J. Cotton Res. Dev.* 28(2): 214-216.
- Reddy, V.R., Baker, D.N. and Hodges, H.F. (1991). Temperature effects on cotton canopy growth, photosynthesis, and respiration. *Agron. J.* 83: 699-704.
- Sankaranarayanan, K., Praharaj, C.S., Nalayani, P., Bandyopadhyay, K.K., Gopalakrishnan, N. (2010). Climate change and its effect on cotton (*Gossypium* sp.). *Indian J. Agric. Sci.* 80:561-575.

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