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Heterotic Studies for Yield and its Component Traits in Upland Cotton (*Gossypium hirsutum* L.)

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ABSTRACT

Forty five intra-hirsutum hybrids along with their parents and check were evaluated to estimate the magnitude of heterosis for yield and fibre quality traits at Agricultural Research Station, Jangamaheswarapuram, Guntur during *kharif*, 2013-14. The standard heterosis was calculated over check hybrid NCS-145. The hybrid NDLH 1938 × RAH 1004 showed significant positive heterosis for seed cotton yield plant^{-1} along with number of bolls plant^{-1}, uniformity ratio, elongation and lint yield plant^{-1}. The hybrid L 770 × G COT 16 showed significant positive heterosis for boll weight along with seed cotton yield plant^{-1}over standard check.

Key words: *Fibre quality, Gossypium hirsutum, Heterosis, Seed cotton yield*

Cotton (*Gossypium* spp) is an important fibre yielding crop of global importance, which is grown in tropical and subtropical regions of more than 80 countries of the world over. In India, cotton is being grown over an area of 126.55 lakh ha with an annual production of 400 lakh bales (1 bale=170 kgs of lint) with a productivity of 537 kg/ha (AICCIP Annual Report, 2014-15). There is a need to improve the productivity of cotton crop by developing a high yielding adaptable cotton variety or hybrid. Hybridisation is the most potent technique for breaking yield barriers and evolving genotypes with higher yield potential. Studies on magnitude of heterosis expressed in F_1s help to asses the ability of the lines that exhibit high amount of exploitable heterosis. Hence present experiment was carried out with the objective of finding out the extent of heterosis over mid parent and standard check for seed cotton yield and fibre quality attributes.'

MATERIAL AND METHODS

The present study was carried out by selecting the ten parents *viz.,* NDLH 1938, L 788, L 770, NA 1325, L604, SURABHI, RAH 1004, HYPS 152, MCU 5 and G COT 16 and forty five intra-specific cross combinations which were generated in diallel fashion without reciprocals. The evaluation of hybrids along with parents and standard check (NCS-145) was done at Agricultural Research Station, Jangamaheswarapuram, Guntur district during *kharif*, 2013-14. Each entry was represented by following 120 x 60 cm spacing with 3 rows with a row length of 6 m. Recommended doses of fertilizers 120 N, 60 P_2O_5 and 40 K_2O kg/ha were applied in split doses. Observations were recorded on five randomly selected plants from each genotype per replication for seed cotton yield plant^{-1}. The data was recorded on seed cotton yield plant^{-1}, number of bolls plant^{-1}, boll weight, seed index, lint index, ginning out turn, 2.5% span length, micronaire value, bundle strength, uniformity ratio, elongation and lint yield plant^{-1} for statistical analysis for estimation of heterosis. The heterotic effects were measured as deviation of F_1 mean from mid parent (relative heterosis) and the standard check (standard heterosis) mean. The test of significance of heterosis over mid parent and standard check was done by 't' test as suggested by Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

The heterosis observed over the mid parent and check for seed cotton yield and fibre quality traits by the forty five crosses has been presented in the Table 1 and 2. The results indicated that the phenomenon of heterosis was observed for all the characters, however, its magnitude varied with the characters.

Heterosis for seed cotton yield plant^{-1} over mid parent and standard check ranged from - 22.34 (L 788 × SURABHI) to 65.79 (NDLH 1938 × RAH 1004) and - 40.11 (L 604 × G COT 16) to 47.47 (NDLH 1938 × RAH 1004), respectively. Nineteen crosses over mid parent and three crosses over standard check exhibited significant positive heterosis. The best heterotic combinations identified were NDLH 1938 × RAH 1004 (65.79), L 770 × G COT 16 (52.65) and RAH 1004 × MCU 5 (43.46) over mid parent and NDLH 1938 × RAH 1004 (47.47), NDLH 1938 × L 788 (23.46) and NDLH 1938 × SURABHI (16.8) over standard check respectively. These results are in conformity with the results of for heterosis over mid parent; Manish Kumar *et al.* (2013), Nirania *et al.* (2014) and Tuteja (2014) over standard check.

Five crosses over mid parent and one cross over standard check exhibited significant positive heterosis for number of bolls plant^{-1}. The best hybrid for the character identified was NDLH 1938 × RAH 1004, which exhibited 47.46 and 28.37heterosis per cent over mid parent and standard check, respectively. For boll weight the crosses L 770 × G COT 16 (48.15 and 34.09), NA1325 × MCU 5 (45.64 and 39.06) exhibited highest significant positive heterosis over mid parent and standard check, respectively. Similar results for significant positive heterosis on number of bolls plant^{-1} and boll weight were reported by Tuteja *et al.* (2013), Nirania *et al.* (2014) and Tuteja (2014).

For the character seed index, the crosses NA 1325 × HYPS 152 (64.38) over mid parent and L 788 × L 770 (42.17) over standard check exhibited the highest hetrosis. Fifteen crosses over mid and twenty eight crosses over standard check exhibited significant positive heterosis for lint index. The best cross identified for lint index was L 788 × L 604 which exhibited 33.45 and 51.55 heterisis percentage over mid parent and standard check respectively.

The hybrids RAH 1004 × MCU 5 (16.0 and 25.76) and L 770 × RAH 1004 (14.53 and 32.0) exhibited highest significant positive heterosis over mid parent and standard check, respectively for ginning out turn. These results are in conformity with the results of heterosis reported by Manish Kumar *et al*. (2013), Tuteja *et al*. (2013), Nirania *et al*. (2014) and Tuteja (2014).

With regards to fibre quality traits like 2.5% span length nine crosses over mid parent and fourteen crosses over standard check exhibited significant positive heterosis. The best hybrid identified for this trait was L 770× L 604 (10.94) over mid parent and over standard check was HYPS 152 × MCU 5 (16.91). Among forty five hybrids, the best crosses over mid parent and standard check identified for micronaire value were RAH 1004 × HYPS 152 (52.17 and 45.42) and RAH 1004 × G COT 16 (36.39 and 40.64) respectively . For bundle strength based on *per se* performance and standard heterosis the top hybrids noticed were L 604 × SURABHI (14.5 and 17.5) and SURABHI × HYPS 152 (11.55 and 17.39) as they exhibited highest significant positive heterosis over mid parent and standard check respectively.

The crosses L 604 × SURABHI (5.69) and NDLH 1938 × RAH 1004 (9.95) showed positive and significant heterosis for uniformity ratio over mid parent and standard check respectively. Based on the overall performance the top heterotic combinations identified for elongation were L 788 × L 604 (6.32) and NDLH 1938 × RAH 1004 (4.91), they showed positive and significant heterosis over mid parent and standard check respectively. The present results are in agreement with the heterosis for quality traits reported by Rajamani *et al.* (2009), Sandip Patil *et al.* (2012) and Deshmukh *et al.* (2014). The heterotic combinations RAH 1004 × G COT 16 (97.52) and NDLH 1938 × RAH 1004(69.43) showed significant positive heterosis for lint yield plant^{-1} over mid parent and standard check.

It could be concluded that, the cross combinations exhibited heterosis for seed cotton yield also showed high heterotic values for both or either of its component traits, number of bolls plant^{-1}, boll weight and lint yield plant^{-1}. The cross combinations NDLH 1938 × RAH 1004 and L 770 × G COT 16 showed the significant standard heterosis values for seed cotton yield and fibre quality component traits.

LITERATURE CITED

Table 1. Percentage heterosis over mid parent and check for no. of bolls plant^{-1}, boll weight, seed index, lint index, ginning out turn and 2.5 % span length of cotton hybrids at ARS, J M Puram during *kharif* 2013-14.

Hybrid	No. of bolls plant^{-1}		Boll weight		Seed index		Lint index		Ginning out turn		2.5 % span length	
	Mid	NCS-145	Mid	NCS-145	Mid	NCS-145	Mid	NCS-145	Mid	NCS-145	Mid	NCS-145
NDLH 1938 × L 788	-2.77	-2.4	-10.27*	0.92	7.08*	-7.14*	-17.33**	-20.84**	-27.37**	-10.72*	10.04**	11.51*
NDLH 1938 × L 770	**34.60****	**31.37****	**22.66****	**39.38****	-19.42**	-30.80**	-6.02*	1.01	**18.76****	28.89**	0.38	5.29
NDLH 1938 × NA 1325	10.45**	6.54*	3.84	16.97**	-7.24*	-15.82**	-5.86*	9.33*	1.14	19.38**	5.66	10.61*
NDLH 1938 × L 604	11.99**	13.94**	-0.74	15.82**	-15.64**	-25.26**	-13.62**	5.29	1.86	25.95**	**10.82****	**15.55****
NDLH 1938 × SURABHI	8.00**	15.47**	-6.81	-1.27	-23.16**	-36.67**	2.08	9.24*	4.82	25.60**	10.30**	8.51
NDLH 1938 × RAH 1004	12.60**	10.46**	-3.23	5.43	-13.64**	-18.91**	-3.36	3.78	7.91*	18.30**	-0.17	-0.89
NDLH 1938 × HYPS 152	0.88	11.98**	-6.04	2.42	-20.04**	-35.87**	-31.24**	-26.55**	-8.91**	11.32*	1.95	2.11
NDLH 1938 × MCU 5	-3.76	3.05	2.75	21.02**	-24.29**	-35.91**	-6.99*	-7.73*	10.40**	28.26**	-4.71	-0.07
NDLH 1938 × G COT 16	6.61*	8.93**	4.8	18.48**	-27.15**	-27.17**	-19.50**	-13.28**	7.14	13.17**	0.52	3.73
L 788 × L 770	8.69**	6.97*	3	18.94**	-1.83	-20.25**	21.83**	10.92**	7.63*	25.46**	-8.51*	-1.01
L 788 × NA 1325	12.21**	9.15**	0.55	15.13*	-12.94**	-25.03**	-13.19**	-13.45**	-12.02**	10.91*	-11.46**	-4.39
L 788 × L 604	-5.47*	-3.05	-0.54	17.90**	-49.45**	-57.56**	-67.65**	-65.88**	**-34.47****	**-13.70****	-9.42**	-2.56
L 788 × SURABHI	-10.21**	-3.27	-2.73	4.85	16.36**	-9.50**	25.60**	13.78**	-8.69**	16.73**	8.20*	10.02*
L 788 × RAH 1004	6.17*	5.01	22.36**	35.57**	15.29**	2.9	**56.21****	**42.10****	5.32	23.93**	7.54*	10.31*
L 788 × HYPS 152	-4.92	6.32	-3.75	6.7	20.66**	-8.83**	17.90**	6.55	-14.48**	11.39*	9.29*	13.06**
L 788 × MCU 5	-5.70*	1.74	6.95	27.94**	-21.86**	-37.47**	25.89**	4.2	12.76**	**40.06****	0.56	8.77
L 788 × G COT 16	9.15**	12.42**	11.06*	27.60**	-24.64**	-28.16**	5.48	-3.7	7.56*	22.25**	-7.38*	-1.37
L 770 × NA 1325	7.67*	1.74	-18.52**	-5.77	6.99*	-8.77**	-0.9	10.42**	1.96	13.85**	-8.75*	1.78
L 770 × L 604	-0.66	-0.87	-13.07**	4.04	11.72**	-7.14*	13.09**	32.52**	7.93*	26.59**	-0.66	10.39*
L 770 × SURABHI	-2.65	2.18	3.87	13.16*	**66.84****	28.35**	18.77**	21.51**	-15.51**	-4.15	-2.61	2.49
L 770 × RAH 1004	0.17	-3.7	3.15	15.47**	52.61**	**34.92****	13.83**	16.89**	-12.92**	-10.08*	-2.3	3.69
L 770 × HYPS 152	-14.49**	**-6.75***	14.85**	28.64**	60.73**	20.09**	33.33**	36.13**	-6.25	8.6	-4.44	2.26

Table 1 (cont…)

Hybrid	No. of bolls plant^{-1}		Boll weight		Seed index		Lint index		Ginning out turn		2.5 % span length	
	Mid	NCS-145	Mid	NCS-145	Mid	NCS-145	Mid	NCS-145	Mid	NCS-145	Mid	NCS-145
L 770 × MCU 5	-8.39**	-3.7	-2.58	17.67**	13.98**	-9.76**	16.85**	10.42**	4.48	14.73**	-10.71**	-0.25
L 770 × G COT 16	-0.87	-0.65	-1.39	14.43*	9.79**	3.73	12.07**	15.46**	8.33*	7.53	-7.18*	2.15
NA 1325 × L 604	3.59	2.18	-7.2	10.16	**-70.97****	**-74.46****	**-81.17****	**-76.30****	-21.84**	-0.9	-3.48	7.05
NA 1325 × SURABHI	1.99	5.88	22.03**	31.76**	44.34**	18.08**	21.39**	34.71**	-11.27**	9.09*	3.26	8.45
NA 1325 × RAH 1004	2.52	-2.61	0.94	12.01*	-3.67	-10.14**	-9.89**	0.34	-4.22	8.01	-4.26	1.42
NA 1325 × HYPS 152	-9.74**	-2.61	6.4	18.13**	20.91**	-3.76	12.22**	24.29**	-5.24	18.77**	-1.08	5.65
NA 1325 × MCU 5	0.37	4.36	12.29**	34.53**	5.88	-11.00**	-4.28	-1.26	-9.94**	7.46	-4.66	6.32
NA 1325 × G COT 16	5.99*	5.01	0.95	16.17**	4.88	4.21	-10.76**	-0.34	-11.05**	-3.25	-9.61**	-0.71
L 604 × SURABHI	-8.84**	-0.54	8.66	21.71**	13.65**	-9.47**	4.46	21.93**	-5.06	22.06**	-3.03	1.44
L 604 × RAH 1004	8.64**	8.93**	15.76**	33.14**	-16.41**	-23.82**	-43.88**	-34.29**	-23.71**	-9.69*	-10.78**	-5.87
L 604 × HYPS 152	-11.07**	0.65	1.05	16.28**	10.85**	-14.16**	-23.76**	-11.18**	-21.74**	2.49	-2.58	3.64
L 604 × MCU 5	-4.69	4.14	-20.75**	-1.85	-25.13**	-38.68**	-32.56**	-26.55**	-8.84**	13.89**	-11.25**	-1.4
L 604 × G COT 16	-2.71	1.53	**-28.94****	**-15.36***	-20.88**	-23.09**	-12.13**	3.19	6.67	22.01**	-11.96**	-3.67
SURABHI × RAH 1004	4.75	10.46**	4.98	9.47	-63.85**	-69.29**	-54.05**	-53.03**	18.64**	35.90**	2.43	2.04
SURABHI × HYPS 152	-9.25**	7.41*	9.57	14.32*	-22.80**	-44.99**	-11.86**	-10.42**	8.86**	38.39**	1.05	1.55
SURABHI × MCU 5	-13.66**	-1.2	-2.81	9.93	18.05**	-10.62**	14.39**	7.56*	-6.32	13.44**	2.15	7.47
SURABHI × G COT 16	-3.53	5.66	-8.15	-0.46	-19.11**	-26.37**	-21.84**	-19.83**	-3.64	6.52	0.54	4.09
RAH 1004 × HYPS 152	-11.09**	-2.61	-8.23	-1.5	-10.12**	-25.64**	-15.98**	-14.29**	-5.29	10.75*	7.2	8.69
RAH 1004 × MCU 5	-8.41**	-3.27	-0.25	15.82**	-6.45*	-18.43**	5.74	-0.17	3.62	14.92**	-14.06**	-8.82
RAH 1004 × G COT 16	1.24	1.96	-5.03	5.77	-30.72**	-28.99**	-20.73**	-18.40**	10.13*	10.52*	6.85	11.58**
HYPS 152 × MCU 5	**-15.99****	-0.44	-3.78	11.78	-32.49**	-50.38**	-31.12**	-35.38**	-2.12	20.87**	-0.77	6.16
HYPS 152 × G COT 16	-13.52**	-1.74	-0.73	10.62	-48.51**	-54.27**	-39.66**	-38.24**	9.70**	23.89**	**-17.07****	**-12.67****
MCU 5 × G COT 16	-7.05**	1.96	-2.69	16.97**	2.56	-4.34	11.75**	5.88	0.24	7.17	-8.97*	0.16

** Significant at 1% level * Significant at 5% level

Table 2. Percentage heterosis over mid parent and check for micronaire value, bundle strength, uniformity ratio, elongation, seed cotton yield plant^{-1} and lint cotton yield plant^{-1} of cotton hybrids at ARS, J M Puram during *kharif* 2013-14.

Hybrid	Micronaire value		Bundle strength		Uniformity ratio		Elongation		Seed cotton yield plant^{-1}		Lint yield plant^{-1}	
	Mid	NCS-145	Mid	NCS-145	Mid	NCS-145	Mid	NCS-145	Mid	NCS-145	Mid	NCS-145
NDLH 1938 × L 788	-13.08**	-1	11.82**	4.51	-0.38	-3.01	0.13	-0.45	-10.55	-1.31	-31.64**	**-9.95**
NDLH 1938 × L 770	-11.08**	-1.54	0.84	-3.35	0.77	-1.91	-2.5	-1.62	**55.48****	**68.68****	**82.87****	**112.39****
NDLH 1938 × NA 1325	-7.43*	-6.34	2.48	-2.75	-2.4	**-5.74***	-0.6	-2.91	12.73	20.17*	14.25*	9.94**
NDLH 1938 × L 604	-7.22*	0.63	**13.34****	4.32	1.36	-2.78	5.19	2.26	6.94	26.88**	8.11	5.01**
NDLH 1938 × SURABHI	11.93**	21.56**	7.2	0.52	0.73	0.17	1.74	4.07	1.27	12.08	18.00**	52.36**
NDLH 1938 × RAH 1004	23.65**	33.33**	-1.32	-2.99	3.51	1.67	3.53	**4.27**	7.87	13.75	15.27*	31.25**
NDLH 1938 × HYPS 152	-5.88*	12.32**	0.23	-7.63	4.86*	2.42	0.48	1.87	-3.94	12.59	-11.78*	23.47**
NDLH 1938 × MCU 5	8.58**	20.38**	-7.01*	-9.63*	-0.83	-5.05*	-2.82	-0.97	-1.7	19.75	6.83	48.21**
NDLH 1938 × G COT 16	-6.81*	4.17	4.25	-1.26	1.36	-0.77	2.32	2.84	9.76	23.67*	16.97*	37.36**
L 788 × L 770	17.19**	24.73**	-9.01**	-10.33**	3.01	1.11	1.24	0.32	10.57	22.51*	17.99**	49.23**
L 788 × NA 1325	35.48**	31.25**	-7.10*	-9.33*	**7.97****	**5.16***	**6.68***	2.26	11.26	21.17*	-0.06	32.74**
L 788 × L 604	2.09	6.34	-3.44	-8.51*	3.47	0.09	1.69	-2.97	-8.13	11.12	**-36.18****	-1.9
L 788 × SURABHI	16.46**	21.47**	7.51*	3.71	**-5.96****	-5.71*	-5.31*	-4.85	-10.85	0.73	-17.92*	14.46
L 788 × RAH 1004	-2.89	0.54	5.64	6.71	-3.45	-4.38	-0.59	-1.68	24.43**	34.09**	30.14**	61.63**
L 788 × HYPS 152	-15.12**	-2.36	3.19	-2.1	2.94	1.39	-2.11	-2.52	-7.08	11.05	-19.17**	21.48*
L 788 × MCU 5	11.86**	19.20**	-3.15	-3.26	-2.15	-5.51*	-1.39	-1.29	0.12	24.27*	11.75*	66.59**
L 788 × G COT 16	8.22*	16.30**	0.26	-2.33	3.09	1.77	2.55	1.23	17.73*	35.38**	26.41**	61.53**
L 770 × NA 1325	20.35**	12.77**	-5.72	-5.74	2.05	-0.62	-2.32	-4.91	-9.37	-2.97	-7.97	7.89
L 770 × L 604	8.52*	9.60*	0.73	-2.16	0.33	-2.97	4	0.78	-13.76	2.72	-9.44	25.09**
L 770 × SURABHI	15.45**	16.76**	-7.97*	-9.03*	0.43	0.68	-4.98*	-3.1	1.48	12.8	-12.41*	8.5
L 770 × RAH 1004	11.37**	11.78**	-9.97**	-6.91	-4.21*	-5.15*	-1.8	-1.42	2.49	8.56	-8.59	-0.72
L 770 × HYPS 152	-2.51	9.06*	-3.63	-6.28	-1.28	-2.78	1.31	2.39	-1.92	15.42	-8.16	23.72**

Table 2 (cont…)

Hybrid	Micronaire value		Bundle strength		Uniformity ratio		Elongation		Seed cotton yield plant^{-1}		Lint yield plant^{-1}	
	Mid	NCS-145	Mid	NCS-145	Mid	NCS-145	Mid	NCS-145	Mid	NCS-145	Mid	NCS-145
L 770 × MCU 5	34.38**	**38.95****	-12.22**	-10.23**	-0.57	-4	1.88	3.49	-9.81	10.3	-7.21	23.86**
L 770 × G COT 16	-13.24**	-9.51*	10.09**	**9.87***	0.04	-1.26	1.1	1.29	-2	10.89	4.98	17.78*
NA 1325 × L 604	18.87**	8.70*	0.11	-3.71	0.25	-3.8	2.83	-3.68	-5.99	10.19	-24.18**	9.54
NA 1325 × SURABHI	34.22**	22.92**	-2.26	-4.31	-5.11*	-5.59*	0.69	-0.58	20.74**	31.91**	9.09	42.05**
NA 1325 × RAH 1004	**41.65****	28.62**	-10.40**	-8.20*	1.08	-0.68	1.26	-1.62	3.05	7.2	-0.5	14.38
NA 1325 × HYPS 152	7.13*	9.60*	1	-2.73	1.7	-0.62	0.89	-1.29	-3.23	12.04	-8.3	29.35**
NA 1325 × MCU 5	20.75**	13.32**	-0.93	0.39	1.74	-2.55	0.1	-1.55	10.05	32.49**	0.68	40.78**
NA 1325 × G COT 16	18.36**	12.14**	-0.83	-1.96	0.77	-1.31	2	-1.1	5.98	17.9	-3.43	14.46
L 604 × SURABHI	28.08**	26.63**	0.77	-4.22	0.39	-0.79	2.2	0.45	-3.64	16.88	-8.21	38.70**
L 604 × RAH 1004	39.52**	36.87**	-4.64	-5.02	5.78**	3.23	3.07	-0.32	17.61*	36.51**	-8.22	24.68**
L 604 × HYPS 152	1.49	11.23**	8.80*	1.67	3.86	0.79	4.02	1.29	-11.05	13.71	-28.44**	15.89
L 604 × MCU 5	**-28.53****	**-27.72****	-4.26	-5.72	4.46*	-0.63	-5.51*	**-7.50***	-22.83**	2.2	-29.09**	13.97
L 604 × G COT 16	11.94**	14.22**	-3.08	-6.95	1.16	-1.6	3.22	-0.39	**-27.84****	**-11.03**	-25.04**	4.52
SURABHI × RAH 1004	-10.28**	-11.87**	-1.48	-0.19	-3.79	-2.7	0.92	2.71	8.67	17.48	26.67**	54.01**
SURABHI × HYPS 152	-27.53**	-20.47**	0.89	-3.98	-3.42	-2.85	-4.48	-2.13	-1.18	18.45	6.39	57.12**
SURABHI × MCU 5	-12.79**	-11.68**	-1.56	-1.37	0.67	-0.68	-2.95	-0.06	-14.15*	6.86	-18.71**	19.06*
SURABHI × G COT 16	-18.97**	-17.21**	-1.85	-4.09	-3.71	-2.93	-5.50*	-4.01	-9.41	4.48	-11.95	10.21
RAH 1004 × HYPS 152	-13.38**	-5.62	-4.87	-5.14	1.14	0.49	0.74	1.62	-15.76*	-3.43	-20.70**	5.02
RAH 1004 × MCU 5	12.12**	12.68**	-10.86**	-6.64	2.03	-0.6	1.05	2.46	-8.27	9.38	-6.14	23.14**
RAH 1004 × G COT 16	-17.20**	-16.03**	-2.57	-0.36	1.96	1.54	-0.65	-0.65	-3.33	6.44	5.03	15.44
HYPS 152 × MCU 5	-24.38**	-15.31**	-4.09	-5.44	-1.16	-4.24	**-5.70***	-3.75	-16.80*	9	-18.63**	28.00**
HYPS 152 × G COT 16	-7.90**	3.99	**-17.40****	**-20.61****	0.68	-0.29	-5.55*	-4.91	-12.49	6.64	-6.07	27.75**
MCU 5 × G COT 16	11.45**	16.39**	-10.55**	-9.53*	6.29**	3.22	-0.8	0.39	-8.65	15.54	-9.27	22.29*

** Significant at 1% level * Significant at 5% level

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