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Morpho-physioalogical analysis of cotton genotypes (*G. hirsutum* L) under rainfed condition

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Abstract
Sixteen promising genotypes along with six checks NH-615, NH-545, AKH 8828, PKV Rajat, Phule 0688 and Phule Yamuna were screened for phenological characters *viz.*, days to 50% flowering, days to first boll opening, days to 50% boll opening, days to maturity, plant height, number of bolls per plant, Number of sympodia, number of monopodia, growth parameters (NAR, AGR, RGR, SLW, LAI), proline content, SPAD chlorophyll content, yield contributing character 100 seed weight, Ginning (%), Boll weight, seed cotton yield per plot, Fiber quality parameters, fiber length, fiber strength and micronaire. Morpho physiological characters studies, for relative growth rate, the genotype NH-677 (0.046) recorded highest RGR and CNDTS-281(0.022) lowest at 61-90 DAS as compare to higher RGR check AKH-8828(0.038). Between 91-120 DAS Net Assimilation Rate differed significantly in genotype. NH-677 recorded more NAR (0.035) as compare to other and lower NAR was noticed in RHC-1306 (0.025). Absolute Growth Rate of NH-677 recorded highest AGR (1.302) and AKH-09-5 recorded lowest AGR (1.036) at 61-90 DAS. Leaf area index, at 60 DAS differed significantly among genotypes and NH 677 recorded more LAI (0.86) as compare to other genotype and least was in CNH-1124 (0.66). As regard to specific leaf weight Genotype NH 677 at 60 DAS (4.26), 90 DAS (4.84) and 150 DAS (4.54) and at 120 DAS, CNH-1111(4.16) found statistically significant over checks PKV Rajat (3.84), Phule-0688 (4.47), AKH-8828 (3.78) and AKH-8828 (4.24) for 60, 90, 120 and 150 DAS respectively.At 60 DAS, genotype NH 677recorded highest leaf area (15.48dm^2) fallowed by RHC 1217 (15.42 dm^2) and CNDTS 281 (15.39 dm^2). At 150 DAS NH 677 recorded highest leaf area (42.97 dm^2) fallowed by CNDTS 281 (41.50 dm^2) and RHC 1217(42.00 dm^2) as compare other genotypes. Significant differences were observed for Proline content by all genotypes studied, highest in genotype NH 677 (41.48) and least in CNH 1142 (29.50). The genotype NH-677 (46.00) recorded highest SPAD chlorophyll as compare to other and least was observe in CNH-1142 (36.75). The data on Specific Relative water Content recorded significant difference at 60 DAS. The two genotypes NH-677 (76.10) and CNDTS-281 (76.83) depicted statistically significant Specific Relative water Content value as compare to higher value check AKH-8828 (72.06). At 90 DAS four genotypes NH-677 (82.57), RHC-1217 (78.43), NH-678 (76.24) and CNDTS-281 (80.78) depicted statistically significant result as compare to higher check AKH-8828 (68.07). Yield and yield component data revealed that genotypes *viz.*,NH-677 (1650 g), NH678 (1250g), RHC1217 (1450g) and CNH1111 (1210g) depicted statistically significant seed cotton yield per plot as compare to higher yield check NH-615 (1170g). Genotype NH 677 recorded maximum bolls per plant (22.54), boll weight (4.17g), ginning out turn (38.85%) and 100 seed weight of (6.70 g) as compare to other genotypes. Data on fibre quality parameter revealed that, genotype CNH 1142 (29.74 mm) for fibre length, genotypes CNH-1124 (3.44 µg/inch) for micronaire and genotype CNH 1142 (21.9 g/tex) for fibre strength found better fibre parameters. Number of day to 50% flowering and first boll opening differed significantly among all the genotypes studied. Genotypes NH 677 recorded less number days to 50% flowering (60.07). There was no significant differences for 50% boll opening among all genotypes studied. The plant height was observed in range of 101.20 cm (RHC 1307) to 125.50 cm (NH 677) at 150 DAS. Genotype NH 677(21.50) and CNDTS 281(20.55) recorded statistically significant difference for more number of symopodia per plant as compare to higher check Phule 0688 (16.88). Thus in present studies, genotype NH 677, RCH 1217, CNDTS 281 and CNH 1111 were found promising for the morho physiological analysis under rainfed condition.

Keywords: Cotton, morphophysiology, seed cotton, *G. hirsutum*, screening

Introduction
Cotton is one most precious gift of nature to the mankind, contributed by the genus "*Gossypium*" to clothe the people all over the world. The effects of water stress on plants depend on the severity and duration of the stress, the growth stage at which plants are

subjected to stress and the genotype of the plant (Kramer, 1983) [16]. A plant is said to be under drought stress when soil water supply is not adequate to meet the transpirational demands (Krieg, 2000) [17]. Cotton is relatively more sensitive against drought. Boll development starts after pollination and is considered as the most sensitive stage to drought stress. Cotton yield is directly affected by number of bolls per plant (Gerik *et al.*, 1996) [13]. Fibre quality is also affected by drought stress. The turgor pressure in the fibre cell is badly affected under drought stress conditions (Dhindsa *et al.*, 1975) [10], which affects fibre quality traits (Yagmur *et al*., 2014) [21]. Moreover, the importance of effects of water-deficit stress on reproductive units of two cotton plants has increased due to its high contribution to yield. However, further studies are still needed for a better understanding on the physiology and metabolism of reproductive units of cotton plants grown under water-deficit conditions.

Therefore, a series of experiments were conducted in order to elucidate the effects of water deficit by analysis of various morpho physiological characters important in rainfed condition. Breeding cultivars for thus realizing need for assessing the performance of some notable varieties, this experiment was taken up to compare the productivity and also differentiate their unique features contributing for higher productivity. This entitled “Morpho-Physiological Analysis of Cotton (*G. hirsutum*) Genotypes Under Rainfed Condition” to evaluate promising cotton genotypes on the basis of morpho physiological traits under *rainfed* condition.

Materials and Methods

The present study comprised of twenty two genotypes of cotton including six check for their morpho physiological analysis under *rainfed* condition during *kharif* season 2018. The experiment was laid out at Cotton Research Scheme, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. These elite genotypes for present study were obtained from Cotton Research Station, Nanded, Cotton Research Station, MPKV Rahuri; Cotton Research Unit PDKV, Akola and Central Institute for Cotton Research, Nagpur. These genotypes were selected on the basis of morphological characters and fiber properties. The experiment was laid out in Randomized Block Design with two replication and twenty two treatments. Observations were recorded on five randomly selected plants excluding border rows, in each genotype per replication. Ancillary characters data *viz.*, Plant height (cm), number of monopodia per plant, number of sympodia per plant, days to 50% flowering, days to first boll opening, days to 50% boll opening, number of days to maturity and Morpho-Physiological and Biochemical Analysis *viz.*, Absolute Growth Rate (AGR), Relative Growth Rate (RGR), Net Assimilation Rate (NAR), Leaf Area Index (LAI), Specific Leaf Weight (SLW), Total Chlorophyll Content (By SPAD Meter), Proline Content (µg/g fresh weight), Relative Water Content (RWC %) whereas yield contributing characters *viz.*, number of bolls per plant, boll weight (g), seed cotton yield per plant (g), test weight (g), ginning percentage and fiber properties *viz.*, Upper half mean length (UHML) (mm), Micronire value (µg $inch^{-1}$) and Fibre strength (g tex^{-1}). Mean value of all the observations in each replication were used for statistical analysis. Statistical analysis was made by the procedure given by Panse and Sukhatme (1967) [18].

Results and discussion

Morphological characters

Plant height

In present study plant height showed non-significant difference up to 90 DAS and significant difference only at 120 DAS (Table 1). In general all the genotypes the plant height increased with increases at 60 DAS and 90 DAS while at 120 DAS no particular trend was observed. In genotypes NH-677 recorded the highest plant height while RHC-1307 in genotypes recorded least plant height. The mean plant height increased progressively up to harvest, the rate of increase in plant was gradual and steady up to 60 days, fast between 60 to 120 days and increased with increasing rate up to 150 days and there after slightly increased till the harvest. The plant height was observed in range of 101.20cm (RHC-1307) to 125.50cm (NH-677) at 150 DAS (Table 1). Many workers observed positive correlation of plant height with fruiting branches, yield and boll weight. (Kim *et al*. 1987, Ansari *et al*. 1989, Baradwaj and Singh 1988) [15, 5, 1]. Further Baradwaj and coworkers (1971) [6], observed high fruiting coefficient with dwarf plant types with few sympodial branches, reported increase in seed cotton yield through desired plant types particularly plants having a height of 110-120 cm. Plant height showed no significant correlation with all the growth parameters. Relatively more number of leaves were observed at 120 DAS compared to other genotypes. However Shoa *et al*. (1994) [20] suggested that leaf number could be used as indicator of growth stage for applying management practices as an important characters. The number of monopodia and sympodia are considered influencing. However there was significant differences for number of nodes among the genotypes. Many workers have reported significant correlation for number of sympodia per plant with yield (Chen *et al*. 1991, Basu and Bhat, 1987 and Channaveeraiah, 1983) [9, 4, 8]. Highest sympodia was observed in NH-677 (Table 3). In present study highly significant positive correlation was observed between the number of sympodia per plant and seed cotton yield (0.808) Barketial *et al*., (1982) [3] noticed similar correlation. Sympodial branches form principle segment of super structure of cotton plant on which fruiting branch develops. Higher number of sympodia indicates formation of more fruiting points (Khorgade and Ekbote, 1980). [14]

Table 1: Differences in Phenological Character of cotton genotypes.

Variety	Number of days to			
	50% Flowering	First boll opening	50% Boll opening	Maturity
NH-677	60.07	83.55	139.36	162.31
NH-678	64.92	85.23	139.75	162.48
NH-635	62.61	87.63	141.57	171.07
AKH-09-5	61.09	89.24	144.49	175.34
AKH-9916	63.16	88.91	141.14	163.34
RHC-1306	62.85	86.14	141.46	171.07
RHC-1307	60.86	93.21	144.34	176.63
RHC-1217	63.99	88.94	143.10	174.62
CNDTS-281	65.00	84.49	140.44	163.17

CNH-2053	62.53	87.84	143.28	170.06
CNH-09-07	62.58	87.70	141.65	169.50
CNH-2046	63.20	88.16	141.93	169.46
CNH-2076	63.02	87.80	140.93	168.12
CNH-1111	63.98	85.23	139.60	162.65
CNH-1124	65.63	90.98	144.09	176.05
CNH-1142	63.35	89.09	142.63	174.63
Checks				
NH-615	60.67	87.30	142.04	167.08
NH-545	62.05	88.30	140.71	170.63
AKH-8828	64.58	86.31	142.54	164.04
PKV RAJAT	62.11	88.50	141.89	173.20
PHULE-0688	62.46	87.28	142.55	171.56
PHULE-YAMUNA	63.66	86.47	141.89	169.66
Mean	62.93	87.65	141.88	169.39
SE ±	1.0661	0.8495	0.8359	3.2733
CD at 5%	3.136	2.4989	2.4589	9.6286

Phenological characters

In the present study there was delay in number of days for 50 percent squaring and 50 percent flowering (Table 1) in Genotype NH-677 recorded early flowering while RHC-1307 was late in flowering by 1-6 days thus earliness appears to have distinct advantage under rainfed condition. Under rainfed, the occurrence of terminal stress is a recurring phenomenon which coincides with 120 DAS mainly due to non-receipt of rainfall. This will invariably affect the genotypes and therefore earliness in flowering and maturity is considered as important characters. Earliness also reduces the occurrence of boll worm.

Leaf area and leaf area index

Leaf area over an unit ground area gives a fairly good idea of photosynthetic surface area. Different crops possess optimum LAI conductive to maximum dry matter production (Watson, 1952). Genotypes indicated variation in leaf area, leaf area index at different growth stages while emplacing the importance leaf area previous study revealed varietal differences in LAI (Bhat *et al*., 1974) [7]. All the genotypes attained LAI of approximately at peak flowering and there after there was a continuous increase in LAI. Among the genotypes, NH-677 (Table 2) recorded higher LAI at 120 DAS or peak flowering stages and this result was similar to that of Ashley *et al.* (1963) [2].

Higher yielding early genotypes recorded maximum LAI at flower initiation and peak flowering whereas late genotypes maintained maximum LAI even during boll development and boll bursting which has resulted in competition between sinks for photo assimilates thus leading to low yield this suggested that higher LAI at flower initiation stage and peak flowering is desirable for high cotton yield because such situation would not lead to competition for photo assimilates.

Specific leaf weight

Specific leaf weight indicates the thickness of the leaf and is known to have a positive correlation with photosynthetic rate (Rasulov and Assrrorov, 1982) [19]. The results in the present study indicated SLW that was more in initial stage, after wards it decreased. SLW was more at 60-90 DAS in CNDTS-281 (Table 2) compared to other genotypes. The increase in SLW with age of crop might be due to either enhanced layer of mesophyll cell or increased thickness of conducing tissue.

Proline content

Proline content in leaf indicate the ability of plant to withstan d at drought or stress condition. The effect of genotypes on proline content recorded at 60,90 and 120 DAS stages (Table 2) of cotton genotypes genotype NH-677 (41.48, 58.87and 73.21is found similar to that de Ronde *et al*. (1999) [11]. The result in the present study indicated proline that was less in initial stage, afterward it increased up to 120 DAS it means the stress period was more in 120 DAS period the occumulation of proline more in stress condtion increases the plant ability withstand in stress condtion.

Growth parameters

The growth parameters like RGR, NAR and AGR have been extensively used in recent years for better understanding a physiological basis of yield variation in crop plants. Increase in yield is not associated with increase in photosynthetic rate alone and it is difficult to find out clear cut answer for improving yield potential. Varietal differences in leaf photosynthetic rate may be caused by variety and environment interaction (Yoshida, 1972) [22]. The RGR was more during early stages and gradually decreases there after. This indicated that RGR in cotton was more closely associated with vegetative growth than seed cotton yield (Coy, 1976) [10]. In this study NH-677 recorded maximum RGR (Table 2) in cotton genotypes. The NAR decreases with age of the plant. The decrease in NAR at later stages could be attributed to mutual shedding of leaves. In present study the NAR differed significantly in spacing at 90-120 DAS and 120-150 DAS in genotypes except at 150 harvest. Among the genotypes NH-677 recorded more NAR compared to other genotypes (Table 2).

Table 2: Relative Growth Rate, Net assimilation rate, Absolute Growth Rate and Leaf area index influenced by cotton genotypes at various growth stages

Variety	Relative growth rate				Net assimilation rate				Absolute growth rate				Leaf area index			
	Days After Sowing				Days After Sowing				Days After Sowing				Days After Sowing			
	30-60	61-90	91-120	121-150	30-60	61-90	91-120	121-150	30-60	61-90	91-120	121-150	30-60	61-90	91-120	121-150
NH-677	0.117	0.046	0.018	0.009	0.067	0.038	0.035	0.042	0.401	1.302	0.460	0.394	0.86	1.51	2.37	2.39
NH-678	0.115	0.042	0.015	0.007	0.064	0.034	0.031	0.036	0.398	1.294	0.455	0.389	0.80	1.48	2.30	2.34
NH-635	0.114	0.030	0.019	0.009	0.061	0.035	0.031	0.035	0.360	1.190	0.398	0.361	0.83	1.28	2.20	2.09
AKH-09-5	0.064	0.039	0.015	0.007	0.043	0.030	0.028	0.028	0.300	1.036	0.367	0.355	0.73	1.05	1.81	1.93
AKH-9916	0.111	0.029	0.011	0.008	0.059	0.038	0.028	0.037	0.347	1.219	0.409	0.366	0.79	1.20	2.18	2.30
RHC-1306	0.112	0.035	0.012	0.007	0.059	0.035	0.025	0.035	0.360	1.261	0.419	0.371	0.69	1.22	2.15	2.27
RHC-1307	0.048	0.032	0.008	0.006	0.041	0.031	0.027	0.030	0.298	1.050	0.364	0.356	0.76	0.97	1.87	1.86
RHC-1217	0.048	0.032	0.008	0.006	0.060	0.034	0.029	0.030	0.330	1.133	0.424	0.375	0.86	1.50	2.30	2.33
CNDTS-281	0.116	0.022	0.012	0.006	0.065	0.037	0.034	0.041	0.400	1.297	0.458	0.391	0.86	1.48	2.31	2.31
CNH-2053	0.112	0.032	0.013	0.006	0.060	0.036	0.033	0.035	0.362	1.256	0.408	0.370	0.75	1.30	2.22	2.20
CNH-09-07	0.113	0.033	0.013	0.006	0.063	0.034	0.032	0.031	0.339	1.179	0.414	0.370	0.74	1.27	2.08	2.10
CNH-2046	0.115	0.042	0.014	0.007	0.060	0.032	0.030	0.033	0.349	1.166	0.438	0.370	0.80	1.20	2.20	2.18
CNH-2076	0.110	0.032	0.014	0.008	0.063	0.035	0.030	0.034	0.360	1.215	0.421	0.376	0.75	1.16	2.22	2.21
CNH-1111	0.115	0.041	0.014	0.007	0.064	0.035	0.032	0.039	0.395	1.299	0.456	0.389	0.78	1.45	2.20	2.25
CNH-1124	0.044	0.033	0.012	0.008	0.042	0.030	0.026	0.025	0.289	1.055	0.363	0.352	0.79	1.02	1.98	2.02
CNH-1142	0.112	0.035	0.011	0.006	0.059	0.032	0.031	0.036	0.343	1.195	0.419	0.369	0.76	1.25	2.13	2.28
Checks																
NH-615	0.110	0.034	0.013	0.005	0.062	0.033	0.032	0.031	0.394	1.154	0.395	0.373	0.80	1.24	2.22	2.20
NH-545	0.112	0.024	0.012	0.006	0.061	0.034	0.031	0.032	0.381	1.173	0.416	0.364	0.80	1.33	2.30	2.24
AKH-8828	0.113	0.038	0.014	0.006	0.061	0.035	0.031	0.036	0.349	1.210	0.415	0.367	0.80	1.26	2.17	2.20
PKV RAJAT	0.111	0.034	0.012	0.008	0.063	0.036	0.030	0.036	0.362	1.235	0.409	0.364	0.69	1.24	2.21	2.24
PHULE-0688	0.112	0.031	0.012	0.006	0.062	0.036	0.026	0.035	0.350	1.268	0.420	0.369	0.79	1.26	2.15	2.19
PHULE-YAMUNA	0.110	0.034	0.017	0.006	0.060	0.039	0.027	0.038	0.360	1.187	0.425	0.369	0.81	1.12	2.17	2.11
Mean	0.104	0.035	0.013	0.007	0.063	0.036	0.031	0.037	0.356	1.199	0.416	0.371	0.78	1.26	2.17	2.19

Table 2: Continued

Table 2 cont: Relative Growth Rate, Net assimilation rate, Absolute Growth Rate and Leaf area index influenced by cotton genotypes at various growth stages

Variety	Specific leaf weight				Proline content			Chlorophyll Content			Relative Water Content		
	Days After Sowing				Days After Sowing			Days After Sowing			Days After Sowing		
	30-60	61-90	91-120	121-150	60	90	120	60	90	120	60	90	120
NH-677	4.39*	4.84*	3.92	4.54*	41.48	58.87	73.21	46.00	50.00	46.60	76.10*	78.03*	82.57*
NH-678	4.26*	4.52	3.88	4.35	39.50	55.50	71.79	43.00	46.50	44.62	72.26	74.26	76.24*
NH-635	3.57	4.33	3.84	4.12	35.50	52.46	69.65	42.89	45.64	39.61	70.30	71.21	66.71
AKH-09-5	3.43	4.39	3.37	3.74	31.43	46.47	61.41	40.36	39.76	36.77	68.52	68.47	66.66
AKH-9916	3.88	4.45	3.67	3.99	35.59	52.21	69.69	44.85	44.65	41.23	71.40	71.66	65.75
RHC-1306	3.60	4.44	3.61	4.14	38.35	53.79	70.99	44.48	42.50	39.67	71.95	69.66	67.94
RHC-1307	3.23	4.00	3.36	3.82	34.73	49.64	61.66	40.20	39.22	37.17	69.06	69.91	70.53
RHC-1217	3.84	4.74	3.87	4.37	40.11	57.00	70.08	39.83	42.59	41.62	74.55	74.87	78.43*
CNDTS-281	3.96	4.75*	3.75	4.49*	40.00	58.14	72.77	41.50	48.80	45.32	76.83*	79.00*	80.78*
CNH-2053	3.68	4.35	3.69	4.20	35.73	54.06	68.21	37.00	44.60	40.75	71.80	73.74	69.04
CNH-09-07	3.97	4.57	3.65	4.22	38.38	50.09	70.28	39.00	42.65	42.95	70.69	71.79	65.34
CNH-2046	3.93	4.40	3.67	4.15	35.53	53.54	69.93	44.33	44.00	41.67	71.83	69.44	64.92
CNH-2076	3.59	4.45	3.58	4.10	37.70	51.63	68.80	41.65	44.26	39.00	69.99	70.91	67.95
CNH-1111	4.30*	4.48	4.16*	4.03	36.41	57.08	73.22	43.75	45.50	44.91	70.80	73.70	66.40
CNH-1124	3.24	4.03	3.47	3.95	31.70	46.86	60.62	36.75	38.89	36.62	69.31	68.83	63.30
CNH-1142	3.75	4.40	3.69	4.21	29.50	53.80	68.03	43.67	47.16	44.50	70.80	73.70	66.40
Checks													
NH-615	3.66	4.46	3.67	4.08	36.55	49.91	70.43	39.18	43.20	42.00	71.09	72.47	65.33
NH-545	3.74	4.46	3.73	4.03	35.55	55.50	71.30	45.52	39.50	42.54	71.11	72.25	65.96
AKH-8828	3.73	4.37	3.78	4.24	36.93	53.84	68.95	41.21	47.34	40.78	72.06	72.19	68.07
PKV RAJAT	3.84	4.45	3.71	4.16	35.14	52.42	67.63	45.03	46.84	39.62	71.01	70.34	67.16
PHULE-0688	3.68	4.47	3.74	4.11	37.71	52.37	68.80	41.61	44.50	39.38	69.61	71.55	66.74
PHULE-YAMUNA	3.65	4.36	3.73	4.10	35.37	53.94	68.14	40.62	43.29	40.97	71.62	72.62	66.65
Mean	3.77	4.44	3.71	4.14	36.35	53.19	68.85	41.93	44.15	41.29	71.02	73.15	71.46
					1.741	1.7891	1.2402	1.8368	1.6741	1.362	1.3454	1.2485	1.1702
					5.1213	5.2628	3.6481	5.4031	4.9245	4.0064	3.9576	3.6725	3.4422

Yield and yield components

A superior genotypes may exhibited identical performance when grown under a set of agro-climatic condition. It is therefore, essential to evaluate genotypes for better yield potential suitable for rainfed. The major factors attributed for the differences in the yield of seed cotton were the yield attributes like boll weight, number of bolls per plant morphological characters like number of monopodial and sympodial branches, phenological characters like days to 50 percent boll opening and days to maturity (Faqir *et al.*, 1984 and Basu and Bhatt, 1987) [12, 4].

The NH-677 genotype recorded significantly more bolls per plant compared to other genotypes (Table 3). Highest boll squaring and yield per plot was observed in genotype NH-677 (Table 3).

Fiber quality parameter: The data on fibre quality parameter recorded in different genotypes is given in Table 3.

UHML

It was observed significant difference in all the genotypes. The genotype CNH 1142 (29.74) was recorded maximum and next by NH-635(28.34),CNH-1124(28.53 mm) the genotype NH-677 showed (27.44 mm) fibre length (Table 3).

Micronaire

Significant difference in all the genotypes with the fine fibre quality was shown by three genotypes *viz,* CNH-1124 (3.44), CNH-1142 (3.64) and CNH-2076 (3.70) the genotypes NH-677 showed (4.85*u*inch) micronair value (Table 3).

Fibre Strength

Significant difference in all the genotypes observed with genotype CNH 1142 (21.9g/tex) recorded maximum strength. All the genotypes ranged from 19.3g/tex to 21.9g/tex strength value. (Table 3).

Table 3: Genotypic differences for ancillary and fibre characters in cotton genotypes.

Variety	No of bolls per plant	Bolls weight (gm)	Yield per plot (gm)	Plant height (cm)	No of Monopodia	No of Sympodia	GOT (%)	100 seed weight	UHML (mm)	Micronaire µg/inch	Fibre strength (g/tex)
NH-677	22.54	4.17*	1650*	125.50	1.99	21.50*	38.85	6.7	27.44	4.85	20.1
NH-678	20.81	3.99	1250*	124.50	1.96	17.55	38.13	6.37	26.38	4.74	21.1
NH-635	20.03	3.60	1140	117.63	1.92	14.78	38.07	6.54	28.54	4.33	19.8
AKH-09-5	13.32	3.11	1008	103.98	1.97	10.21	34.82	6.7	28.44	4.24	19.9
AKH-9916	18.52	3.21	875	117.79	1.54	14.89	38.17	6.45	25.15	5.22	19.3
RHC-1306	18.62	3.62	1120	119.00	1.93	14.60	36.7	6.36	27.11	4.92	21.4
RHC-1307	11.68	3.08	725	101.20	1.94	11.07	34.22	6.43	25.63	4.58	20.2
RHC-1217	19.15	3.86	1450*	117.74	1.98	18.60	38.53	6.47	25.10	4.86	20.0
CNDTS-281	22.02	3.94	1110	124.50	1.98	20.55*	37.5	6.49	25.69	4.62	19.5
CNH-2053	16.27	3.61	725	111.62	1.95	14.69	38.21	6.36	25.37	5.04	19.0
CNH-09-07	17.53	3.69	905	112.50	1.67	13.77	37.64	6.38	26.02	4.30	19.8
CNH-2046	18.90	3.66	805	10.82	1.98	14.95	37.97	6.36	26.05	4.81	18.9
CNH-2076	16.82	3.74	1003	113.46	1.93	16.94	37.45	6.3	26.08	3.70	19.9
CNH-1111	21.76	3.90	1210*	123.00	1.94	18.60	37.62	6.49	25.26	5.04	20.6
CNH-1124	10.80	3.02	565	102.00	1.98	18.60	33.79	6.31	28.53	3.47	21.7
CNH-1142	17.80	3.58	950	114.25	1.93	15.44	37.88	6.43	29.74	3.64	21.9
Checks											
NH-615	17.42	3.71	1170	118.00	1.94	14.36	38.05	6.43	27.45	4.53	21.1
NH-545	17.33	3.30	990	119.77	1.91	15.59	37.33	6.36	26.21	4.83	19.9
AKH-8828	18.29	3.15	715	115.25	1.93	14.52	38.36	6.44	28.91	5.34	20.2
PKV RAJAT	19.67	3.66	990	110.87	1.96	14.47	37.69	6.55	26.33	5.18	19.0
PHULE-0688	18.72	3.20	970	118.10	1.91	16.88	38.71	6.47	24.67	4.69	19.7
PHULE-YAMUNA(Ch)	18.97	3.71	1105	110.29	1.95	14.38	37.67	6.24	23.9	4.43	19.2
Mean	18.04	3.74	1028	110.40	1.9	18.70	37.43	6.44			
SE ±	1.09	0.09	0.11	4.16	0.11	0.83	0.53	0.07			
CD at 5%	3.21	0.27	0.33	12.49	NS	2.45	1.56	0.22			

Conclusion

The genotypes NH 677, RCH 1217, CNDTS 281 and CNH 1111 were superior in respect of growth attributes, yield attributes and yield. Genotype NH-677 have higher efficiency to tolerate drought condition as it showed highest value for proline content as well as Relative Water Content. CNH 1142 was found superior in fibre quality parametres.

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