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Kanak Bhati
Department of Genetics and Plant Breeding, N.M.C.A., NAU, Navsari, Gujarat, India

Dr. Ronak Bhakta
Pulses and Castor Research Station, NAU, Navsari, Gujarat, India

Aditi D Patel
Department of Genetics and Plant Breeding, N.M.C.A., NAU, Navsari, Gujarat, India

Kajal Rathod
Department of Genetics and Plant Breeding, N.M.C.A., NAU, Navsari, Gujarat, India

Correspondence
Kanak Bhati
Department of Genetics and Plant Breeding, N.M.C.A., NAU, Navsari, Gujarat, India

Variability, heritability and genetic advance studies for yield and its components in castor (*Ricinus communis* L.)

Kanak Bhati, Dr. Ronak Bhakta, Aditi D Patel and Kajal Rathod

Abstract
Assessment of genetic diversity was conducted using a set of forty genotypes of castor (*Ricinus communis* L.) grown in a randomized block design with three replications during *rabi* season 2015 at Pulses and Castor Research Station, Navsari Agricultural University, Navsari. Analysis of variance revealed significant genotypic differences for all ten characters under study. The genotypic and phenotypic coefficient of variation was observed high for yield per plant, effective spikes per plant, capsules per primary spike, effective primary spike length and plant height up to primary spike. A high estimate of heritability was observed for days to 50 percent flowering, yield per plant, effective primary spike length, effective spikes per plant, plant height up to primary spike, capsules per primary spike, 100 seed weight and number of nodes up to primary spike.

Keywords: Castor, Variabilility, Heritablity, genetic-advance and yield

Introduction
Castor (*Ricinus communis* L.) is a monospecific non-edible oilseed crop, member of family Euphorbiaceae or spurge which is indigenous to Africa and India. It is having chromosome number 2n=20. By virtue of hardiness against water stress and temperature, it plays crucial role in the economy of arid and semi-arid regions of the world. Most wild type are large perennials often developing into small trees, cultivated types are usually short annuals and grown in arid and semi-arid regions. Castor oil is of high value for industrial oil feed stocks because of the very high non edible oil content (48-60%) in the seed and only commercial source of hydroxy fatty acids (ricinoleic acids) to the entire world. A great variation in phenotypic expression is observed due to its cross-pollinated nature. Yield in castor results due to additive gene action which happens normally in many other crops along with that there is interaction with environment that influences the yield trait. Genetic variability is utmost important to dig out superior genotypes, variability studies along with heritability and genetic advance helps in finding the gene action of particular trait and thud helps in deciding suitable breeding method to exploit the particular trait of interest.

Materials and methods
The experimental material for the present study comprised of forty genotypes. These genotypes were grown at Pulses and Castor Research Station, Navsari Agricultural University, Navsari. Lists of various castor genotypes are as follows: SKP-84, VP-1, ANDCP 8-1, Geeta, JP-86, SKP-72, SKP-106, JP-65, RB-1, JI-96, JI-224, JI-258, JI-263, JI-346, JI-357, JI-368, JI-378, JI-380, JI-384, JI-390, JI-397, JI-398, JI-401, JI-402, JI-403, JI-406, JI-409, JI-412, JI-415, JI-416, JI-422, JI-423, JI-430, SKI-271, SKI-332, SKI-343, RG-43 and JI-35.
These genotypes were sown in October, 2015 in Randomized Block Design with three replications under irrigated condition. Each entry was accommodated in a single row of 6.0 m length with spacing of 120 cm x 60 cm. The experiment was surrounded by guard row to avoid damage and border effects. The recommended agronomical and plant protection practices were followed for the successful raising of the crop. The observations were recorded on five randomly selected plants in each entry and replication on ten quantitative characters viz., days to 50 percent flowering, days to maturity, number of nodes up to primary spike, plant height upto primary spike (cm), effective primary spike length (cm), capsules per primary spike, effective spikes per plant, 100 seed weight (g), yield per plant (g) and oil content (%).

For this purpose, analysis of variance for all possible pairs of nine characters was carried out using the procedure of Heritability in broad sense was calculated by using formula given by Allard (1960) [2]. The expected genetic advance as expressed in percent of mean was calculated by the method suggested by

Result and discussion

The analysis of variance indicating the mean sum of squares for all the ten characters studied showed that genotypic differences were highly significant for all the ten characters studied indicating considerable amount of genetic variability among tested genotypes in the present study (Table 1). Similar results for most of the characters were also reported by Patel *et al.* (1985) [24], Mehta and Vashi (1997) [15], Patel *et al.* (2008) [19], Rao *et al*. (2009) [26], Uguru *et al*. (2010) [32], Abimiku *et al*. (2012) [1], Patel and Patel (2014) [21].

From breeders point of view it is important to consider some of the economically important quantitative traits that would help in selecting a particular genotype such as earliness, plant height, primary spike length, effective spikes per plant and most importantly yield per plant, thus from the experimental studies the following mentioned genotypes could be used in breeding programme to get the genotype with ideal economically important quantitative traits, the genotypes are as follows *viz.*, for early maturing genotype were JI-263 (127.00 days) matured earliest followed by JI -359 (129 days) and JI-423 (129.33 days). Normally dwarf plant height is preferable for commercial production while, when used for staking purpose tall height is preferred. Shortest genotypes were as follows ANDCP-8-1 (27.67 cm) followed by RG-43 (28 cm) and JI-424 (32.33 cm) while, tallest genotypes was JI-430 (114.67 cm) followed by 48-1 (103.00 cm) and JI-401(96.33 cm). Effective primary spike length ranges from SKP-84 (85.33 cm) followed by JI-430 (81.33 cm) and JI-422 (75.33 cm); effective spikes per plant were highest in Geeta (18.33), followed by RB-1 (15.67) and JI-430 (15.00) and RB-1 recorded the highest yield (407.20 g) followed by JI-263 (387 g) and JI-346 (360.67 g).

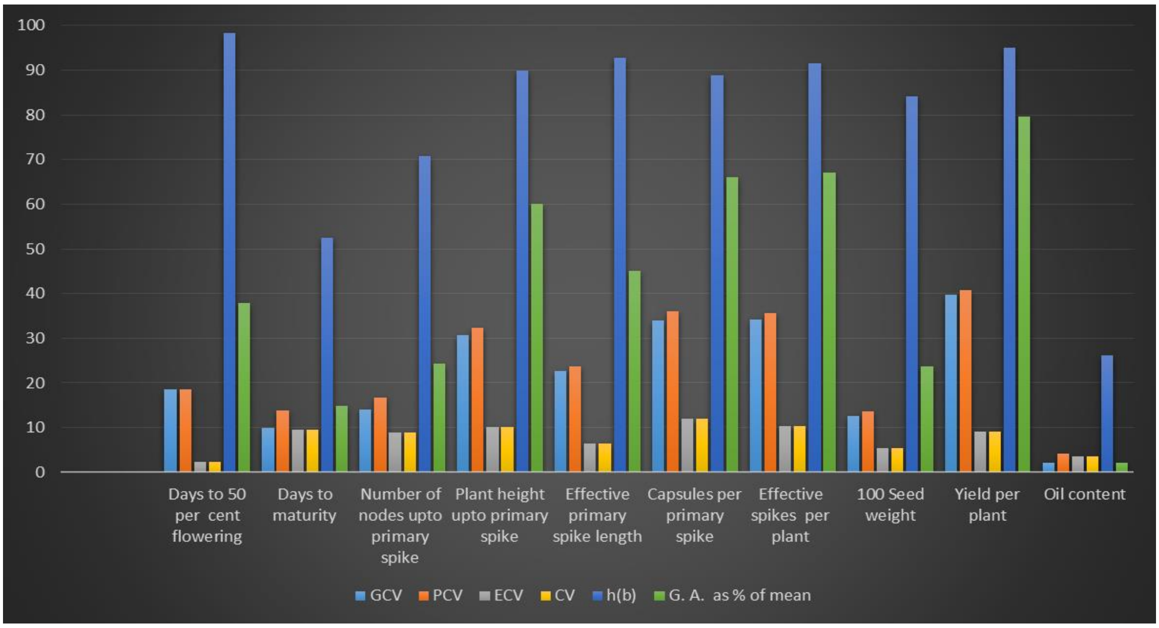
Yield per plant had highest genotypic and phenotypic coefficient of variation followed by effective spikes per plant, capsules per primary spike, plant height up to primary spike, effective primary spike length, while the traits *viz*., number of nodes up to primary spike, days to 50 percent flowering and 100 seed weight had moderate genotypic and phenotypic coefficient of variation. Traits like, days to maturity and oil content had lower coefficient of variations.

A high estimate of heritability was recorded for all the characters studied except for oil content (26%), they are as follows, day to 50 percent flowering (98%), yield per plant (95%), effective primary spike length (93%), effective spikes per plant (91%), plant height up to primary spike (90%), capsules per primary spike (89%), 100 seed weight (84%) and number of nodes up to primary spike (71%) in (Table 1). Similar results were reported by Patel *et al.* (1985) [24], Mehta and Vashi (1997) [15], Patel *et al.* (2008) [19], Rao *et al*. (2009) [26], Uguru *et al*. (2010) [32], Abimiku *et al*. (2012) [1], Udaya *et al*. (2013) [31], Patel and Patel (2014) [21].

The highest genetic advance was observed for yield per plant (79.64 %) followed by effective spikes per plant (67.18 %), capsules per primary spike (65.98 %), plant height up to primary spike (24.26 %), effective primary spike length (45.10 %), days to 50 percent flowering (37.79 %), number of nodes up to primary spike (24.26 %) and 100 seed weight (23.65 %). Days to maturity (14.85 %) had moderate genetic advance while oil content (2.18 %) had low genetic advance mentioned in (Table 1).

In present study high heritability coupled with high genetic advance was observed for days to 50 percent flowering, plant height up to primary spike, effective primary spike length, capsules per primary spike, effective spikes per plant, yield per plant and number of nodes up to primary spike. Thus these characters are governed by additive gene action and could be transferred to next generation by simple selection. Character days to maturity showed moderate genetic advance with moderate heritability thus governed by both additive as well as non-additive gene action. While, trait oil content had low heritability and low genetic advance thus governed by non additive gene action thus, heterosis breeding would be useful in improving this trait.

Based on these findings, it can be suggested that for improving yield per plant in castor more emphasis should be given to days to maturity, effective primary spike length, effective spikes per plant, 100 seed weight and number of nodes up to primary spike.



Graph 1: Estimate of variability parameters for ten different characters among 40 castor genotypes

Table 1: Broad sense heritability and advance as percent of mean for different characters in castor

Characters	Heritability (h^2)	Genetic advance % mean	Method of improvement
Days to 50 percent flowering	98.4 (H)	37.79 (H)	Direct selection
Days to maturity	52.5 (M)	14.85 (M)	Could be further improved
Numbers of nodes up to primary spike	70.8 (H)	24.26 (H)	Direct selection
Plant height up to primary spike	90.0 (H)	60.06 (H)	Direct selection
Effective primary spike length	92.7 (H)	45.10 (H)	Direct selection
Capsules per primary spike	88.9 (H)	65.98 (H)	Direct selection
Effective spikes per plant	91.5 (H)	67.18 (H)	Direct selection
100 seed weight	84.2 (H)	23.65 (H)	Direct selection
Yield per plant	95.0 (H)	79.64 (H)	Direct selection
Oil content	26.1 (L)	2.18 (L)	Heterosis breeding

Table 2: Analysis of variance for various characters in 40 castor genotypes.

Source of variation	D.F	Mean Square									
		Days to 50 percent flowering	Day to maturity	Number of nodes up to primary spike	Plant height up to primary spike	Effective primary spike length	Capsules per primary spike	Effective spikes per plant	100 Seed weight	yield per plant	Oil content
		1	2	3	4	5	6	7	8	9	10
Replication	2	27.01	1014.43	2.36*	30.53	5.76	27.36	2.76	1.90	418.849	1.13
Genotype	39	794.90**	851.94**	17.92**	1271.52**	515.67**	1850.76**	34.97**	70.74**	23529.93**	5.16**
Error	78	4.23	197.25	2.16	45.18	13.19	73.67	1.055	4.15	406.33	2.51
CD 5%		3.35	22.83	2.39	10.93	5.90	13.96	1.67	3.31	32.77	2.57
S.Em		1.1732	8.0065	0.8382	3.8320	2.0701	4.8933	0.5856	1.1620	11.49	11.4916

* Significant at 5.0 percent level of probability
** Significant at 1.0 percent level of probability

Table 3: Estimate of variability parameters for ten different characters among 40 castor genotypes.

Characters	Mean ± S. Em	Genotypic variance	Phenotypic variance	Environment variance	GCV (%)	PCV (%)	ECV (%)	CV (%)	h^2(b)	G. A. as % of mean
Days to 50 percent flowering	87.82 ± 1.19	263.56	267.79	4.24	18.49	18.63	2.34	2.34	98.4	37.79
Days to maturity	148.5 ± 68.11	218.23	415.47	197.25	9.94	13.72	9.45	9.44	52.5	14.85
Number of nodes upto primary spike	16.38 ± 0.85	5.25	7.42	2.16	13.99	16.62	8.98	8.97	70.8	24.26
Plant height upto primary spike	65.81 ± 3.88	408.78	453.96	45.18	30.72	32.38	10.21	10.21	90.0	60.06
Effective primary spike length	56.92 ± 2.10	167.50	180.69	13.19	22.74	23.62	6.38	6.37	92.7	45.10
Capsules per primary spike	71.66 ± 4.96	592.36	666.04	73.68	33.96	36.01	11.98	11.97	88.9	65.98
Effective spikes per plant	9.86 ± 0.59	11.31	12.36	1.06	34.10	35.65	10.42	10.41	91.5	67.18
100 Seed weight	37.66 ± 1.18	22.19	26.35	4.16	12.51	13.63	5.41	5.41	84.2	23.65
Yield per plant	221.32 ± 411.64	7707.86	8114.19	406.33	39.67	40.70	9.11	9.11	95.0	79.64
Oil content	45.39 ± 0.91	0.88	3.39	2.51	2.07	4.06	3.49	3.488	26.1	2.18

GCV (%) : genotypic coefficient of variation	PCV (%) : phenotypic coefficient of variation	H^2(b) : Heritability (Broad sense)

References

1. Abimiku OE, Azagaku ED, Ndor E. Genetic variability and correlation studies in some quantitative characters in castor. Asian Journal of Agricultural Sciences. 2012; 4(6):368-372.
2. Allard RW. Principles of Plant Breeding. John Willey and Sons, New York, 1960.
3. Dhapke SK, Khorgade PW, Narkhede MN. Estimates of genetic variability in castor. Agricultural Science Digest. 1992; 12(3):141-143.
4. Dorairaj S, Kandasami, Muhammd V. Genetic variability in castor. Madras Agriculture Journal. 1973; 60(12):1504-1507.
5. Fisher RA. The use of multiple measurements in taxonomic problems. Annuals for Eugenics, 1936; 7:179.
6. Fisher RA, Yates F. Statistical Tables for Biological Agricultural and medical Research. Oliver and Boyd, Edinberg, 6th Ed. 1963, 63.
7. Golakia PR, Kavani RH, Monpara BA. Genetic variation and trait relationship in castor. National Journal for Plant Improvement. 2007; 9(1):60-62.
8. Goodarzi F, Hassani A, Darvishzadeh R, Hamati MH. Genetic variability and trait association in castor bean. Genetika. 2015; 47(1):265-274.
9. Goulden. Methods of statistical analysis. Asia pulb. House, New Delhi, 1962.
10. Hafiz MA, Sarwar G, Haq MA. Genetic variability and interdependence of morphological traits in castorbean (*Ricicnus communis* L.) mutants. Songklanakarin journal of Science and Technology. 2012; 34(3):279-286.
11. Halilu AD, Aba DA, Ogunwole JO. Genetic variability, genetic gain and relationships of yield and yield components in castor (*Ricinus communis* L.). Biosciences Regular Paper RRBS. 2013; 7(5):181-186.
12. Jaimini N. Genetic variability, association studies, genetic divergence and stability analysis in newly evolved pistillate lines of castor (*Ricinus communis* L.).

M.Sc. (Ag.) Thesis, Gujarat Agricultural University, Sardarkrushinagar (Gujarat), 2002.
13. Lakshmamma P, Prayaga L, Mohan YC, Lavanya C. Genetic variability and character association in Castor. National. Journal of Plant Improvement. 2005; 7(2):122-126.
14. Lenka D, Mishra B. Path coefficient analysis of yield in rice varieties. Indian Journal of Agricultural Sciences. 1973; 43:376-379.
15. Mehta DR, Vashi PS. Variability, heritability and genetic advance in castor. Agricultural Science Digest. 1997; 17(4):236-238.
16. Najan BR, Kadam JR, Kadlang AD. Study on yield traits in castor (*Ricinus communis* L.). Journal of Oilseeds Research. 2010; 27:77-79.
17. Panse VG, Sukhatme PV. Statistical methods for Agricultural Workers (Third edition). I.C.A.R., New Delhi, 1985.
18. Patel DK, Ravindrababu Y, Prajapati DB. Variability and character association analysis in Castor (*Ricinus communis* L.). International Journal of Plant Sciences. 2011; 6(2):292-295.
19. Patel HK, Patel CG, Bhatt RK, Bhatt JP. Genetic variability and correlation studies in castor (*Ricinus communis* L.). International Journal of Agriculture Sciences. 2008; 5(1):129-131.
20. Patel JB, Pathak HC, Prajapati BH. Genetic variability, correlation and path coefficient analysis over environments in castor (*Ricinus communis* L.). Current Bioscience, 2004; 2(2):458-462.
21. Patel JK, Patel PC. Genetic variability, heritability and genetic advance for yield and yield components in castor genotypes. International Journal of Plant Sciences. 2014; 9(2):385-388.
22. Patel PS, Jaimini SN. Variability in castor (*Ricinus communis* L.). Indian Journal of Agricultural Sciences. 1988; 58(5):394-396.
23. Patel PS, Patel DR, Patel ID. Variability studies on yield components in castor. Gujarat Agricultural University Research Journal. 1991; 17:116-118.
24. Patel VJ, Dobarya KL, Fatteh UG, Dangaria CJ. Genetic variability studies in castor (*Ricinus communis* L.). Madras Agricultural Jouranl. 1985; 72(8):466-468.
25. Radhamani T, Ushakumari R. Variability studies in castor Germplasm accessions (*Ricinus communis* L.). Asian Journal Biological Sciences. 2013; 8(1):69-71.
26. Rao PV, Shankar VG, Reddy AV. Variability studies in castor. Research on crops, 2009; 10:696-698.
27. Sarwar G, Hafiz MA, Hussein J. Genetic variability and interdependence of morphological traits in castorbean (*Ricinus communis* L) mutants. Songklanakarin Journal for Science and Technology. 2010; 34(3):279-286.
28. Singh A, Srivastava AN. Genetic diversity in relation to yield and its components in castor. Indian Journal Agriculture Science. 1978; 48(1):25-28.
29. Singh BD. Plant breeding principles and methods. Kalyani Publisher, New Delhi, India. 1983, 506.
30. Sunil N, Kumar AA, Varaprasad KS. Collection of diversity in castor germplasm from parts of Andhra Pradesh. Indian Journal Plant Genetic Resources. 2005; 18(3):136-139.
31. Udaya BK, Satyanarayana RV, Srinivasa RM. Genetic variability in castor for yield and its contributing traits. International Journal of Food Agriculture and veterinary Science. 2013; 3(3):103-108.
32. Uguru MI. Genetic variability and breeding value of castor genotypes. Libyan Agriculture Research Centre Journal. 2010; 2(2):60-64.