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CORRELATION STUDIES IN EARLY SEGREGATING GENERATION IN GROUNDNUT (*ARACHIS HYPOGAEA* L.)

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ABSTRACT
The present experiment was conducted to study correlation for yield and yield contributing characters in F_3 generation derived from four crosses of groundnut (involving parents; ICGV 05163, ICGV 06045, ICGV 93261, TCGS 1043 and TCGS 913; TCGS 1043 was used as common female parent). Correlation analysis indicated that yield (mature pod weight per plant) was significant and positively associated with number of primary branches per plant (PB) (0.273 to 0.401), plant height per plant (PH in cm) (0.179 to 0.404), pegs number per plant (PN) (0.478 to 0.613), total biomass per plant (TB in g) (0.779 to 0.819), shoot weight per plant (SW in g) (0.448 to 0.542), root weight per plant (RW in g) (0.311 to 0.458), number of mature pods per plant (MP) (0.742 to 0.853), number of immature pods per plant (IM) (0.161to 0.387) , harvest index (HI in %) (0.435 to 0.572) and kernel weight per plant (KW in g) (0.950 to 0.980) for all the four crosses. Hence, suggesting that all the above mentioned characters may be considered as prime traits during the course of selection to have the higher potential yields in case of groundnut.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is one of the main oilseed and food legume crop in India. It is a self pollinated crop with chromosome number, $2n = 4x = 40$. It is being grown in 5.25 M ha with a production of 9.47 M.t and productivity of 1804 kg ha^{-1} (FAO STAT 2014). Groundnut *(Arachis hypogaea* L.) is an important oilseed crop. Cultivated groundnut is a principle source of human nutrition predominantly in tropical and subtropical areas of the world. Groundnuts are an excellent source of plant protein which contains about 45-55% oil, 27-33% protein as well as essential minerals and vitamins. Over 60% of global groundnut production is crushed for extraction of oil for edible and industrial uses, while 40% consumed for food uses and seed purpose. Groundnut oil is an excellent cooking medium because of its high smoking point. Countries like India, China, Myanmar and Vietnam, use groundnut oil for cooking purpose extensively. In any plant breeding programs, understanding the relationships between yield and other characters is of paramount importance for making the best use of these relationships in selection. The efficiency of selection mainly depends on the direction and magnitude of association between yield and its components. Correlation analysis provides an opportunity to study the magnitude and direction of association of yield with its components and also among various components. If primary character *i.e.,* pod yield has a low heritability, consideration of several characters with high heritability correlated to primary character *i.e.,* indirect selection increases the efficiency of selection for yield. The secondary characters that are easier to measure than the primary character can be identified through correlation studies. Such secondary characters can be used for preliminary screening with low selection intensity and mainly in the early generations of selection. Several correlation analysis have been conducted in guar for vegetable pod yield purpose by Girish (2012) and Shabarish and Dharmatti (2014); Kameleshwar *et al.* (2013) in green gram; Lukhele (1981) in sorghum, Jogoly *et al.* (2011) and Kumar *et al.* (2014) in groundnut. Correlation between two characters may be due to linkage and / or pleiotropy. If caused by linkage, an undesirable correlation can be disrupted through hybridization followed by selection in segregating generations. Several correlation studies in segregating generation of groundnut has been done by Balaiah *et al.* (1980); Nagabhushanam *et al.* (1992); Seethala Devi (2004); Raut *et al.* (2010) and John *et al.* (2014). With this view, the present study was conducted to evaluate F_3 generations of four groundnut crosses to determine the association between yield and yield component characters.

MATERIALS AND METHODS

The present investigation was carried out during *kharif* 2013 at Regional Agricultural Research Station, Tirupati situated at an altitude of 182.90 m above mean sea level, 13° N latitude and 79°E longitude. The experimental soil was of sandy clay

loam type. The experimental material consisted of four F_3 populations derived from TCGS 1043 × ICGV 05163, TCGS 1043 × ICGV 06045, TCGS 1043 × ICGV 93261 and TCGS 1943 × TCGS 913 and five parents involved *viz*., ICGV 05163, ICGV 06045, ICGV 93261, TCGS 913 and TCGS 1043. The material was made available by Department of Genetics and Plant Breeding, Regional Agricultural Research Station (RARS), Tirupati. F_3 population in each cross was derived from raising seeds obtained from single pod picked up from each plant in F_2 population. The field was ploughed and harrowed to a fine tilth. Four F_3 populations and five parents were sown in unreplicated plots during *kharif* 2013 at dryland farm of RARS (Regional Agricultural Research Station) Tirupati. The F_3 populations were grown in 15 rows of 5 m length and parents in 4 rows of 5 m length. The parents and the F_3 populations were sown following a spacing of 30 cm between the rows and 10 cm between the plants within a row. The crop was fertilized at 20 kg N, 40 kg P_2O_5 and 50 kg K_2O and 500 kg gypsum per ha in the form of urea, single super phosphate and murate of potash respectively. Weeding was carried out twice before 45 DAS during the crop growth period. Data on the following 17 characters *viz*., number of primary branches per plant (PB), number of secondary branches per plant (SB), plant height per plant (PH in cm), pegs number per plant (PN), pegs to pod ratio (Pegs/Pod), SCMR (SPAD chlorophyll meter reading), SLA (Specific leaf area), total biomass per plant (TB in g), shoot weight per plant (SW in g), root weight per plant (RW in g), shoot to root ratio (S/R), mature pods number per plants (MP), immature pods number per plant (IP), shelling out-turn (SO%), harvest index (HI%) and kernel weight per plant (KW in g) were recorded during the course of experimentation. SLA was determined by dividing leaf are by its dry weight at 60 DAS by using leaf area meter while soil plant analysis development meter reading (SCMR) was recorded on leaflets of third leaf at 60 days after sowing by using SPAD meter. Data were collected on 250 randomly selected plants in each cross and 30 plants in each parent for yield and yield components and correlation analysis was done. Phenotypic correlation coefficients were estimated as per the method given by Johnson *et al*. (1955). The correlation coefficients were calculated for individual crosses.

$$r_p(xy) = \frac{Cov_p(xy)}{(V_p x)^{1/2} (V_p y)^{1/2}}$$

Where,

$r_p(xy)$ = Phenotypic correlation coefficient between x and y characters

$Cov_p(xy)$ = Phenotypic covariance between x and y characters

$(V_p x)$ = Phenotypic variance of character x

$(V_p y)$ = Phenotypic variance of character y

The significance of correlation coefficients were tested by comparing the observed value of correlation coefficients with table value of correlation coefficients given by Fisher and Yates (1963) for n - 2 degrees of freedom.

RESULTS AND DISCUSSION

Number of Primary branches per plant

Number of primary branches per plant showed significant positive correlation with yield in F_3 populations in all the four crosses *viz*., TCGS 1043 × ICGV 05163 (0.348), TCGS 1043 × ICGV 06054 (0.273), TCGS 1043 × ICGV 93261(0.401) and TCGS 1043 × TCGS 913 (0.325) (as Table 1). It means that selection for more number of primary branches can be done to increase yield because this will be reflected in higher mature pod weight per plant which is a trait directly related to yield. The present finding was in accordance with Balaiah *et al*. (1980) who reported that number of primaries had positive and significant association with pod yield in 105 semi-spreading F_2 segregants of groundnut and also with Labana *et al*. (1980) who reported significant positive correlation for number of primary branches with number of pods per plant in F_2 generation of a cross, M 145 × U2 – 47- 3. Bhagat *et al*. (1986) reported that pod yield had a significant positive phenotypic correlation with number of mature pods. Similarly John *et al*. (2014) reported strong positive correlation of pod yield with number of primary branches in six F_2 population of groundnut. The above findings were also supported by Vasanthi *et al*. (2015) in 29 released and pre-released cultivar of groundnut.

Number of secondary branches per plant

Only in the cross, TCGS 1043 × ICGV 93261 (0.161) number of secondary branches showed positive significant correlation with yield and in rest of the three crosses there were found no association of number of secondary branches per plant with yield in F_3 generations. So selection for number of secondary branches in cross TCGS 1043 × ICGV 93261 will increase the yield. The present finding was supported by Sandhu and Khehra (1977) in F_3 generation of C-501 × Ah-6595 and by Nagabhushanam *et al*. (1992) in F_1 and F_2 generation of inter- and intra-specific crosses in groundnut. John *et al*. (2005) also reported significant and positive correlation in four single crosses in groundnut.

Plant height per plant

In all the four crosses *viz*., TCGS 1043 × ICGV 05163 (0.179), TCGS 1043 × ICGV 06054 (0.287), TCGS 1043 × ICGV 93261 (0.194) and TCGS 1043 × TCGS 913 (0.404) plant height showed positive and significant correlation with yield in F_3 populations. The above finding was supported by Labana *et al*. (1980) and Nigam *et al*. (1984) where height of the main axis had positive and significant association with mature pod weight in 97 advanced generation selections of inter sub-specific and intra-sub specific crosses of groundnut. But in contrast, significant negative correlation of height of main axis with yield was reported by Nagabhushnam *et al*. (1992) in F_1 and F_2 generations of inter and intra specific crosses in groundnut.

Pegs number per plant

In all the four crosses viz., TCGS 1043 × ICGV 05163 (0.598), TCGS 1043 × ICGV 06045 (0.478), TCGS 1043 × ICGV 93261(0.548) and TCGS 1043 × TCGS 913 (0.613) pegs number per plant showed positive and significant correlation with yield in F_3 populations. The present result was in accordance with Nigam *et al*. (1984) who reported pod yield was significantly and positively associated with pegs number in ninety-seven advanced generation selections derived from

inter sub-specific and intra sub-specific crosses. Sumathi and Ramnathan (1995) also reported that number of pegs is positively correlated with pod yield in F_3 and F_4 generation of five crosses in groundnut.

Pegs to pod ratio

Significant negative correlation of pegs to pod ratio was found with yield in crosses, TCGS 1043 × ICGV 93261 (-0.218) and TCGS 1043 × TCGS 913 (-0.325). In general, pegs to pod ratio should be low to have a high yield so here significant negative correlation is beneficial to attain high yield. But in case of crosses TCGS 1043 × ICGV 05163 and TCGS 1043 × ICGV 06045, trait pegs to pod ratio was not having any association with yield so here pegs to pod ratio should not be taken as selection criterion for yield improvement.

SPAD chlorophyll meter reading (SCMR)

Non-significant positive correlation of SCMR with yield in F_3 populations in crosses *viz*., TCGS 1043 × ICGV 05163 (0.55), TCGS 1043 × ICGV 06045 (0.18) and TCGS 1043 × ICGV 93261 (0.073) indicates scope for obtaining recombinants with high yield and high SCMR in these crosses as SCMR is highly correlated to WUE (water use efficiency). But in cross TCGS 1043 × TCGS 913 (-0.151), significant negative association was observed with yield hence it cannot be taken as selection criterion for yield improvement. Balota *et al*. (2012) reported positive and significant correlation of pod yield with SCMR in 18 virginia type peanut cultivars. Similarly, Girthai *et al*. (2012) reported positive and significant correlation of SCMR with harvest index in $F^{4:6}$ and $F^{4:7}$ progenies of four crosses in groundnut.

SLA (Specific leaf area)

Significant negative correlation of SLA with yield in F_3 populations of crosses *viz*., TCGS 1043 × ICGV 05163 (-0.153), TCGS 1043 × ICGV 06045 (-0.323) and TCGS 1043 × ICGV 93261(-0.139) was observed indicating that we can have a plant with low SLA and high yield and this correlation is beneficial for obtaining a drought tolerant segregant with high yield and low SLA. In support of present finding, Girthai *et al*. (2012) reported strong negative correlation of SLA with pod yield in 140 peanut lines in the $F^{4:6}$ and $F^{4:7}$ generations of 140 peanut lines.

Total biomass per plant, shoot weight per plant and root weight per plant

For all these three characters same pattern of correlation was observed and that was significant positive association with yield in all the four crosses, TCGS 1043 × IVGV 05163, TCGS 1043 × ICGV 06045, TCGS 1043 × ICGV 93261and TCGS 1043 × TCGS 913. The present finding was supported by Azad and Hamid (2000) where pods number was reported to be significantly and positively associated with pod yield. For total biomass, same result was shown by Korat *et al*. (2010) in a study of 80 bunch type groundnut genotype. Yanbin Hong *et al*. (2012) reported that total biomass had strong positive association with pod yield in 12 peanut varieties. But in contrary to the present finding, Painawadee *et al*. (2009) reported that root dry weight, root length, root surface and root volume were closely related to biomass production but they were not related to yield and yield components in F_2 and F_3 generation of a cross of two parents (ICGV 98324 × KK 4).

Shoot to root ratio

Significant positive correlation of shoot to root ratio was observed in two crosses, TCGS 1043 × ICGV 06045 (0.190) and TCGS 1043 × TCGS 913 (0.198) with yield and in crosses, TCGS 1043 × ICGV 05163 and TCGS 1043 × TCGS 913 it was non - significantly correlation with yield. In contrary to this finding, Yanbin Hong *et al*. (2012) reported significant negative correlation between root to shoot ratio and yield in twelve varieties of groundnut.

Number of mature and immature pods per plant

Significant positive correlation of these two traits were observed with yield in all the four crosses, TCGS 1043 × ICGV 05163, TCGS 1043 × ICGV 06045, TCGS 1043 × ICGV 93261 and TCGS 1043 × TCGS 913. So for yield advantage we can go selection for more number of mature and immature pods per plant. In support of the present finding high positive association of pod yield with number of mature pods was observed by Labana *et al*. (1980) and by Gupta (1987). Several other researchers who supported the above findings in groundnut are Nagabhushanam *et al*. (1992), Pushkaran and Nair (1993), Johar Singh and Mohinder Singh (2001), Borkar and Dharanguttikar (2014) and Parameshwarappa *et al*. (2005).

Shelling out-turn (%)

Significant positive correlation of shelling out-turn was observed with yield in F_3 populations of these three crosses *viz*., TCGS 1043 × ICGV 05163(0.136), TCGS 1043 × ICGV 06045 (0.210) and TCGS 1043 × ICGV 93261(0.223) indicating selection for high shelling out-turn will increase yield in F_3 populations of theses crosses. The present study was in accordance with the findings of Bhagat *et al*. (1986) who reported significant positive phenotypic correlation pod yield with shelling percentage and Pushkaran and Nair (1993) in a

Table 1: Correlation of pod yield with other 16 characters in all the four crosses

	C1	C2	C3	C4
PB	.348 **	.273 **	.401**	.325**
SB	-.008	.034	.161*	.007
PH	.179 **	.287 **	.194**	.404**
PN	.598 **	.478 **	.548**	.613**
Pegs/Pod	.001	-.114	-.218**	-.325**
SCMR	.055	.018	.073	-.151*
SLA	-.153 *	-.323 **	-.139*	-.095
TB	.779 **	.787 **	.814**	.819**
SW	.448 **	.542 **	.513**	.520**
RW	.458 **	.311 **	.343**	.407**
S/R	-.088	.190**	.090	.198**
MP	.742 **	.782**	.853**	.841**
IP	.161 *	.288**	.335**	.387**
SO	.136 *	.210**	.223**	.079
HI	.572 **	.435**	.548**	.457**
KW	.967 **	950**	.980**	.970**

* Significant at 5 % level; ** Significant at 1% level; PB: Primary branches; SB: Secondary branches; PH: Plant height; PN: Pegs number; Pegs/Pod: Pegs/pod ratio; SCMR: SPAD chlorophyll meter reading; SLA: Specific leaf area; TB: Total biomass; SW: Shoot weight, RW: Root weight; S/R: Shoot to root ratio; MP: Mature pod; IP: Immature pod; SO:Shellingout-turn; HI:Harvest index; MPW; Mature pod weight; KW: Kernel weight. C1, C2, C3 and C4 are representing cross first, second, third and fourth respectively.
C1 (TCGS 1043 × ICGV 05163; C2 (TCGS 1043 × ICGV 06045); C3 (TCGS 1043 × ICGV 93261); C4 (TCGS 1043 × TCGS 913)

study of groundnut genotypes. Similar results were registered by Kotazamandis *et al*. (2006) in F_2 generation of four crosses in groundnut, Raut *et al*. (2010) in F_2 generation of six crosses in groundnut and John *et al*. (2014) in six F_2 population of groundnut.

Harvest index (%)

Significant positive correlation of harvest index was observed with yield in F_3 generation of all the four crosses *viz*., TCGS 1043 × ICGV 05163 (0.572), TCGS 1043 × ICGV 06054 (0.435), TCGS 1043 × ICGV 93261(0.548) and TCGS 1043 × TCGS 913 (0.457) indicating that selection for high harvest index will be rewarding for yield enhancement. The present finding was supported by Johar Singh and Mohinder Singh (2001) in five advanced lines and eight segregating populations of two crosses in groundnut. Similarly Vijayasekhar (2002) reported highly significant positive association of pod yield per plant with harvest index. The following researchers also supported the present finding in groundnut are John *et al*. (2005), Painawadee *et al*. (2009) and Korat *et al*. (2010).

Kernel weight

Significant positive correlation of kernel weight was observed with yield in F_3 populations for all the four crosses *viz*., TCGS 1043 × ICGV 05163 (0.967), TCGS 1043 × ICGV 06054 (0.950), TCGS 1043 × ICGV 93261(0.980) and TCGS 1043 × TCGS 913 (0.970) indicating that selection for high kernel weight will be rewarding for increasing yield. The present finding was supported by Mishra and Yadava (1992) who reported significant positive association of kernel weight with dry pod yield in 20 groundnut varieties. The observation of this present study also finds supports by the reports of Vijayasekhar (2002), Phudenpa *et al*. (2004), Seethala Devi (2004), John *et al*. (2005), Parameshwarappa *et al*. (2005), Giri *et al*. (2009), John *et al*. (2009), Ladole *et al*. (2009), Raut *et al*. (2010), John *et al*. (2014) Gupta *et al*. (2015) and Darvhankar *et al*. (2015).

The present results on correlation coefficients revealed that kernel weight per plant, harvest index, number of mature pods per plant, shelling out-turn, number of immature pods per plant, pegs number per plant, number of primary branches per plant, plant height per plant, total biomass per plant, shoot weight per plant and root weight per plant were the most important attributes and may contribute considerably towards higher yield *i.e.,* mature pod weight per plant in all the four crosses. Also there was observed significant negative correlation of SLA with yield and non- significant correlation of SCMR with yield in three crosses indicating the possibilities of getting high yield with low SLA and manipulation of chlorophyll content for yield improvement respectively. Thus all the studied characters should be taken in to consideration while selecting for high yielding genotypes in groundnut.

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NATIONAL ENVIRONMENTALISTS ASSOCIATION

AND ITS OFFICIAL ORGAN

The Bioscan

An International Quarterly Journal of Life Science

Started in 1988, the National Environmentalists Association has been reorganized in 2006 and now is an association functioning with full vigour and new impetus to meet its objectives with the co-operation of like minded environment conscious academicians from different parts of the nation.

MEMBERSHIP OF THE ASSOCIATION

Any graduate having interest in environmental conservation and protection of nature and natural resources can be the member of the association.

To be the member of the association the application form given below should be duly filled up and sent to the Secretary of the association along with a demand draft of Rs. 750/- (After the 25% concession) for annual membership and Rs. 7500/- (After the 25% concession) for life membership.

FELLOWSHIP OF THE ASSOCIATION

The Association is awarding FELLOWSHIP to deserving academicians / researchers /scientists who are LIFE MEMBERS of the Association after reviewing their bio-data by the Fellows and the Executive Members of the association. The Fellows are privileged to write **F.N.E.A.** after their names **.**The prestigious Fellowship also includes a citation in recognition of their contribution to society in general and the endeavour for the noble cause of environment in particular.

AWARDS OF THE ASSOCIATION

The Association in its Seminars and Conferences provides the following category of awards on annual basis.

1. **The young scientists award** : It is given to the researchers below the age of 35 years.

2. **The senior scientists award** : It is awarded to the academicians above the age of 35 years.

3. **The best paper award**: It is awarded to the contributor of the Journal **The Bioscan** during the year.

4. **The best paper presentation award** : It is awarded to the scholar whose presentation is the best other than the young scientist category.

5. **The best oration award** : It is awarded to the scholar who delivered invited speech.

6. **The recognition award** : It is awarded to those senior scholars who have contributed to the subject through their continued research .

7. **The environmental awareness award** : It is awarded to those who, apart from their research contribution, have done commendable extension work for environmental betterment.

The number of recipients of award in each category will vary depending upon the recommendation of the panel of judges and the executive committee. The association has the provision to institute awards in the name of persons for whom a with desired sum is donated in consultation with the executive body.

PUBLICATION OF THE ASSOCIATION

In order to provide a platform to a vast group of researchers to express their views and finding of research as well as to promote the attitude of quality research among the scholars of younger generation the association publishes an international quarterly journal – **THE BIOSCAN (ISSN:0973-7049).** For the benefit of the potential contributors **instructions to authors** is given separately in this journal. However, the details regarding the journal and also the association can be seen on our website *www.thebioscan.in.*

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