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Analysis of the Performance, Variability and nature of Redgram [*Cajanus cajan* (L.) Mill sp.] Productive Traits in Rainfed alfisols of Andhra Pradesh

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ABSTRACT: Investigation was undertaken during *kharif* 2022 at Agricultural Research Station, Ananthapuramu to analyse sixteen genotypes of Redgram (*Cajanus cajan* L.). The primary focus of the research revolved around conducting correlation studies and examining genetic diversity in seed yield and its associated characteristics. Significant variability was noted in all the parts being inspected. The coefficients of variation for productivity metrics, including seed yield, number of pods/ plant, number of branches / plant and 100 seed weight, were notably high. Considerable variation was seen in the days to 50% blooming, plant height, pod length and number of seeds / pod. The inquiry found that the evaluated qualities showed substantial heritability and a considerable expected genetic advancement. The independent variables, which included plant height, number of branches / plant and number of pods/ plant had a strong positive correlation with the dependent variable, seed yield. Plant height, days to 50% blooming and 100-seed weight were shown to have the most significant direct impact on seed yield, according to an examination of correlation coefficients among several characteristics impacting seed yield.

Keywords: Genetic Variability, Character Association, Path Analysis, Redgram, Seed yield.

INTRODUCTION

Redgram (*Cajanus cajan* (L.) Millsp.) is one of India's most economically valuable pulse crop. This crop is unique due to its provision of high-quality protein, an essential constituent of our daily dietary requirements. Given its multifarious uses as a fuel, animal feed, and food source, it is imperative to incorporate it into a balanced diet, which aids in alleviating poverty (Rao *et al.,* 2002). This crop is essential for rainfed and dry-land farming because it can yield commercially viable crops even in low-moisture soils. India is the global leader in both categories, with a dominant share of 74% in land area and 63% in total production. The primary factor contributing to the low redgram yields in Andhra Pradesh's rainfed alfisols is the erratic and unequal distribution of rainfall. Hence, it is imperative to enhance redgram productivity to meet the market's requirements. There is a pressing demand on identifying stable and high-yielding genotypes. Furthermore, it is essential to evaluate the proportional influences of genetic and non-genetic variations on different traits using genetic advancement, heritability estimations, and genetic coefficient of variability. A comprehensive understanding of the correlation between yield and quality is necessary for all individuals engaged in plant breeding to augment crops genetically. Research on genetic diversity and linkage provides useful insights. Still, it's possible that these studies need to capture the complete picture of how each trait, directly and indirectly, affects seed yield. Path coefficient analysis deconstructs the correlation coefficient into its parts to better understand the interplay between independent variables and the dependent variable. Combining evaluations of genetic variability with studies of correlation and path coefficients also allows breeders to increase the productivity and yield of any crop. This study evaluated genetic variability, correlation, and path coefficient studies within the context of seed yield and its attributes. The goal was to improve redgram productivity by assisting in the discovery of superior lines.

MATERIAL AND METHODS

During the *kharif* season in the year 2022, researchers from the Agricultural Research Station in Ananthapuramu, Andhra Pradesh, studied sixteen different redgram cultivars (*Cajanus cajan* (L.) Millsp.). The study station is situated 373 metres above mean sea level and may be found at 14 degrees 41 minutes north latitude and 77 degrees 40 minutes east longitude. This experimental study was conducted replicated twice in rainfed alfisols and utilised a randomised complete block design. Standard package of practises were adopted. Seeds were sown in two rows of four metres length, with a 90 × 20 cm. Five competitive plants were chosen at random and evaluated for their potency according to the following parameters: plant height, number of branches per plant, pod length, seed yield per hectare, and 100-seed weight (g). To find the phenotypic and genotypic coefficients of variation, the methods proposed by Burton and De Vane (1953) were used. Allard (1960) outlined the processes that were followed in order to determine genetic advancement and heritability. Our estimates of the genotype-phenotype associations were based on the methodologies offered by Johnson *et al*. (1955). Following the procedures laid out by Dewey and Lu (1959), the researchers employed phenotypic correlations to ascertain the direct and indirect impacts of component quality on seed yield.

RESULTS AND DISCUSSION

Eight variables showed statistically significant genetic variation when the variance analysis was run. High genotypic and phenotypic coefficients of variation were observed for 100-seed weight, number of branches / plant, pod length and seed yield, as shown in Table 1. Both the genotype and phenotype coefficients of variation hold statistical significance. Pod length, days to 50% blooming, seed production per pod, and total plant height were some of the plant parameters that displayed a significant level of genetic and phenotypic heterogeneity. When comparing genotypic and phenotypic coefficients of variation, the latter consistently outperformed the former across the board. In essence, this establishes that features' appearance was influenced by external influences. Therefore, phenotypic selection may not be the optimal strategy for enhancing specific traits.

Breeders rely heavily on heritability estimates because they reveal the extent to which observable factors impact genetic worth. The study's results demonstrated a high degree of heritability, suggesting that certain genetic traits could be improved by selective breeding. Using heritability estimates to assess the effectiveness of genotype selection in relation to phenotype performance does not reveal any information about the possible improvements that could emerge from this selection. It will be easier to address this problem if you are familiar with both heritability estimates and genetic progress (expressed as a percentage of the mean). Because of this, simplified selection is achievable. Due to the strong genetic progress and high heritability seen in the average values of all variables, additive gene effects are expected to have a significant impact on the inheritance of these traits. So, if you choose these traits early on, you can anticipate excellent things.

According to the correlation coefficients displayed in Table 2, there are several pairs of attributes that are significantly correlated with each other. Positive and statistically significant correlations were found between seed yield and number of pods / plant (0.696), plant height (0.687), days to 50% flowering (0.642) and number of branches / plant (0.546). Thus, it stands to reason that selecting for these qualities will improve seed yield. Seed yield and seed / pod were inversely related to pod length. There was no statistically significant relationship between seed yield and the 100-seed weight feature. Padi (2003), Sarsamkar *et al.* (2007), Hamid *et al.* (2011), Saroj *et al*. (2013), Vijayalakshmi *et al.* (2013), Kesha Ram *et al*. (2016), Singh and Singh (2016), Laxmi Narayanan *et al*. (2018), and Satyanarayana *et al*. (2018) have all reached the same conclusion.

Table 1: Genetic variability parameters in redgram [*Cajanus cajan* (L.) Millsp.] for seed yield and its attributes.

Character	Mean	Range	GCV (%)	PCV (%)	Heritability	GAM
Days to 50% blooming	108.75	61.22 to 116.00	13.22	13.27	99.02	27.29
Plant height (cm)	175.19	112.22 to 199.33	17.44	18.31	90.13	34.11
Number of branches / plant	14.03	11.00 to 19.00	21.23	26.84	62.61	36.59
Number of pods / plant	211.88	121.11 to 312.66	38.27	42.14	84.28	75.66
Pod length (cm)	4.87	4.51 to 6.11	17.22	17.47	96.48	35.28
Number of seeds / pod	4.05	3.96 to 4.81	12.21	12.82	89.67	23.39
100 seed weight (g)	10.42	8.27 to 18.48	24.71	25.76	92.01	48.76
Seed yield (q/ha)	9.22	8.17 to 12.24	31.44	36.48	73.16	54.65

Table 2: Correlation coefficients between seed yield and its component characters in redgram [*Cajanus cajan* (L.) Millsp.].

Character	Days to 50% blooming	Plant height (cm)	Number of branches / plant	Number of pods / plant	Pod length (cm)	Number of seeds / pod	100 seed weight (g)	Seed yield (q/ha)
Days to 50% blooming	1.000	0.911**	0.462**	0.611**	0.241	0.246	0.011	0.642**
Plant height (cm)		1.000	0.507**	0.624**	0.112	0.124	0.001	0.687**
Number of branches / plant			1.000	0.702**	0.423**	-0.352*	-0.324*	0.546**
Number of pods / plant				1.000	0.452**	0.397**	0.531**	0.696**
Pod length (cm)					1.000	0.926**	0.676**	-0.309*
Number of seeds / pod						1.000	0.585**	-0.302*
100 seed weight (g)							1.000	-0.124
Seed yield (q/ha)								1.000

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

A favourable and statistically significant link was found between the number of days before days to 50% blooming and all plant metrics, including plant height, number of branches / plant, number of pods / plant and seed yield. The traits number of branches / plant, number of pods / plant and seed yield were all positively correlated with total plant height. In addition to plant height, number of pods / plant, seed yield, and days to 50% blooming, another set of variables found to be substantially associated with number of branches / plant was days to 50% blooming. Plant height, number of branches / plant, days to 50% blooming, and number of seed /pod were all positively linked with seed yield when all four were included at once. The statistics presented here demonstrate that the seed yield of redgram can be greatly affected by a number of variables, such as plant height, number of branches / plant, number of clusters /plant and seed output.

Partitioning of correlation coefficients for various component characters with seed yield into direct and indirect contributions (Table 3) revealed that days to 50% blooming has maximum direct effect (0.5631) on seed yield followed by 100 seed weight (0.5624) and plant height (0.1613). These results are in conformity with Padi (2003), Sarsamkar *et al.* (2007), Saroj *et al.* (2013), Vijayalakshmi *et al.* (2013), Chandana *et al.* (2014), Kesha Ram *et al.* (2016), Laxmi Narayanan *et al.* (2018) and Satyanarayana *et al*. (2018). Similarly, for plant height (0.687) it was due to the indirect effects of days to 50% blooming (0.5184) and its own direct effect (0.1613). Likewise, the high correlation coefficient of number of pods / plant (0.696) with seed yield was due to the indirect effects of days to 50% blooming (0.3451) followed by number of seeds / pod (0.1569) in spite of negative indirect effects of 100 seed weight (-0.2971). The value of residual effects was 18.72% suggesting that about 81% of the total variations for seed yield in redgram were explained. Finally, the path coefficient analysis revealed importance of days to 50% blooming, 100 seed weight and plant height for their contribution either directly or indirectly to seed yield and hence, during selection these traits should be given utmost attention for developing of high seed yielding redgram varieties.

Table 3: Direct and indirect contributions of component characters for seed yield in redgram [*Cajanus cajan* (L.) Millsp.].

Character	Days to 50% blooming	Plant height	Number of branches / plant	Number of pods / plant	Pod length	Number of seeds / pod	100 seed weight	Correlation with Seed yield
Days to 50% blooming	**0.5631**	0.1482	-0.0757	0.0103	-0.0533	-0.1027	-0.0077	0.642**
Plant height	0.5184	**0.1613**	-0.0816	0.0106	-0.0226	-0.0489	0.0019	0.687**
Number of branches / plant	0.2617	0.0804	**-0.1624**	0.0121	0.0747	0.1388	-0.1793	0.546**
Number of pods / plant	0.3451	0.1008	-0.1141	**0.0173**	0.0994	0.1569	-0.2971	0.696**
Pod length	0.1392	0.0169	0.0673	-0.0082	**-0.2176**	-0.3682	0.3811	-0.309*
Number of seeds / pod	0.1453	0.0193	0.0569	-0.0065	-0.2024	**-0.3966**	0.3305	-0.302*
100 seed weight	0.0072	0.0002	0.0512	-0.0097	-0.1478	-0.2334	**0.5624**	-0.124

Bold: Direct effects Residual effects; 18.72%

CONCLUSION

Upon meticulous analysis of character association and path studies, our investigation of sixteen genotypes of Redgram (*Cajanus cajan* L.) during the kharif season of 2022 at Agricultural Research Station, Ananthapuramu, has provided valuable insights into enhancing redgram seed yield. The study focused on conducting correlation studies and evaluating genetic diversity in seed yield and associated traits. The research unveiled significant variability across all examined parameters, highlighting the potential for targeted trait selection to improve seed yield. The coefficients of variation for key productivity metrics, including seed yield, number of pods/plant, number of branches/plant, and 100-seed weight, were notably high, indicating substantial diversity among the genotypes. Notably, traits such as days to 50% blooming, plant height, and number of pods/plant exhibited both high heritability and considerable genetic advance. These traits, characterized by their heritability and genetic advance, emerge as promising candidates for targeted selection to enhance redgram seed yield. The correlation analysis revealed strong positive associations between seed yield and independent variables such as plant height, number of branches/plant, and number of pods/plant. Furthermore, our path analysis identified specific traits, namely plant height, days to 50% blooming, and 100-seed weight, with the most significant direct impact on seed yield. These findings provide a comprehensive understanding of the key determinants influencing redgram seed yield, paving the way for informed breeding strategies.

FUTURE SCOPE

The study titled presents an intriguing avenue for future research and application. The substantial variability observed in the examined traits among sixteen Redgram genotypes during the kharif 2022 season provides an opportunity for further investigation into the underlying genetic factors influencing these traits. The high coefficients of variation for key productivity metrics indicate the potential for targeted breeding efforts to enhance seed yield, number of pods per plant, number of branches per plant, and 100-seed weight. The significant heritability and expected genetic advancement underscore the feasibility of genetic improvement through selective breeding. The strong positive correlations identified between independent variables, such as plant height, number of branches per plant, and number of pods per plant, with the dependent variable, seed yield, suggest potential avenues for trait improvement through targeted selection. Future research could delve into the specific genetic markers associated with these traits and explore molecular breeding techniques for accelerated genetic enhancement. Additionally, the study sets the stage for field trials and validation of the identified correlations and their impact on Redgram productivity under diverse environmental conditions, providing valuable insights for sustainable agriculture in rainfed alfisols of Andhra Pradesh.

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Conflict of Interest. None.

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