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Original article

Genetic Analysis of Groundnut Genotypes for Quality Related Traits

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Abstract

Groundnut (*Arachishypogaea*) is an important cash crop of Pakistan. Groundnut has nutritional features like calcium, phosphorous, iron, zinc, proteins vitamin E and vitamin B complex. Little work has been done so far on groundnut quality aspects.Keeping this in mind present study was conducted comprising of eight groundnut genotypes collected from Barani Agriculture Research Institute (BARI) Chakwal which were evaluated for quality traits and their inheritance mechanism during Kharif season, 2016. Biochemical analysis for different traits were performed like protein content, oil content, calcium, phosphorous, iron, amino acid and Aflatoxin. The collected data were subjected to statistical analysis for ascertaining the significance of traits. Genotype 11CG005 gave good performance regarding oil content, iron content while genotype 11CG004 performed best for protein content and calcium content and it was also in safer limits for aflatoxin content. For phosphorous content, genotype 10CG008 gave best performance whereas genotype 11CG003 showed better results for amino acid content. High heritability with high genetic advance was showed by oil content, calcium content and protein content which indicated additive type of gene action for these traits while aflatoxin, amino acid, phosphorus and iron showed moderate heritability with little genetic advance which indicated predominance ofnon-additive type of gene action for the studied traits.The study is helpful in generating detailed information on quality traits of groundnut that can be used in future groundnut breeding programs of the country.

Keywords: Quality evaluation, Oil, Protein, Calcium, Phosphorus, Iron, Amino acid, Aflatoxin.

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INTRODUCTION

Groundnut is an herbaceous crop belonging to Fabaceae family. Plant may be erect or spreader type with thin stem and alternate leaves. It has yellow flowers from which pegs are produced these pegs penetrate into the soil and nuts are produced underground thus named as groundnut. In oil seed crop it is ranked first in position and in food crop on 13th position. Genomic constitution of cultivated groundnut is AABB and it is segmental allopolyploid originate from hybridization between two diploid species (Din *et al.,* 2012).

Groundnut is an important food and oil crop in the semiarid tropics, contributing to household food consumption and cash income.Groundnut is grown in more than 100 countries covering over26 million (M) hectares (ha) area in 2014 with a global production ofabout 44 M metric tons and an average yield of about 1,655 kg/ha(FAOSTAT 2017). Asia (58.3%) and Africa (31.6%) accounted forabout 90% of the world's production with China (16.6 M tons), India(6.6 M tons) and Nigeria (3.4 M tons) being the top three largestproducing countries (FAOSTAT, 2017).Its seed contains about 35-55% oil content. Its oil is good for health as it contains 22% linoleic acid, 61% oleic acid and also contains 26% proteins along with small quantities of calcium, phosphorous, iron, zinc and boron. It is beneficial for health as it contains vitamins, fats, antioxidants, proteins and minerals. Besides its benefits, it is reported that it causes allergies in some peoples, also the Aflatoxin produced in groundnut are the cause of liver cancer and the alpha linoleic acid present in groundnut oil is the cause of prostate cancer (Janila*et al.,* 2011 ; Desmae*et al.,* 2018)

Groundnut has many economic importance used in edible oil production, cosmetics, as a cover crop, highly nutritious for human body, as a fodder, in organic farming, and its residues are used for animal feed. In India, it is used as edible oil while in some other countries including India it is used in confectionary due to high protein content, high energy value and low cholesterol. Knowledge of genetic control of quality traits is important in crop improvement procedure. Earlier studies revealed that additive gene action and GCA controls the important economic traits in groundnut while recent studies indicate that both additive and non-additive type of gene action plays significant role in controlling quality traits (Lal *et al.,* 2014. Alam*et al.,* 2013).

Quality of groundnut is determined by its physical, sensory, chemical and nutritional factors. Physical factors include seed size, seed shape, seed weight, blanching efficiency. Sensory factor includes flavor, texture and color. Nutritional factor includes protein content, oil content, vitamins, antioxidants, carbohydrates, fatty acid composition and minerals (Janila*et al.,* 2013; SK Tirkey*et al.,* 2018).

Keeping in view the importance of quality traits of groundnut the present study was carried out with the objective to study the inheritance mechanism of quality related attributes in different groundnut genotypes.

Materials and Methods

The present study was conducted at University Research Farm (URF), Koont Chakwal during Kharif Season, 2016. For this purpose, eight promising groundnut genotypes possessing good quality traits were collected from Barani Agriculture Research Institute (BARI), Chakwal. Selected groundnut were sown at University Research Farm (URF), Koont following Randomized Complete Block Design (RCBD) with three replications. Row to row distance was kept as 30 cm and plant to plant distance was kept as 10 cm.

Statistical Analysis

The data regarding different biochemical traits such as oil content, calcium content, iron content, protein content, aflatoxin content, phosphorus content, amino acid content were recorded and were subjected to Analysis of Variance by using statistical software 8.1(Steel *et al.,* 1997) to ascertain the significance of traits and means were compared according to mean differences.Broad sense heritability and genetic advance of different quality traits were calculated according to Johnson *et al*., (1955).

Results and Discussion

Genotypes were evaluated for different biochemical analysis. Analysis of variance indicated that all the parameters showed significant results except protein and aflatoxin (Table a). All the attributes indicated highly significant differences among groundnut genotypes. All the genotypes depicted the high genetic variability, broad sense heritability and genetic advance was recorded in calcium, oil, protein, aflatoxin and aminoacid content respectively. These things showed that groundnut genotypes can be improved through selection procedure.

Results for the mean comparison of recorded quality traits were determined during the study (Figure 1).Maximum value of calcium was noted in 11CG004 (57.4) followed by genotype 11CG005 (55.59) and genotype 11CG002 (55.5), whereas minimum values was recorded in genotype 10CG009 (49.43) respectively.Our results are well supported by the similar findings of Ehsun*et al.*(2013) during their study on groundnut. The calculated broad sense heritability in groundnut for calcium was (96 %) coupled with high genetic advance (3.8129) which showed that studied traits is highly heritable and showed considerable improvement over the parents(Table c). Thornten*et al.* (2014) reported that calcium content was heritable as it is converted as it is correlated with pod size, seed and hull percentage.

In addition maximum value for oil content was recorded in genotype 11CG005 (53.2) and minimum value were observed in genotype 10CG008 (44.2). The percentage of oil content of groundnut

in present study is supported by Asibuo et al.(2008).The calculated heritability for oil content was 97 % coupled with higher genetic advance 4.4638 (Table b) which showed that potential of this trait is heritable and showed considerable improvement over the parents.

Moreover,maximum protein content value was recorded in genotype11CG004 (30.42) and 11CG003 (29.42) whereas minimum value was recorded in genotype 10CG008(20.20) respectively. Maximum value of iron content was recorded in genotype 10CG007 (0.80) and minimum values were recorded in genotype 10CG009 (0.164). The result of present study is in agreement with the findings of Ayoola*et al.*(2012).They calculated heritability for protein content was (96 %) coupled with higher genetic advance of 5.0736 (Table.c) which showed that the studied trait is highly heritable and depicted considerable improvement over the parents.

The maximum value of phosphorus content was noted in genotype 10CG008 (0.92) whereas minimum value was recorded in genotype 11CG005 (0.64). Results of present study are supported by Ayoola*et al.*(2012). The current study is also in line with the findings of Jonah *et al.*(2013). The calculated heritability for iron percentage was (98 %) coupled with low genetic advance (0.300) (Table. c).

The highest value for aflatoxin was recorded in genotype 11CG004 (3.7) while minimum value was recorded in genotype 10CG007 (2.44). The results are in range of work done by Jabeen*et al.*(2011) on groundnut for aflatoxin. The calculated heritability for aflatoxin was 69 % coupled with low genetic advance of 0.57 (Table c), which showed moderate heritability while minimum genetic advance in the next generation.

The Maximum value for aminoacid was recorded in genotype 11CG003 (3.86) and minimum value was observed in genotype 11CG004 (2.94).Our Results are in line with Alam*et al.*(2013) in their previously conducted research on groundnut. The calculated heritability for amino acid was (75 %) coupled with low genetic advance (0.34) (Table c), which showed that the studied trait is moderately heritable and minimum chances of improvement over the parents. Amino acids increase the concentration of chlorophyll in the cell thus increasing the rate of photosynthesis.

Conclusion

The present study indicated that groundnut has a good nutritional value. Minerals analyzed in this study are in range of those consumed globally. Groundnut genotypes 11CG005, performed best for oil content, iron content while genotypes 11CG004 performed best for protein content and calcium content. For phosphorous content genotype 11CG008 gave best performance and also had showed high results for amino acid content. These desirable attributes can be commercially exploited in the industry to address the malnutrition problem. Oil content, calcium content and protein content showed high

heritability coupled with high genetic advance which indicates additive type of gene action. However, aflatoxin is a major problem but in these genotypes, it was observed in safer limit.

The present study will be useful in generating detailed information on quality traits of groundnut that can be used in improving groundnut quality for future groundnut hybridization programs.

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Table a. Analysis of variance for quality traits of Groundnut

SOV	**Replication** **D.F=2**	**Genotypes** **D.F=7**	**Error** **D.F=14**
Oil	1.4314	31.8083**	0.6621
Protein	10.8879	42.6095	0.0928
Calcium	2.4307	24.1047**	0.9447
Phosphorus	0.00007	0.02592**	0.00014
Iron	0.00006	0.14267**	0.00014
Aflatoxin	4.6751	0.79401	0.16459
Amino acid	0.08315	0.39403*	0.06426

DF: degree of freedom; SOV: sources of variation

Table b. Estimation of Heritability and Genetic Advance of biochemical parameters of groundnut genotypes

Parameters	**H^2**	**G. A**
Oil	0.979	4.4638
Protein	0.962	5.0736
Calcium	0.961	3.8129
Phosphorous	0.883	0.1149
Iron	0.985	0.3006
Aflatoxin B1	0.7639	0.5728
Amino acid	0.759	0.3849

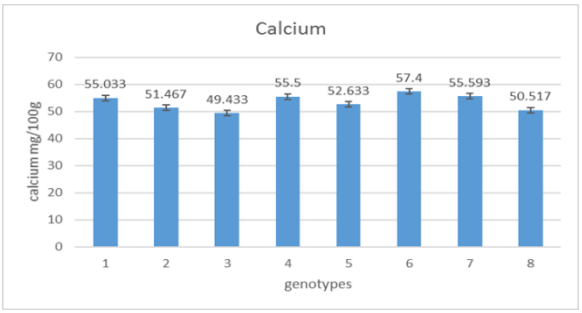

Figure a: Mean values for calcium content

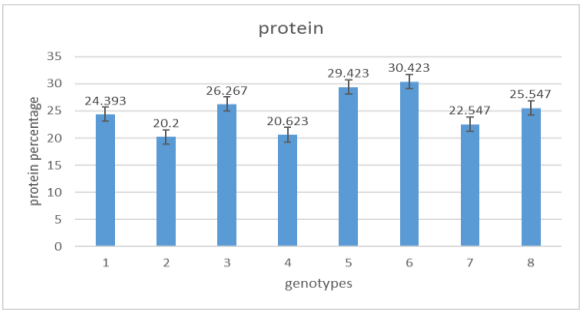

Figure b: Mean values for protein content

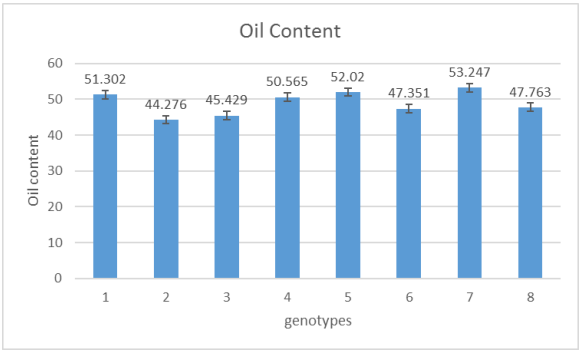

Figure c: Mean values for oil content

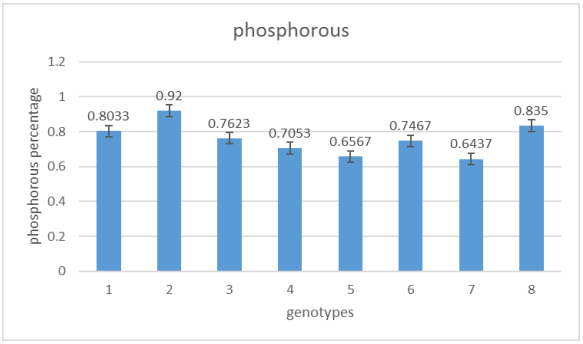

Figure d: Mean values for phosphorous content

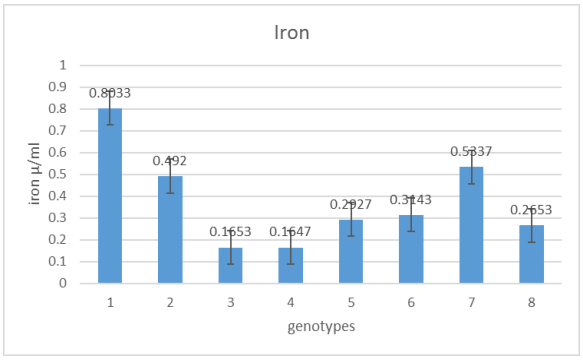

Figure f: Mean values for iron content

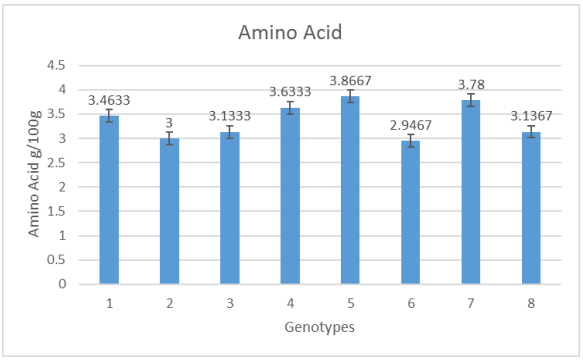

Figure g: Mean values for amino acid co

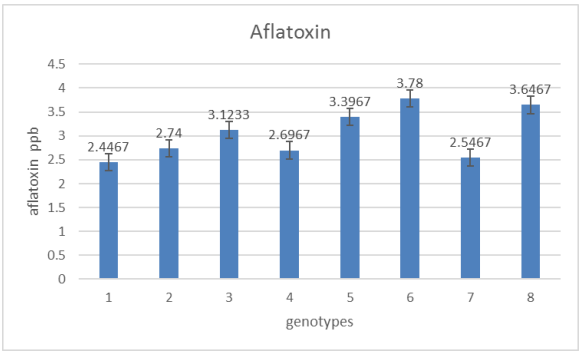

Figure h: Mean values for aflatoxin content

Table c. Proximate composition of groundnut genotype

Genotypes used	**Oil**	**Protein**	**Calcium**	**Phosphorous**	**Iron**	**Aflatoxin**	**Amino acid**
10CG007	51.3019	34.15	54.3	0.809	0.820	30.5	3.73
10CG008	44.2763	29.31	51.4	0.93	0.494	29.02	3
10CG009	44.9780	29.98	49.8	0.763	0.165	31.04	3.12
11CG002	50.4819	29.73	55.5	0.702	0.167	29.8	3.6
11CG003	52.3365	35.59	52.5	0.657	0.298	29.43	3.9
11CG004	47.4741	34.32	57.5	0.748	0.313	30.11	3.02
11CG005	54.3393	32.06	55.8	0.657	0.532	31.12	3.98
11CG007	48.1257	33.94	50.76	0.834	0.268	31.19	3.13