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RESEARCH ARTICLE

Variability studies for seed yield and its components in soybean

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Abstract

Fifty genotypes of soybean were evaluated to determine variability, heritability and genetic advance for 14 seed yield and its component traits. The analysis of variance revealed significant variations for all characters. The estimates of phenotypic (PCV) and genotypic (GCV) coefficients of variation indicated that the values of PCV were higher than that of GCV, but the differences were closer between these two estimates for all the traits. This indicated that expression of characters under study was less influenced due to environmental factors. The high values of GCV and PCV were observed for plant height, biological yield per plant, harvest index, seed yield per plant and fodder yield per plant indicating presence of sufficient variability for selection in these traits. High heritability accompanied by high genetic advance as percent of mean were observedfor days to 50 per cent flowering, plant height, number of branches per plant, number of pods per plant, 100-seed weight, biological yield per plant, harvest index, seed yield per plant and fodder yield per plant indicating better scope for their improvement through selection, as these characters were predominantly governed by additive genetic variance.

Key words: Soybean, genetic advance, heritability, variability

Introduction

Soybean [*Glycine max* (L.) Merrill] is considered a miracle crop because of its dual qualities viz., protein and oil content in seed. These two parameters in one crop have thus, gained considerable importance in the agricultural economy of the World. It is considered as a wonder crop due to its dual qualities i.e. high protein (40-44%) and oil content (20%). Improvement through selection depends upon the variability existing in the available genotypes. Selection is effective only when the observed variability in the population is heritable in nature. Variability in a group of germplasm is a prerequisite for a successful breeding programme (Jandong *et. al.*, 2019). Heritability is a good index of transmission of quantitative characters from parents to their off-spring. Improvement in the mean genotypic value of selected plants over parental population is known as genetic advance Hanson et. al., (1956). The genetic advance is the product of heritability, phenotypic standard deviation and selection differential, heritability estimates along with genetic advance would be more realistic in soybean for selecting the best individual. The present study was undertaken to assess and estimate the magnitude and nature to variation among 50 genotypes of soybean with respect to various seed yield and its component traits which could be utilized in crop improvement programme.

Materials and methods

The present investigation was conducted at Agricultural Research Station, Junagadh Agricultural University, Amreli, during kharif 2018. The experiment consisted of 50 genotypes, which were evaluated in randomized block design with three replications. The recommended package of practices was followed for raising a healthy crop. The data were recorded on five randomly selected competitive plants in each replication and each genotype for 12 characters *viz*., plant height (cm), number of branches per plant, number of pods per plant, pod length (cm), number of seeds per pod, 100-seed weight (g), biological yield per plant (g), harvest index (%), protein content (%), oil content (%), seed yield per plant (g) and fodder yield per plant. Observations of days to 50 per cent flowering and days to maturity were recorded on plot basis. Observations like harvest index (%), protein content (%) and oil content (%) were measured as following. Harvest index (%) was calculated in percentage by using the formula as HI = Grain yield/ Biological yield ×100. Protein content (%) was calculated from seed by Nuclear Magnetic Resonance (NMR) spectroscopy method. For this, a random sample of dried seeds was obtained from bulk produce of each genotype from each replication.. Oil content (%) was measured by by Nuclear Magnetic Resonance (NMR) spectroscopy method. For this, a random sample of dried seeds was obtained from bulk produce of each genotype from each replication.

The mean and standard errors were worked out as per standard methods and coefficients of variation were computed. Heritability (h^2bs) and genetic advance as percentage of mean (GA %) were calculated as per the formula suggested by Hanson *et. al.,* (1956) and Johnson *et, al.,* (1955).The genotypic (GCV) and phenotypic (PCV) coefficients of variation were estimated according to the formula given by Burton and De Vane (1953).

Results and discussion

The analysis of variance revealed that all the characters showed significant variation among the genotypes studied, which indicated that experimental material had sufficient amount of variability (Table 1). The estimates of phenotypic (PCV) and genotypic (GCV) coefficients of variation (Table 2) indicated that the values of PCV were higher than that of GCV, but the difference was closer between these two estimates for all the characters. These indicated that greater role of genetic components and expression of characters under study was less influenced due to environmental factors. *et. al.,* (2006) and Chardrawat *et. al.,* (2017) were also reported similar results. The perusal of the data revealed that higher PCV and GCV were recorded for plant height, biological yield per plant, harvest index, seed yield per plant and fodder yield per plant indicated that selection with these characters may be a good approach for enhancing seed yield of the genotypes. However, GCV and PCV were moderate for days to 50 per cent flowering, number of branches per plant, number of pods per plant and 100-seed weight and low for days to maturity, pod length, number of seeds per pod, protein content and oil content. High values of genotypic (GCV) and phenotypic (PCV) coefficients of variation were reported in soybean for plant height by Chandrawat *et. al.,* (2017), for biological yield per plant by Baraskar *et. al.,* (2015), Lal *et. al.,* (2018) and *et. al.,* (2018), for harvest index by Reni and Rao (2013) and Kumar *et. al.,* (2018), for seed yield per plant by Gohil et al. (2006), Jain *et. al.,* (2018), Lal *et. al.,* (2018) and Neelima *et. al.,* (2018) and for fodder yield per plant by Adiya *et. al.,* (2011).

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Table 1: Analysis of variance (mean sum of squares) for different characters in soybean

Source	d.f.	Days to 50 per cent flowering	Days to maturity	Plant height (cm)	Number of branches per plant	Number of pods per plant	Pod length (cm)	Number of seeds per pod	100-seed weight (g)	Biological yield per plant (g)	Harvest index (%)	Protein content (%)	Oil content (%)	Seed yield per plant (g)	Fodder yield /plant (g)
Replication	2	0.9	1.6	10.93	0.1	47.8	0.0	0.05	0.0	4.0	17.9	0.16	0.03	1.85	7.18
Treatment	49	52.2**	58.0**	624.0**	0.6**	393.5**	0.3**	0.1**	6.9**	144.0**	144.4**	12.3**	0.2**	27.5**	102.0**
Error	98	0.95	1.28	19.46	0.11	28.13	0.08	0.05	0.11	4.61	6.60	0.21	0.26	1.36	3.07

*, ** significant at 5% and 1% levels, respectively

Table 2: The estimates of genotypic and phenotypic variance and other genetic parameters for different characters in soybean

Sr. No.	Characters	σ^2_g	σ^2_p	GCV (%)	PCV (%)	h^2_{bs}(%)	GA % mean
1	Days to 50 per cent flowering	17.11	17.43	10.18	10.27	98.20	20.78
2	Days to maturity	18.92	19.34	4.88	4.94	97.80	9.95
3	Plant height (cm)	201.52	208.01	28.27	28.72	96.90	57.33
4	Number of branches per plant	0.17	0.21	12.25	13.48	82.60	22.94
5	Number of pods per plant	121.81	131.18	18.26	18.95	92.90	36.24
6	Pod length (cm)	0.08	0.11	9.56	10.89	77.00	17.28
7	Number of seeds per pod	0.04	0.06	8.08	9.41	73.70	14.28
8	100-seed weight (g)	2.27	2.31	17.67	17.81	98.40	36.09
9	Biological yield per plant (g)	46.48	48.02	20.95	21.30	96.80	42.47
10	Harvest index (%)	45.95	48.15	20.85	21.34	95.40	41.95
11	Protein content (%)	4.04	4.11	6.08	6.13	98.30	12.42
12	Oil content (%)	0.07	0.08	1.38	1.46	88.90	2.67
13	Seed yield per plant (g)	8.72	9.18	23.53	24.13	95.10	47.25
14	Fodder yield per plant (g)	32.9	34.00	25.97	26.37	97.00	52.69

Moderate values of GCV and PCV for days to 50 per cent flowering were also reported by Ekka *et. al.*, (2016), Koradi and Basavaraja (2019), Kumar *et. al.*, 2018) and Nileema *et. al.*, (2018); for number of branches per plant by Aditya et al. (2011) and Kumar *et. al.*, (2013), for 100-seed weight by Aditya *et. al.*, (2011), Reni and Rao (2013), Kumar *et. al.*, (2018) and Koraddi and Basavaraja (2019) whereas, low magnitude for days to maturity was reported by Chandrawat *et. al.*, (2017), Manav and Arora (2017), Joshi *et. al.*, (2018) and Nileema *et. al.*, (2018), Ekka *et. al.*, (2016); for number of seeds per pod by Baraskar *et. al.*, (2014), Kumar *et. al.*, (2018) and Lal *et. al.*, (2018), for protein content by Chandrawat *et. al.*, (2017) and Neelima *et. al.*, (2018) and for oil content by Chandrawat *et. al.*, (2017). Heritability is the relative role of heredity in the expression of phenotype. Heritability is a good index of transmission of quantitative characters from parents to their offspring. In the present study, the estimates of heritability were observed to be high for all the characters *viz*.,days to 50 percent flowering (98.20%), days to maturity (97.80%), plant height (96.90%), number of branches per plant (82.60%), number of pods per plant (92.90%), pod length (77.00%), number of seeds per pod (73.70%), 100-seed weight (98.40%), biological yield per plant (96.80%), harvest index (95.40%), protein content (98.30%), oil content (88.90%), seed yield per plant (95.10%) and fodder yield per plant (97.00%). This indicated that selection based on phenotypic levels would be useful for the improvement of the traits. Earlier workers also reported high magnitude of heritability for seed yield and its component traits Joshi *et. al.*, (2018), Neelima *et. al.*, (2018) and Koraddi and Basavaraja (2019).

Improvement in the mean genotypic value of selected plants over parental population is known as genetic advance. The genetic advance is the product of heritability, phenotypic standard of deviation and selection differential, heritability estimates along with genetic advance would be more realistic in soybean for selecting the best individual. High heritability accompanied by high genetic advance for days to 50 per cent flowering, plant height, number of branches per plant, number of pods per plant, 100- seed weight, biological yield per plant, harvest index, seed yield per plant and fodder yield per plant indicating better scope for their improvement through selection, as these characters were predominantly governed by additive genetic variance. Our results are in agreement with those reported by Joshi *et. al.,* (2018), Lal *et. al.,* (2018) and Neelima *et. al.,* (2018).

High heritability coupled with moderate genetic advance as a percent of mean were observed for pod length, number of seeds per pod and protein content which revealed possibility of existence of both additive and non-additive gene effects. Similar results were earlier reported by Akram *et. al.*, (2016), Chandrawat *et. al.*, (2017) and Lal *et. al.,* 2018). High heritability accompanied with low genetic advance as a percent of mean were observed for days to maturity and oil content which indicated that preponderance of non-additive gene effects for the inheritance of characters, and it would be difficult to improve through direct selection. Similar results were reported by Mahbub *et. al.,* (2016), Manav and Arora (2017) and Baraskar *et. al.,* (2014).

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