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Estimation of Heritability for Seed Cotton Yield in Cotton Based on Regression Approach

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Main focus of this study was to calculate the heritability for seed cotton yield based on regression approach by utilising the ten F_5 and ten F_6 lines of two populations derived from a heterotic box. Ten F_6 lines of RSG group derived from (DSMR-10 X DSG-3-5) cross were regressed over same F_5 lines for seed cotton yield. Similar procedure was done for lines of RGR group (DRGR-32-100 X DRGR-24-178) cross. By utilising the regression value heritability of seed cotton yield was calculated as suggested by Smith and Kinman, 1965. The narrow sense heritability for RSG group and RGR group lines was 24.90 and 21.21 *per cent*. Broad sense heritability was also calculated based on RBD analysis separately for RSG and RGR group lines.

Keywords: Consistency of combining ability, heritability, RSG group and RGR group.

Cotton is an important commercial crop grown for its fibre. Seed cotton yield determines the commercial value of cotton and the heritability value plays a key role in determining selection strategy for improvement. Apart from establishing half sib and full sib relations for determining components of variance and determining heritability of the trait, it is also possible to use information on consecutive generations to work out regression value for a trait and estimate heritability for a trait (Smith and Kinman, 1965 and Salimath and Patil, 1990). There are very limited studies focusing on determining heritability of yield *per se* based on regression approach. In this study F_5 and F_6 populations of a heterotic box representing opposite heterotic groups subjected to reciprocal selection were utilized.

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MATERIALS AND METHODS

For determining heritability of yield *per se* F_5 and F_6 lines developed through reciprocal selection in cotton of a heterotic box involving elite lines of robust/stay green group (RSG) and RGR (high relative growth rate) were used. This heterotic box comprises of DSMR-10 line (of stay green group), DSG-3-5 line (of robust group) and two DRGR-32-100 and DRGR-24-178 lines (of RGR group). These lines were crossed (DSMR-10 X DSG-3-5) (DRGR-32-100 X DRGR-24-178) two give two F_1. Resulting F_1s were advanced to the F_4 and F_5 generation where recombinational variability for combining ability was evaluated. Here, regression of ten parental lines of F_6 generation over F_5 generation was carried out to determine the heritability of yield *per se*.

Regression Approach

The seed cotton yield values of F_5 and F_6 lines were utilized for determining regression values

i.e., (b_{F6F5}). Heritability (h^2_{NS}) of yield *per se* was calculated based on regression approach given by Smith and Kinman, (1965).

$h^2 = (b / 2r_{XY})$

where, h^2 = Narrow sense heritability

b = Regression coefficient

r_{XY} = Coefficient of parentage [which works out to be (31/32) for this situation]

The mean seed cotton yield of lines was used for regression of F_6 lines over F_5 lines, finally giving the regression value ($b_{F6:F5}$). The regression value ($b_{F6:F5}$) was divided with the coefficient of parentage (31/32) depending upon the generations of the lines used in the analysis.

The set of F_5 and F_6 lines were evaluated in replicated block design and MSS values in the ANOVA for genotypes and error component were utilised in determining broad sense heritability ($h^2 = V_g/V_p$).

RESULTS AND DISCUSSION

Regression of seed cotton yield of F_6 lines over F_5 lines were carried out for RSG and RGR group, ANOVA of regression coefficient was presented in table 1 (a) and 1(b) respectively.

The regression value ($b_{F6:F5}$) for the lines derived from (DSMR-10 x DSG-3-5) cross was (0.48) (Tab.2). Narrow sense heritability (h^2_{NS}) for yield *per se* of the lines derived from (DSMR-10 x DSG-3-5) cross observed was 24.90 *per cent*. The regression value ($b_{F6:F5}$) for the lines derived from (DRGR-24-178 x DRGR-32-100) cross was (0.41) (Tab.3). The heritability (h^2_{NS}) for the lines derived from (DRGR-24-178 x DRGR-32-100) cross observed was 21.21 *per cent*. Cahaner and Hillet (1980), Salimath and Patil (1990) and Sunderman *et al.* (1965) have also reported similar low narrow sense heritability values in different crops.

Broad sense heritability was estimated from the ANOVA of RBD obtained for RSG group (DSMR-10 x DSG-3-5) cross was 76.30 *per cent* and RGR group (DRGR-24-178 x DRGR-32-100) cross was 90.00 *per cent*. Comparison of broad sense heritability obtained by RBD analysis and narrow sense heritability obtained by regression approach has been shown in tab. 4. In earlier studies wide range of broad sense heritability values were obtained for seed cotton yield by Naveed *et al.*, 2004 (33 %), Aziz *et al.*, 2006 (74.10 %), Desalegn *et al.*, 2009 (44 %), Alkuddsi *et al*., 2013 (43.74 %), Reddy *et al*., 2014 (80 %), Singh *et al*., 2014 (78.55 %) and Ambedkar , 2015, (89.10 %).

Yield *per se* is a trait which is highly influenced by environment. In this study, narrow sense heritability for RSG and RGR groups of lines

Table 1(a). Analysis of variance for regression coefficient of RSG group lines

Model	Unstandardized Coefficients		Standardized Coefficients	't' value	Significance
	B	Std. Error	Beta		
(Constant)	1087.96	611.05		1.78	0.11
F_5	0.48**	0.37	0.41	1.27	0.24

a. Dependent variable F_6

Table 1(b). Analysis of variance for regression coefficient of RGR group lines

Model	Unstandardized Coefficients		Standardized Coefficients	't' value	Significance
	B	Std. Error	Beta		
(Constant)	1065.38	326.73		3.26	0.01
F_5	0.41**	0.20	0.58	2.04	0.07

a. Dependent variable F_6

was 24.90 and 21.21 *per cent* respectively. In present study considerable difference was obtained between broad sense heritability and narrow sense heritability values indicating role of both additive and non additive gene action. This is an indication that genotypic values for yield are determined by both breeding value and dominance deviation. (Falconer, 1981).

Table 2. Regression of F6 lines over F5 lines of RSG group (DSMR-10 x DSG-3-5) cross for heritability of per se yield

Sl. No.	F_5 lines	Seed cotton yield (kg ha^{-1})	F_6 lines	Seed cotton yield (kg ha^{-1})
1	RSG F_5 1	1620.47	RSG F_6 1	2128.48
2	RSG F_5 2	1804.54	RSG F_6 2	2760.77
3	RSG F_5 3	1984.95	RSG F_6 3	2097.22
4	RSG F_5 4	1891.55	RSG F_6 4	1381.96
5	RSG F_5 5	1445.01	RSG F_6 5	1552.09
6	RSG F_5 6	957.97	RSG F_6 6	1741.90
7	RSG F_5 7	1394.35	RSG F_6 7	1320.61
8	RSG F_5 8	998.85	RSG F_6 8	1579.86
9	RSG F_5 9	1814.59	RSG F_6 9	1894.54
10	RSG F_5 10	1826.13	RSG F_6 10	2003.47
Regression of *per se* yield of F_6 lines over F_5 lines (b) = 0.48				
Heritability (h^2_{NS}) of *per se* yield = 24.90 %				

Table 3. Regression of F_6 lines over F_5 lines of RGR group (DRGR-24-178 x DRGR-32-100) cross for heritability of *per se* yield

Sl. No.	F_5 lines	Seed cotton yield (kg ha^{-1})	F_6 lines	Seed cotton yield (kg ha^{-1})
1	RGR F_5 1	804.74	RGR F_6 1	1728.50
2	RGR F_5 2	1008.10	RGR F_6 2	1263.68
3	RGR F_5 3	1458.35	RGR F_6 3	1406.25
4	RGR F_5 4	1690.70	RGR F_6 4	1748.62
5	RGR F_5 5	1936.06	RGR F_6 5	1763.90
6	RGR F_5 6	1575.23	RGR F_6 6	1499.20
7	RGR F_5 7	1896.99	RGR F_6 7	1899.55
8	RGR F_5 8	1880.95	RGR F_6 8	1664.13
9	RGR F_5 9	2094.94	RGR F_6 9	2332.23
10	RGR F_5 10	1385.85	RGR F_6 10	1819.01
Regression of *per se* yield of F_6 lines over F_5 lines (b) = 0.41				
Heritability (h^2_{NS}) of *per se* yield = 21.21 %				

Table 4. Comparison of broad sense heritability obtained by RBD analysis and narrow sense heritability obtained by Regression approach

Sl. No.	Cross name	Broad sense heritability (%)	Narrow sense heritability (%)
1.	RSG group (DSMR-10 x DSG-3-5)	76.30	24.90
2.	RGR group (DRGR-24-178 x DRGR-32-100)	90.00	21.21

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