Plant Archives Vol. 15 No. 2, 2015 pp. 997-1001 *ISSN 0972-5210*

NATURE AND DEGREE OF DISTRIBUTION FOR YIELD AND YIELD ATTRIBUTES IN SIX BACKCROSS POPULATIONS OF GROUNDNUT (*ARACHIS HYPOGAEA* L.)

R. Prabhu*, N. Manivannan, A. Mothilal[1] and S. M. Ibrahim[2]

Department of Oilseeds, CPBG, T.N.A.U., Coimbatore - 641 003 (Tamil Nadu), India.
[1]Regional Research Station, T.N.A.U., Vridhachalam - 606 001 (Tamil Nadu), India.
[2]Agricultural College and Research Institute, T.N.A.U., Madurai - 625 104 (Tamil Nadu), India.

Abstract

Skewness and kurtosis statistics gives an insight into the shape of the distribution. Considering the skewness, negative skewness was observed in all the six backcross populations studied for 100-kernel weight, sound mature kernel per cent and shelling percentage, except the cross CO 7 × COG 0437 (100-kernel weight and shelling percentage) and ICGV 03128 × GPBD 4 (100-kernel weight). In addition to these characters, 100-pod weight and number of primary branches were also negatively skewed for one or more crosses, which indicated that the individuals are clustered towards higher mean values. Apart from these characters, plant height and disease scores registered positive skewness on varied crosses, which implied that the individuals are clustered towards lower mean values. Regarding the kurtosis, the crosses *viz*., ICGV 03128 × GPBD 4, TMV Gn 13 × GPBD 4 and VRI 2 × GPBD 4 exhibited platy kurtosis for pod and kernel yield per plant, which indicated the presence of more variability. All backcross populations registered platykurtosis for disease scores except the cross ICGV 03128 × GPBD 4 and CO 7 × COG 0437. Similarly, the characters *viz*., plant height, number of primary branches, number of pods per plant, 100-pod weight, shell weight and shelling percentage also showed platy kurtic nature for one or more crosses. In terms of shape, these characters recorded lower, wider peak around the mean and thinner tails. Hence, as a concluding remark based on measures of shape in both BC_1F_1 and BC_2F_1 generation, directional selection will effectively enhance the *per se* performance of these traits.

Key words : Groundnut, backcross population, skewness, kurtosis, yield, yield attributes.

Introduction

Groundnut (*Arachis hypogaea* L.) also called peanut is one of the principal economic oilseed crops of the world. Several biotic and abiotic stresses limit the realization of the full genetic potential of modern improved groundnut varieties. Among the biotic stresses, late leaf spot (*Phaeoisariopsis personata*) and rust (*Puccinia arachidis*) are widespread and economically most important (Subrahmanyam *et al*., 1984). A survey of genetic variability is essentially the first step in crop amelioration (Hutchinson, 1958). In self pollinated crop, hybridization stands as one of the methodology by which favorable genes available in different genotypes could be combined into a genotype through genetic recombination. The development of genetic variability with hybridization and selection supplements the spontaneous variability for the crop improvement. An insight into the nature and degree of distribution present in population is of utmost importance as it forms the basis for selection in any crop improvement programme.

Skewness and kurtosis reflects the nature of variability existing in a genetic population under study. The frequency distribution was studied for the quantitative traits, under third and fourth order statistics *viz*., skewness and kurtosis. Skewness, characterizes the degree of asymmetry in the population. A positively skewed distribution indicates that the individuals of the population bunched up towards the lower mean values whereas, negatively skewed distribution exhibits that the individuals are clustered towards higher mean values. Similarly, kurtosis characterizes the relative peak size and flatness of a population distribution compared to normal distribution (Balanda and MacGillivray, 1988). Positive kurtosis

***Author for correspondence:** E-mail : rajprabhu03@yahoo.com

indicates leptokurtic distribution, negative kurtosis indicates platykurtic distribution and zero value indicates normal or mesokurtic distribution (Pearson, 1929).

Materials and Methods

Crosses were made between foliar disease susceptible genotypes *viz*., CO 7, ICGV 00350, ICGV 03128, TMV Gn 13, VRI 2 and foliar disease resistant genotype COG 0437, GPBD 4 in order to develop a foliar disease resistant lines with acceptable pod and kernel yield potential in groundnut. The F_1's of four crosses *viz*., ICGV 00350 × GPBD 4, ICGV 03128 × GPBD 4, TMV Gn 13 × GPBD 4, VRI 2 × GPBD 4 and BC_1F_1's of two crosses *viz*., CO 7 × GPBD 4, CO 7 × COG 0437 were again backcrossed with the respective donor parent. The resultant four crosses in BC_1F_1 generation and two crosses in BC_2F_1 generation were used to investigate the population distribution for 12 yield and yield attributing characters in groundnut. The crop was raised during *Rabi* 2013-14, at the Oilseeds Farm, Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore (Tamil Nadu), India. Recommended cultural practices were followed throughout the crop growing period. The spacing adopted was 30 × 10 cm. All the BC_1F_1 and BC_2F_1 crosses were evaluated along with parents in non replicated trial.

Observations were recorded on 12 characters *viz*., plant height (cm), number of primary branches, number of pods per plant, 100-pod weight (g), 100-kernel weight (g), shell weight (g), shelling percentage, sound mature kernel (SMK) (%), pod yield per plant (g), kernel yield per plant (g), late leaf spot (LLS) score and rust score. Nine point disease scale suggested by Subrahmanyam *et al*. (1995) was used to screen the lines for sources of resistance to late leaf spot and rust. The skewness and kurtosis were calculated by adopting the statistical procedures given by Kapur (1981). According to him, β_1 = skewness and if $\beta_1 > 0$, then positively skewed; $\beta_1 < 0$, then negatively skewed and $\beta_1 = 0$, then symmetric distribution. Similarly, β_2 = kurtosis and if $\beta_2 > 1$, then leptokurtic; $\beta_2 < 1$, then platykurtic and $\beta_2 = 0$, then mesokurtic. The skewness and kurtosis was divided by the respective standard errors to calculate 't' value. The calculated 't' value was compared with table 't' value with (n-1) degrees of freedom to assess significance. The standard error (SE) can be computed as follows, SE $(\beta_1) = (6)^{1/2} / N$ and SE $(\beta_2) = (24)^{1/2} / N$; N = number of observations made in particular cross.

Results and Discussion

In order to introgress foliar disease resistance genes from GPBD 4 and COG 0437, a backcross breeding programme was initiated. The susceptible genotypes *viz*., CO 7, ICGV 00350, ICGV 03128, TMV Gn 13 and VRI 2 were used as recurrent parents. Four crosses *viz*., ICGV 00350 × GPBD 4, ICGV 03128 × GPBD 4, TMV Gn 13 × GPBD 4, VRI 2 × GPBD 4 in BC_1F_1 and two crosses *viz*., CO 7 × GPBD 4, CO 7 × COG 0437 in BC_2F_1 generation were studied for the nature and degree of population distribution for yield and yield attributing traits using the measures of shape *i.e.* skewness and kurtosis. The results on the estimates of skewness, kurtosis and their distribution across the backcross populations for yield and yield attributes are presented in tables 1 and 2, respectively.

Skewness

BC_1F_1 generation

In the present investigation, normal distribution/no skewness was recorded by the cross ICGV 03128 × GPBD 4 for pod yield per plant and number of primary branches whereas, the crosses *viz*., ICGV 00350 × GPBD 4 and VRI 2 × GPBD 4 recorded the same for the trait 100-pod weight.

All the four crosses exhibited positive skewness for the traits kernel yield per plant, number of pods per plant and shell weight. In addition to these characters, pod yield per plant (ICGV 00350 × GPBD 4, ICGV 03128 × GPBD 4 and VRI 2 × GPBD 4), plant height (ICGV 00350 × GPBD 4), number of primary branches (ICGV 00350 × GPBD 4 and TMV Gn 13 × GPBD 4), 100-kernel weight (ICGV 03128 × GPBD 4), late leaf spot score (ICGV 00350 × GPBD 4 and TMV Gn 13 × GPBD 4) and rust score (ICGV 00350 × GPBD 4, ICGV 03128 × GPBD 4 and TMV Gn 13 × GPBD 4) also registered positive skewness.

Similarly, negative skewness was observed in all the four crosses for shelling percentage and sound mature kernel per cent. Apart from these characters, plant height (ICGV 03128 × GPBD 4, TMV Gn 13 × GPBD 4 and VRI 2 × GPBD 4), number of primary branches (VRI 2 × GPBD 4), 100-pod weight (ICGV 03128 × GPBD 4 and TMV Gn 13 × GPBD 4), 100-kernel weight (ICGV 00350 × GPBD 4, TMV Gn 13 × GPBD 4 and VRI 2 × GPBD 4), late leaf spot score (ICGV 03128 × GPBD 4 and VRI 2 × GPBD 4) and rust score (VRI 2 × GPBD 4) were also negatively skewed.

BC_2F_1 generation

In case of BC_2F_1 generation, normal distribution/no skewness was observed for rust score in the cross CO 7 × GPBD 4 whereas, the cross CO 7 × COG 0437 recorded it for plant height and 100-kernel weight.

Table 1 : Estimates of skewness and kurtosis for 12 characters in six backcross populations of groundnut.

S. no.	Character	Skewness						Kurtosis					
		BC_1F_1				BC_2F_1		BC_1F_1				BC_2F_1	
		C1	C2	C3	C4	C5	C6	C1	C2	C3	C4	C5	C6
1.	Plant height (cm)	0.81**	-0.25**	-0.25**	-0.29**	0.29**	0.24	0.18	-1.09**	-0.74**	1.93**	0.30*	0.21
2.	Number of primary branches	0.66**	0.08	1.78**	-0.22**	0.36**	1.04**	0.14	-0.69**	4.54**	1.17**	0.63**	0.30
3.	Number of pods per plant	1.40**	0.48**	0.33**	0.54**	0.78**	2.05**	5.08**	0.15	-0.46**	0.40**	1.10**	4.07**
4.	100-pod weight (g)	-0.16	-0.52**	-0.48**	0.02	0.69**	1.74**	-1.17**	0.56**	-1.02**	-0.87**	-0.05	2.44**
5.	100-kernel weight (g)	-0.84**	0.80**	-0.89**	-0.44**	-1.46**	0.19	-0.11	0.06	0.09	0.31**	4.84**	-0.38
6.	Shell weight (g)	1.89**	0.31**	0.69**	0.44**	1.06**	1.73**	6.70**	-0.62**	0.37**	-0.14*	0.45**	2.34**
7.	Shelling percentage	-1.85**	-0.49**	-2.32**	-2.06**	-0.40**	0.34*	3.24**	0.13	6.75**	5.03**	-1.02**	1.43**
8.	SMK (%)	-2.56**	-1.43**	-1.76**	-1.66**	-2.28**	-1.35**	9.18**	0.98**	2.93**	2.14**	5.75**	0.61
9.	Pod yield per plant (g)	1.30**	0.08	0.27**	0.54**	0.91**	1.82**	3.20**	-1.03**	-0.97**	-0.31**	0.57**	2.75**
10.	Kernel yield per plant (g)	1.02**	0.33**	0.26**	0.55**	0.92**	1.80**	1.80**	-0.62**	-1.00**	-0.37**	1.09**	2.87**
11.	LLS score	0.46**	-0.26**	0.44**	-0.17**	0.22**	0.80**	-0.64**	-0.36	-0.85**	-0.59**	-0.50**	-0.74*
12.	Rust score	0.44**	1.45**	0.21**	-0.13**	0.12	0.70**	-1.15**	2.16**	-1.41**	-1.14**	-0.64**	-0.33

C1 - ICGV 00350 × GPBD 4, **C2 -** ICGV 03128 × GPBD 4, **C3 -** TMV Gn 13 × GPBD 4, **C4 -** VRI 2 × GPBD 4, **C5 -** CO 7 × GPBD 4, **C6 -** CO 7 × COG 0437

*, ** Significant at 5 % and 1 % level of probability, respectively.

Positive skewness was observed in both the crosses for kernel yield per plant, pod yield per plant, number of primary branches, number of pods per plant, 100-pod weight, shell weight and late leaf spot score. And the characters plant height (CO 7 × GPBD 4), shelling percentage and rust score (CO 7 × COG 0437) also possessed positive skewness.

Negative skewness was registered in both the crosses for sound mature kernel per cent while, the cross CO 7 × GPBD 4 indicated the same for 100-kernel weight and shelling percentage.

Kurtosis

BC_1F_1 generation

With regard to kurtosis in BC_1F_1 generation, mesokurtosis was observed for plant height and number of primary branches (ICGV 00350 × GPBD 4), number of pods per plant, shelling percentage and late leaf spot score (ICGV 03128 × GPBD 4). Additionally, the character 100-kernel weight registered mesokurtosis in crosses *viz*., ICGV 00350 × GPBD 4, ICGV 03128 × GPBD 4 and TMV Gn 13 × GPBD 4 also.

Leptokurtosis was exhibited in all four crosses for sound mature kernel per cent and in the cross ICGV 00350 × GPBD 4 for kernel yield and pod yield per plant. In addition to these characters, plant height (ICGV 03128 × GPBD 4 and TMV Gn 13 × GPBD 4), number of primary branches (TMV Gn 13 × GPBD 4 and VRI 2 × GPBD 4), number of pods per plant (ICGV 00350 × GPBD 4 and VRI 2 × GPBD 4), 100-pod weight (ICGV 03128 × GPBD 4), 100-kernel weight (VRI 2 × GPBD 4), shell weight (ICGV 00350 × GPBD 4 and TMV Gn 13 × GPBD 4), shelling percentage (ICGV 00350 × GPBD 4, TMV Gn 13 × GPBD 4 and VRI 2 × GPBD 4) and rust score (ICGV 03128 × GPBD 4) also recorded leptokurtic nature.

Platykurtosis which indicated more variability was registered in all the crosses except ICGV 00350 × GPBD 4 (kernel yield and pod yield per plant) and ICGV 03128 × GPBD 4 (100-pod weight, late leaf spot score and rust score). Similarly, the characters *viz*., plant height (VRI 2 × GPBD 4), number of primary branches (ICGV 03128 × GPBD 4), number of pods per plant (TMV Gn 13 × GPBD 4) and shell weight (ICGV 03128 × GPBD 4 and VRI 2 × GPBD 4) also showed platykurtic nature.

BC_2F_1 generation

In case of BC_2F_1 generation, mesokurtosis was observed in the cross CO 7 × GPBD 4 for 100-pod weight whereas, the cross CO 7 × COG 0437 exhibited the same for plant height, number of primary branches, 100-kernel

Table 2 : Population distribution for 12 characters among six backcrosses of groundnut.

S. no.	Character	Skewness						Kurtosis					
		BC_1F_1			BC_2F_1			BC_1F_1			BC_2F_1		
		NO	PS	NS	NO	PS	NS	MK	LK	PK	MK	LK	PK
1.	Plant height (cm)	-	1	2,3,4	6	5	-	1	2,3	4	6	5	-
2.	Number of primary branches	2	1,3	4	-	5,6	-	1	3,4	2	6	5	-
3.	Number of pods per plant	-	1,2,3,4	-	-	5,6	-	2	1,4	3	-	5,6	-
4.	100-pod weight (g)	1,4	-	2,3	-	5,6	-	-	2	1,3,4	5	6	-
5.	100-kernel weight (g)	-	2	1,3,4	6	-	5	1,2,3	4	-	6	5	-
6.	Shell weight (g)	-	1,2,3,4	-	-	5,6	-	-	1,3	2,4	-	5,6	-
7.	Shelling percentage	-	-	1,2,3,4	-	6	5	2	1,3,4	-	-	6	5
8.	SMK (%)	-	-	1,2,3,4	-	-	5,6	-	1,2,3,4	-	6	5	-
9	Pod yield per plant (g)	2	1,2,4	-	-	5,6	-	-	1	2,3,4	-	5,6	-
10.	Kernel yield per plant (g)	-	1,2,3,4	-	-	5,6	-	-	1	2,3,4	-	5,6	-
11.	LLS score	-	1,3	2,4	-	5,6	-	2	-	1,3,4	-	-	5,6
12.	Rust score	-	1,2,3	4	5	6	-	-	2	1,3,4	6	-	5

1- ICGV 00350 × GPBD 4, **2-** ICGV 03128 × GPBD 4, **3-** TMV Gn 13 × GPBD 4, **4-** VRI 2 × GPBD 4, **5-** CO 7 × GPBD 4, **6-** CO 7 × COG 0437

NO - No skewness, **PS** - Positive skewness, **NS** - Negative skewness, **MK** - Mesokurtosis, **LK** - Leptokurtosis, **PK** - Platykurtosis.

weight, sound mature kernel per cent and rust score.

Leptokurtosis was registered in both the crosses *viz*., CO 7 × GPBD 4 and CO 7 × COG 0437 for kernel yield per plant, pod yield per plant, number of pods per plant and shell weight. In addition to these characters, plant height, number of primary branches, 100-kernel weight and sound mature kernel per cent (CO 7 × GPBD 4), 100-pod weight and shelling percentage (CO 7 × COG 0437) also recorded leptokurtic nature.

Platykurtosis was exhibited in both crosses for late leaf spot score whereas, in the cross CO 7 × GPBD 4 for the characters *viz.,* shelling percentage and rust score. These findings are similar to the reports of Priyadharsini (2012) and Anitha (2013) for one or more characters.

Conclusion

Considering the skewness, negative skewness was observed in all the six backcross populations for 100-kernel weight, sound mature kernel per cent and shelling percentage, except the cross CO 7 × COG 0437 (100-kernel weight and shelling percentage) and ICGV 03128 × GPBD 4 (100-kernel weight). In addition to these characters, 100-pod weight (ICGV 03128 × GPBD 4 and TMV Gn 13 × GPBD 4) and number of primary branches (VRI 2 × GPBD 4) were also negatively skewed. Negatively skewed distribution indicated that the individuals are clustered towards higher mean values. Apart from these characters, plant height (ICGV 00350 × GPBD 4 and CO 7 × GPBD 4), disease scores in all the six backcrosses except the cross VRI 2 × GPBD 4 (late leaf spot and rust score), ICGV 03128 × GPBD 4 (late leaf spot) and CO 7 × GPBD 4 (rust score) registered positive skewness which indicated that the individuals are clustered towards lower mean values.

Regarding the kurtosis, the crosses *viz.,* ICGV 03128 × GPBD 4, TMV Gn 13 × GPBD 4 and VRI 2 × GPBD 4 exhibited platykurtosis for pod and kernel yield per plant which indicated the presence of more variability. All backcross populations possessed platykurtosis for disease scores except the cross ICGV 03128 × GPBD 4 (late leaf spot and rust score) and CO 7 × COG 0437 (rust score). Similarly, the characters *viz.,* plant height (VRI 2 × GPBD 4), number of primary branches (ICGV 03128 × GPBD 4), number of pods per plant (TMV Gn 13 × GPBD 4), 100-pod weight (ICGV 00350 × GPBD 4, TMV Gn 13 × GPBD 4 and VRI 2 × GPBD 4), shell weight (ICGV 03128 × GPBD 4 and VRI 2 × GPBD 4) and shelling percentage (CO 7 × GPBD 4) also showed platykurtic nature. In terms of shape, these characters showed lower, wider peak around the mean and thinner tails. Hence, as a concluding remark based on measures of shape in both BC_1F_1 and BC_2F_1 generation, directional selection will effectively improve the *per se* performance of these traits.

References

Anitha, B. K. (2013). Identification of quantitative trait loci for oil yield and marker assisted backcross for high oleic acid

in groundnut (*Arachis hypogaea* L.). *Ph.D. (Ag.) Thesis*. Submitted to the Tamil Nadu Agricultural University, Coimbatore.

Balanda, K. P. and H. L. MacGillivray (1988). "Kurtosis: A Critical Review". *The American Statistician*, **42(2)** : 111-119.

Hutchinson, G. E. (1958). Concluding remarks. Cold Spring Harbor Symp. *Quantitative Biology*, **22** : 415-427.

Kapur, S. K. (1981). *Elements of practical statistics*, Oxford and IBH Publishing Co., New Delhi, pp. 148-154.

Pearson, K. (1929). Inequalities for moments of frequency functions and for various statistical constants. *Biometrika*, **21(1-4)** : 361-375.

Priyadharshini, M. (2012). Molecular marker analysis for yield and yield component traits under non stress and drought stress conditions in groundnut (*Arachis hypogaea* L.). *Ph.D.(Ag.) Thesis*. Submitted to Tamil Nadu Agricultural University, Coimbatore.

Subrahmanyam, P., J. H. Williams, D. McDonald and R. W. Gibbons (1984). The influence of foliar diseases and their control by selective fungicides on a range of groundnut (*Arachis hypogaea* L.) genotypes. *Annals of Applied Biology*, **104** : 467-476.

Subrahmanyam, P., D. McDonald, F. Waliyar, L. J. Reddy, S. N. Nigam, R. W. Gibbons, V. R. Rao, A. K. Singh, S. Pande, P. M. Reddy and P. V. Subba Rao (1995). Screening methods and sources of resistance to rust and late leaf spot of groundnut, *Information Bulletin No*. 47. ICRISAT, Patancheru, A.P., India, pp. 24.