The Pharma Innovation Journal 2022; 11(8): 1721-1723

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(8): 1721-1723

www.thepharmajournal.com
Received: 07-06-2022
Accepted: 16-07-2022

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Phenotypic, genotypic variability and genetic control in morphological characters of Charota (*Cassia tora*)

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Abstract
Cassia tora fifty accession were studied for fifteen traits studied at research cum instructional farm at IGKV, Raipur (C.G). The high PCV than GCV value showed that influence of environment in expression of traits. The character number of seed per pod, seed length (cm) and carbohydrate % has 0.461%, 0.4% and 0.35% respectively has very less difference between PCV and GCV. Hence the character is less influence by the environment. High genetic advance along with high heritability was observed for plant height (cm) 49.41% and 97.87%, number of secondary branches per plants 86.402% and 92.05, number of pod per plant 93.3544 and 96.332 and seed yield per plant (g) 105.489% and 96.53% which stipulate that additive gene action preponderant in the expression of these characters; hence these characters may be used for genetic improvement of accession via. Selection procedure. IGH heritability associated with moderate GA as % of mean was reported for the seed width (cm) and seed length (cm). Moderate to low GA % as a mean, implying that non additive genetic variation played a role in their expression.

Keywords: *Cassia tora*, PCV, GCV and genetic control

Introduction
Cassia tora Linn. Commonly known as sickle pod, coffee pod, sickle senna, wild senna which belongs to the family Leguminosae. It is grown in warm and moist soil over tropical part of Asia and Africa. The shrub can be grown in wild land.

It is an annual herb of about 30 to 90 cm in height. The main branches of *Cassia tora* is straight, hard, profusely branched, the leaves have three pairs of leaflets that are opposite, ovate or oblong in shape and oblique at the base. In axel of the leaves yellow color flower comes with five petals. Plant bear flower during rainy season and develop into fruits during winter season. The seed is rhombohedra and are in shades of brown which varies from 30 to 50 seed per pod. The pods are sickle shaped 10 to 15 cm long.

Cassia tora naturally grown in rural area of Bastar, Bilaspur, Durg and Sarguja District of Chhattisgarh. The Surguja District accounts for more than 60 % of the Charota production of the State. In season of 2016 the production of Jagdalpur District is 300-350 quintals per day and the market price of *Cassia tora* seed in recent is 4000-5000 Rs per quintals or 40-60 Rs per kg as reported by R.K. Sonwani, *et al.*, (2018) [8]. The demand of tora seed is increasing in recent five years. The Government of Chhattisgarh has decided the 16 Rs per kilogram rate as minimum support price of this medicinal plant seed.

The present area of aromatic and medicinal crops in the state is 3520 ha with the production of 22,195MT in the year 2020-21. (Directorate, NHM, 2019-20).

The review of the properties of *Cassia Tora* reveals that wide range of phytochemical constituents have been isolated from the plant and it possess important activities like Laxative, Remedies for Skin Diseases, Ringworm, Eye Diseases, Liver Complaint, Dysentery and Anthelmentic. Various other activities like Antioxidant, Hypoglycemic, Hypolipidemic, Antinociceptive, Antiplasmodial, Antifungal & Antimicrobial, Hyperglycemia & Hypertensive have also been reported by Das, Chandan *et al*., 2011 [3].

Cassia gum was extracted by endosperm using solvent precipitation method as reported in literature. The seeds were found to yield substantial quality of gum. The gum used as thickener, emulsifier, foam stabilizer, frozen dairy desserts, poultry products etc.

In view of the greater demand in phytopharmaceutical industries its commercial production become important to do large scale production and development of better varieties. Little information available about the physiological, genetically parameters of variation and character association to develop suitable lines. The magnitude of variability in the existing material and association among various physiological traits are pre requisite for yield and

selection of better plant type. This parameter however varies with the type of material used and environmental condition to which accessions are subjected. Such study has not been made yet in Chhattisgarh state.

Material and Method

The experiment was conducted at Research Cum Instructional Farm, Department of Plant Physiology, College of Agriculture, IGKV Raipur (C.G.) during *Kharif* 2021-2022. Agro- climacterically Raipur is located in Chhattisgarh Plains with latitude of 21°13'16" NL, longitude of 81°14'3" EL and altitude is 298.5m over mean sea level. The experimental consist of 50 germplasm of *Cassia tora* collected from different places of Chhattisgarh. This germplasm was evaluated in a RCBD design in two replications during *Kharif* 2021-2022. The material was planted with the spacing 45 x 45 cm row to row and plant to plant in 2021. All recommended package of practices was adopted to raise the healthy crop. The germplasm was allowed to grow till four month and the characterization was done according to descriptor of NBPGR. Randomly five plants were selected from each treatment for recording observations in replications for following fifteen characters *viz*; days to flowering, plant height (cm), number of secondary branches per plant, number of tertiary branches per plant, number of pods per plant, internode length (cm), collar width (cm), pod length (cm), pod width (cm), number of seed per pod, seed length (cm), seed width (cm), 100 seed weight (g), carbohydrate % and seed yield per plant (g).

Result

The statistical procedure in which character separates the total variation into different components known as analysis of variation. The different components of variance is estimated through ANOVA. The result obtained by data presented in Table 1. Analysis of variance that the mean, sum of squares of accession/treatments and replication were highly significant towards all characters except treatment days to flowering. This depicts that enough variability present among all 50 accessions relevant to all traits which are estimated.

Genotypic and phenotypic coefficient of variation are simple variation measures of variability, these measures are commonly used for the assessment of variability. The relative value of these type of coefficient gives an idea about the magnitude of variability present in a genetic population. The PCV and GCV are classified as proposed by Siva Subramanium and Madhava Menon (1973) [7], PCV and GCV were classified as low (less than 10%), moderate (10-20) and high (more than 20%).

PCV and GCV of various characters were calculated in percentages and PCV values are found to be slightly higher than the GCV. It shows the presence of environmental factors in governing the trait variation. The character number of seed per pod, seed length (cm) and carbohydrate % has 0.461%, 0.4% and 0.35% respectively has very less difference between PCV and GCV. Hence the character is less influence by the environment.

Based on the genetic analysis for seed yield and its attributing traits it was observed that among 15 traits, Number of tertiary branches/ plant have high degree of GCV (58.18%) and PCV (61.01%) seed yield per plant (g) (40.88% and 41.83%), number of pods per plant (35.95% and 36.55%) number of secondary branches per plant (33.30% and 33.89%), carbohydrate (%) (28.79% and 29.15%), internode length (cm) (25.01%, 26.41%), pod length (cm) (13.95%, 14.38%), collar width (cm) (11.06% and 14.38%), number of seeds per pods (13.95% and 14.41%) have moderate degree GCV and PCV. Pod length (cm) (8.33% and 8.74%), seed width (cm) (6.80% and 8.12%) has low degree of GCV and PCV respectively. Table 2. Similar findings were also reported by Chandramohanan and Mohanan, 2005 [2] in *cassia tora* and Meher *et al*. 2020 in soybean.

Heritability implies the relative role of genetic factors in phenotypic expression and often serves as an indicator of inheritance of a given trait to its offspring. Since heritability is normally expressed in percent, it is the heritable component of phenotypic variation. Genetic advance combined with heritability aids in determining the likely genetic influence for any given character. It is not necessary for a phenotype with a high heritability (h^2) to also have a high genetic advance (GA) (Johnson *et al*., 1955). In the current study, an attempt was made to 44 evaluate heritability in a broad sense and categories it as low (< 40%) moderate (40-60%), and high (> 60%) as Johnson *et al*. (1955) suggested.

For most of the character studied in this study, the high magnitude of heritability was found. The maximum heritability was observed for the character Days to flowering (98.02%) subsequently 100 seed weight (gm), (98.01%), plant height (cm) (97.87%), pod width (cm) (98%), Internode length (cm) (97.75%), seed width (cm) (97.65%), carbohydrate (%) (96.63%), seed yield per plant (gm) (96.53%) no of pods per plant (96.32%), no of seeds per pods (96.9%), pod length (cm) (95.75%), no of tertiary branches (94.36%), number of secondary branches (92.05%). Sankarnarayanan (1994) reported similar findings in *Cassia spp*.

The heritability evaluation, on the other hand, does not indicate the degree of genetic development that may be achieved by the selection of better genotypes. The heritability values are only authentic if it is subsequently high genetic advance. To make it easier to compare diversity in various cultivars traits, genetic advance (GA) was studied as a % of the mean. The percentage of genetic advance over the mean was divided into three categories: high (> 20%), moderate (20% - 10%), and low (< 10).

The maximum value of GA as% of mean was noted for No of tertiary branches /plant (146.47%), seed yield per plant (g) (105.45%), No of pods per plant (93.35%), carbohydrate (%) (75.10%), internode length (cm) (62.35%),100 seed weight (g) (55.47%), plant height (cm) (49.41%), pod length (cm) (34.26%), no of seeds per pods (35.65%), moderate GA% was recorded for days to flowering (5.60%), pod width (cm) (14.31%), seed length (cm) (20.96%).

High genetic advance along with high heritability was observed for plant height (cm) 49.41% and 97.87%, number of secondary branches per plants 86.402% and 92.05, number of pod per plant 93.3544 and 96.332 and seed yield per plant (g) 105.489% and 96.53% which stipulate that additive gene action preponderant in the expression of these characters; hence these characters may be used for genetic improvement of accession via. Selection procedure. High heritability associated with moderate GA as % of mean was reported for the seed width (cm) and seed length (cm). Moderate to low GA% as a mean, implying that non additive genetic variation played a role in their expression Table.2. Similar reporting was also done by Chandramohanan and Mohanan, 2005 [2] and Abubakar *et al*, 2019 [1].

Table 1: Analysis of variance of *cassia tora*

Source of variation	Days of flowering	Plant Height (cm)	No of Secondary branches	No. of Tertiary Branches	Internode Length (cm)	Collar Width (cm)	Pod Length (cm)	Pod Width (cm)	No. of Pods Per Plant	No. of seeds Per Pods	Seed Length (cm)	Seed Width (cm)	100 Seed Weight (gm)	Carbohydrate %	Seed Yield Per Plant (g)
Replication	2.89	515.1992	44.9838	115.305	3.77914	1.1004	15.4213	0.033	920.941	56.4001	0.02341	0.01369	0.561	178.329	12.3061
Treatment	11.84	477.07766	33.4491	57.0833	1.7564	0.23717	5.45011	0.001	602.902	28.4984	0.00277	0.00068	0.26813	267.052	20.7705
Error	2.685918	16.149269	0.58573	2.70875	0.09552	0.01589	0.28018	0.0002	9.996	0.92541	0.00013	0.00012	0.0117	3.25967	0.47609

Table 2: Estimation of genetic parameter for different characters in *Cassia tora*

Character	Min.	Max.	GCV %	PCV%	h^2 (%)	Genetic advance	GA as % of mean
Days of flowering	76	86	2.674	3.3681	98.02	4.4854	5.6046
Plant Height (cm)	36.775	101.5	19.3609	20.0278	97.87	38.7435	49.4109
No of Secondary branches	7.12	24.335	33.3063	33.8947	92.05	10.5157	86.402
No. of Tertiary Branches	1.46	23.745	58.1806	61.0101	94.36	13.1269	146.473
Internode Length (cm)	2.31	6.21	25.0133	26.4127	97.75	2.2783	62.5362
Collar Width (cm)	2.325	3.7	11.065	11.8331	92.89	0.8211	27.3156
Pod Length (cm)	8.51	16.6	13.6627	14.3841	95.75	4.0317	34.2605
Pod Width (cm)	0.29	0.42	6.5578	7.9296	98	0.0524	14.3178
No. of Pods Per Plant	18.585	87.495	35.9528	36.5539	96.32	44.7075	93.3544
No. of seeds Per Pods	20.875	41	13.9514	14.412	96.9	9.4891	35.6544
Seed Length (cm)	0.335	0.505	8.3348	8.7472	91.98	0.09132	20.9663
Seed Width (cm)	0.205	0.295	6.8009	8.1261	97.65	0.0369	15.0264
100 Seed Weight (gm)	0.755	2.375	21.9504	22.9297	98.01	0.9049	55.4739
Carbohydrate %	22.95	64.545	28.7992	29.1529	96.63	29.9515	75.1075
Seed Yield Per Plant (g)	3.085	15.9	40.8844	41.8325	96.53	8.219	105.489

Conclusion

The mean sum of square due to accession / treatment was and replication was found to be highly significant for all the characters under study indicating the presence of variation in all accessions for all characters.

The PCV Showed slightly high value than GCV which indicate the influence of environment for the expression of characters. Based on the genetic analysis for seed yield and its attributing traits it was observed that among 15 traits, Number of tertiary branches/ plant have high degree of GCV (58.18%) and PCV (61.01%) seed yield per plant (g) (40.88% and 41.83%), number of pods per plant (35.95% and 36.55%) number of secondary branches per plant (33.30% and 33.89%), carbohydrate (%) (28.79% and 29.15%), internode length (cm) (25.01%, 26.41%), pod length (cm) (13.95%, 14.38%), collar width (cm) (11.06% and 14.38%), number of seeds per pods (13.95% and 14.41%) have moderate degree GCV and PCV. Pod length (cm) (8.33% and 8.74%), seed width (cm) (6.80% and 8.12%) has low degree of GCV and PCV respectively.

High hereditability with GA % was observed in plant height (cm), No. of secondary branches per plant, no. of pods cluster per plant, seed yield per plant (g) which showed additive gene action in the expressions of these characters hence these characters may be used for genetic improvement of accession via selection.

High genetic advance along with high heritability was observed for plant height (cm) 49.41% and 97.87%, number of secondary branches per plants 86.402% and 92.05, number of pod per plant 93.3544 and 96.332 and seed yield per plant (g) 105.489% and 96.53% which stipulate that additive gene action preponderant in the expression of these characters; hence these characters may be used for genetic improvement of accession via. Selection procedure. High heritability associated with moderate GA as % of mean was reported for the seed width (cm) and seed length (cm). Moderate to low GA% as a mean, implying that non additive genetic variation played a role in their expression.

Acknowledgement

Authors are grateful to Indira Gandhi Krishi Vishwavidyalaya for the support and guidance to conduct the experiment and also Thankful to AICRP and MAPs project for their support.

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