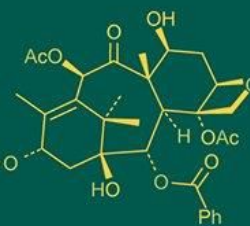
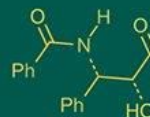
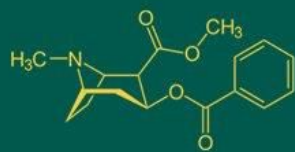


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Genetic variability studies in American cotton (*Gossypium hirsutum* L.)

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Abstract

Thirty genotypes of American cotton (*Gossypium hirsutum* L.) were studied the genetic variability, heritability and genetic advance for twelve yield contributing traits at Cotton Research Unit, Dr. PDKV, Akola (MS). Analysis of variance revealed significant magnitude of variation among thirty genotypes collected from major cotton growing regions of country. Phenotypic coefficients of variation (PCV) were higher in magnitude than genotypic coefficients of variation (GCV) for all twelve traits, high values of GCV and PCV were observed for traits viz., number of monopodial branches per plant, number of sympodial branches per plant, number of bolls per plant and lint yield per plant. The estimates of ECV indicated the numbers of monopodial and sympodial branches per plant are highly influenced by environmental factors so the selection for these traits will not be effective. The high heritability (*broad sense*) were estimated in traits viz., plant height, days to 50 per cent flowering, days to 50 per cent boll bursting, number of bolls per plant, lint index, lint yield per plant and ginning outturn indicating predominance of additive gene action and hence simple selection would effective for improvement of these traits. The cultivar AKH 08-3 found to be best performer for seed cotton yield and number of bolls.

Keywords: Cotton, genetic variability, GCV, PCV, ECV, heritability and *Gossypium hirsutum*

Introduction

The cotton being a king of fibres is shrub having soft, fluffy staple fiber that grows in a boll/ protective case, around the seeds of plants belonging to genus *Gossypium* in the mallow family *Malvaceae*. Globally, cotton is native to tropical and subtropical regions including the Americas, Africa, Egypt and India. The greatest diversity of wild cotton species is found in Mexico, followed by Australia and Africa. Cotton is reported to be independently domesticated in the Old and New Worlds. The archeological evidences have found cotton fabric fragments dating back some eight hundred years in the Indus Valley. The art of making cotton fabrics began in India and spread throughout the Old World. As long ago as 445 BC, the Greek historian Herodotus wrote of India "There are trees growing wild that produce better, finer wool than sheep".

Although the India has achieved self-sufficiency in seed cotton production, the area under cotton cultivation is decreases day by day due to increased input investment and also the productivity of cotton in India is very low compared to global average. Hence, it is essential to develop a new high yielding cultivars of cotton with good fibre quality parameters to improve the production level of white gold. Genetic variability of character within a population is the proportion of observable differences in a character between cultivar within a population that is due to result of their differences at genetic level. The factors including genetic constitution, environment conditions and random chance may all responsible for the variation between cultivars/genotypes in their observable characteristics. The heritability measures the fraction of the variability due to phenotype that can be attributed to genetic variation. The hereditary parent-hood of genepool plays important role in crop improvement. In breeding program for development of high yielding varieties of cotton, genetic information regarding various yield and yield contributing characters including fibre quality aspect is very helpful for breeders to improve genetic architecture of the cotton crop in a desired objectives, including higher production levels (Nadeem and Azhar, 2004; Ali & Khan, 2007, Abbas *et al.*, 2008 and Vaibhav Ujjainkar, 2022) [13, 3, 1, 22].

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The seed cotton yield is a complex polygenic character which is final product resulting from the interaction of various yield attributing characters including plant geometry aspects and yield factors of crop. For judicious improvement of cotton yield, the knowledge of relationship of component traits with yield is very important for purpose of effective selection and subsequent improvement of most yield contributing characters. Selection changes the genetic structure of population due to preservation of superior alleles and discarding the undesirable alleles (Budak *et al.*, 2004) [5]. Cotton improvement through practicing the selection therefore will more depend on exploration and creation of variability at genetic level. The superior cultivars resulting from the recombination of better performing or superior allelomorphs at different loci are then precisely selected at different breeding stage. The selection is based merely on phenotypic/morphological expressions, may often misleading because of the influential role of environmental conditions. Hence, the estimates of variability at genotypic, phenotypic and subsequently at environmental level is of great importance in the effective selection of germplasm, which are measured by their coefficients i.e. GCV, PCV and ECV. Moreover, the genotypic coefficient of variation (GCV) does not give an precise conclusions regarding the total heritable variations in population. The relative amount of heritable variation could be assessed by heritability that's why the proportion of phenotypic variance attributable to genetic variance i.e. heritability will have to be estimated for adding precision (Magadam *et al.*, 2012 and Ujjainkar & More, 2023) [12, 22]. Keeping the above facts in view, the study was planned with thirty cultivars of cotton to estimate genetic variability parameters and heritability among cotton cultivars.

Materials and Methods

The experimental material comprised of thirty improved *G.hirsutum* cultivars received from various research units under AICRP on Cotton, which were raised in a Randomized Block Design with three replications as per the

recommended package and practices for healthy plant stand at Cotton Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (MS). Data were recorded for twelve yield and yield contributing characters viz., plant height, days to 50 per cent flowering, days to 50 per cent boll bursting, number of monopodia and sympodial branches per plant, number of bolls per plant, boll weight, seed index, lint index, single plant seed cotton yield, lint yield and ginning outturn.

The means for twelve yield and yield contributing parameters were worked out and subjected for analysis of variance (ANOVA) according to statistical procedure of Falconer (1967) [9]. The genotypic, phenotypic and environmental coefficients of variation (GCV, PCV and ECV) along with magnitude of heritability (h^2) in the broad sense were calculated as per method given by Falconer (1981) [10] and Allard (1960) respectively, while the genetic advance was estimated as per procedure given by Burton (1952) [6].

Results and Discussion

The higher extend of variability in the initial germplasm assures the better opportunities of producing desirable forms of the potent cultivars. Hence, the foremost objective of germplasm conservation is to explorer, collect and conserve the genetic variability in indigenous collection of crop species to make it available for current and future generations in their crop improvement endeavors. The analysis of variance (Table. 1) revealed significant differences among the thirty cultivars for all the twelve important yield and yield contributing characters studied indicating that the data generated from the above diverse material will provide reliable information. The results pertaining to genetic parameters viz., phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), broad sense heritability (h^2) and genetic advance as percent of mean for all the twelve characters are furnished in Table 2.

Table 1: Analysis of variance for twelve yield and yield components traits in cotton

Characters	Source of Variation		
	Replication (df-2)	Cultivars (df-29)	Error (df-58)
Plant Height (cm)	4.58	168.35**	11.05
Days to 50% Flowering	0.71	26.18**	2.85
Days to 50% Ball Bursting	6.43	27.67**	2.81
No of Monopodial branches per plant	0.05	0.25**	0.08
No of Sympodial branches per plant	1.94	9.74**	3.49
No of bolls per plant	4.72	37.27**	1.67
Boll weight (g)	0.02	0.15*	0.08
Seed Index (g)	1.48	0.86**	0.28
Lint Index	0.30	0.48**	0.09
Seed Cotton Yield per plant (g)	1.80	8.42**	2.68
Lint Yield per plant (g)	0.18	1.33**	0.31
Ginning Outturn (%)	0.33	8.60**	0.60

*, ** significant at 5% and 1% of level of significance.

The plant height recorded a mean value of 85.63 cm and it ranges between 69.56 cm and 105.33 cm. The phenotypic, genotypic and environmental coefficient of variation were found to be 9.30, 8.46 and 3.88 respectively. The days to 50 per cent flowering ranges from 63.33 to 72.67 days with a mean of 68.42 days. The phenotypic, genotypic and environmental coefficients of variability for this character were estimated at 4.76, 4.08 and 2.47 respectively. The

mean, range, phenotypic coefficient of variation, genotypic coefficient of variation and environmental coefficient of variation for number of days to 50 per boll bursting were found to be 123.17 days, 118-128 days, 2.70, 2.34, and 1.36 respectively. Number of monopodial and sympodial branches per plant recorded a mean value of 1.52 and 13.78 respectively. Their phenotypic, genotypic and environmental coefficient of variation were also estimated

as 24.54, 17.13 (PCV), 15.67, 10.47 (GCV) and 18.88, 13.56 (ECV) respectively. The important yield contributing traits *viz.*, number of bolls per plant and boll weight recorded a mean value of 20.83 and 2.48 g respectively, while the range observed was 20.64-24.67 and 2.03-3.03 g respectively. Their phenotypic, genotypic and environmental coefficient of variation were also estimated as 17.67, 12.48 (PCV), 16.54, 6.07 (GCV) and 6.20, 11.25 (ECV) respectively. The phenotypic, genotypic and environmental coefficients of variations of 9.58, 12.06 (PCV), 6.09, 9.17 (GCV) and 11.25, 7.39 (ECV) were estimated for seed index and lint index character, which exhibited the range of 5.93-8.10 g, 2.95-4.53 and mean of 7.20, 3.90 respectively.

The yield traits *viz.*, seed cotton yield per plant and lint yield per plant exhibited the range of 12.60-20.03 g and 4.18-7.18 g whereas, the mean recorded were 15.60 g and 5.47 g respectively. The PCV, GCV and ECV recorded were 13.74, 8.86, 10.50 (Seed cotton yield) and 14.69, 10.66, 10.11 (Lint yield) respectively. The important traits from textile industry point of view i.e. ginning outturn exhibited the mean of 35.08 per cent with range of 32.00-37.33 per cent. The phenotypic, genotypic and environmental coefficients of variations of 5.15, 4.66 and 2.21 were estimated for ginning

outturn character. In present investigation, the influence of environmental factors was profoundly observed in all the characters since, phenotypic coefficient of variations (PCV) values were found to be higher in magnitude than those of corresponding genetic coefficient of variations (GCV) as depicted in Table 2 and Fig.1. These findings having the agreement with the findings of Sakthi *et al.* (2007) [18], Tomar *et al.*, (1992) [20], Venkatesan (2008) [24] and Gnanasekaran *et al.* (2018). The high to moderate estimates of PCV and GCV in traits *viz.*, number of monopodial branches per plant, number of sympodial branches per plant, number of bolls per plant, seed cotton yield and lint yield per plant may be subjected to selection as these characters may respond to rigorous selection within available material to achieve the goal of breeding program. The remaining characters *viz.*, period for flowering, boll bursting, seed index, lint index and ginning outturn exhibited low range of PCV and GCV indicating the lower magnitude of variation/diversity for these traits in available genotypes used in present investigation. The similar kind of results were reported by Dheva and Potdukhe (2002) [8], Preetha and Raveendran (2007) [15], Venkateswaralu *et al.* (2010) [25], Gnanasekaran *et al.* (2018) [11], Sri Subalakhshmi *et al.* (2022) [19] and Rani Chapra *et al.*, (2023) [16].

Table 2: Genetic components of variance for twelve quantitative traits in cotton

Characters	Range		Mean	GCV	PCV	ECV	h ² (b) %	GA
	Min	Max						
Plant Height (cm)	69.56	105.33	85.63	8.46	9.30	3.88	82.59	13.56
Days to 50% Flowering	63.33	72.67	68.42	4.08	4.76	2.47	73.19	4.91
Days to 50% Ball Bursting	118.00	128.00	123.17	2.34	2.70	1.36	74.66	5.12
No of Monopodial branches per plant	0.89	2.22	1.52	15.67	24.54	18.88	40.77	0.31
No of Sympodial branches per plant	10.67	17.33	13.78	10.47	17.13	13.56	37.37	1.82
No of bolls per plant	20.64	24.67	20.83	16.54	17.67	6.20	87.67	6.64
Boll weight (g)	2.03	3.03	2.48	6.07	12.78	11.25	22.57	0.15
Seed Index (g)	5.93	8.10	7.20	6.09	9.58	7.39	40.39	0.57
Lint Index	2.95	4.53	3.90	9.17	12.06	7.83	57.84	0.56
Seed Cotton Yield per plant (g)	12.60	20.03	15.60	8.86	13.74	10.50	41.61	1.84
Lint Yield per plant (g)	4.18	7.18	5.47	10.66	14.69	10.11	52.66	0.87
Ginning Outturn (%)	32.00	37.33	35.08	4.66	5.15	2.21	81.56	3.04

Heritability is an important component of genetic analysis of available germplasm to provide guidelines for executing trait based selection in breeding program. The estimates of heritability supplemented with the genetic advance provides an idea about the gene action involved in the expression of various polygenic traits especially quantitative traits and provides a reliable criterion in decision during selection program. The higher magnitude of heritability (h²) in broad sense was recorded in traits *viz.*, number of bolls per plant (87.67%) followed by plant height (82.59%), ginning outturn (81.56%), days to 50 per cent boll bursting (74.66%) and days to 50 per cent flowering (73.19%) as depicted in Table 2 and Fig.2. The high heritability coupled with high

genetic advance (as % mean) was observed for characters plant height (82.59%, 13.56), days to 50 per cent flowering (73.19%, 4.91), days to 50 per cent boll bursting (74.66%, 5.12), number of bolls per plant (87.67%, 6.64) rendering the probability of selecting cultivars for these characters which would behave with fidelity. Similar kind of findings are reported by Abbas *et al.* (2013) [2], Vinodhana *et al.* (2013) [26], Dahiphale *et al.* (2015) [7] and Reddy *et al.* (2015) [17] and Patil *et al.* (2011) [14]. Such kind of observations regarding heritability and genetic advance indicates the effect of non-additive gene action and hence heterosis breeding may be rewarding for these traits.

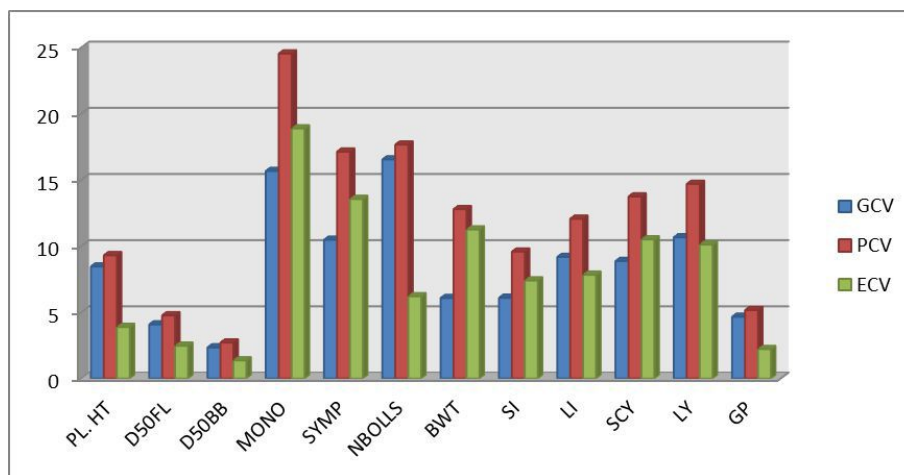


Fig 1: GCV, PCV and ECV estimates for twelve quantitative traits

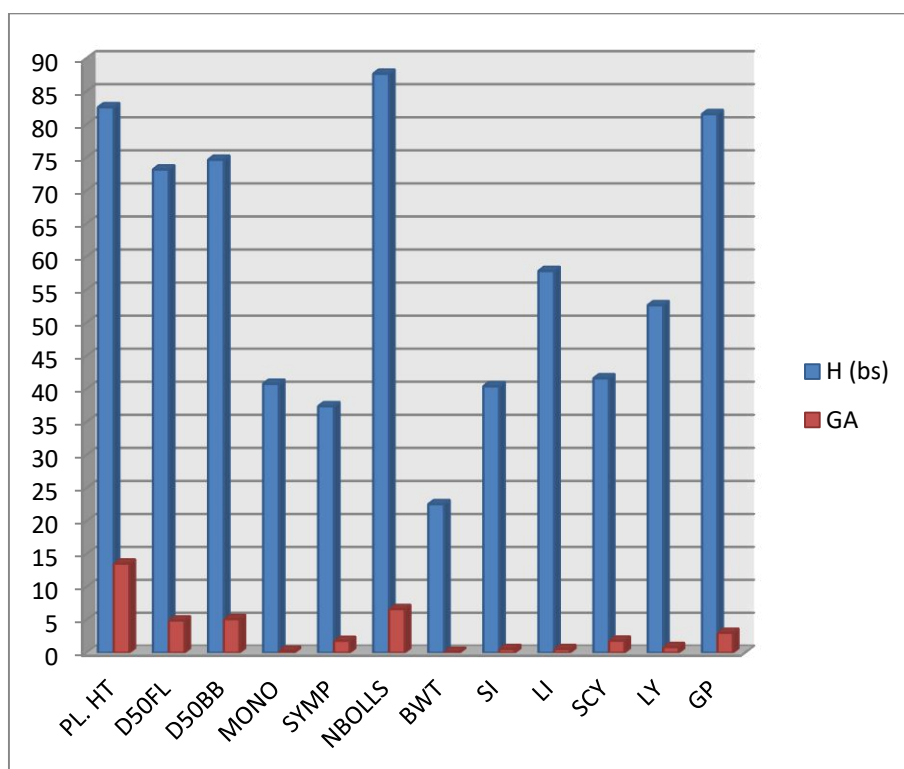


Fig 2: Heritability (h^2) and Genetic Advance estimates for twelve quantitative traits

Conclusion

In the present study, it may be concluded that the analysis of variance highly significant differences between thirty cultivars for the twelve yield and yield parameters indicated the presence of substantial genetic variation. High heritability coupled with high genetic advance for the characters *viz.*, plant height, days to 50 per cent flowering, days to 50 per cent boll bursting, number of bolls per plant rendering the probability of selecting genotypes for these traits which would behave with fidelity being the preponderance of additive gene action in the inheritance of these traits. Whereas, cultivars AKH 08-3, GTHV 13/17, BS 3, GBHV 183 and AKH 08-8 are potent cultivar for characters under investigation which can be included in breeding program.

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