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Direct and Indirect Contributions of Yield Attributes to the Kernel Yield of Groundnut (*Arachis Hypogaea* L.) Grown Under *Alectra* Infestation at Samaru, Nigeria

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Abstract: *Field trial was conducted in 1999 and 2000 at Samaru in the northern Guinea Savanna ecology of Nigeria to assess the reaction of 36 groundnut genotypes to Alectra vogelii (Benth). The research field was naturally infested with Alectra. The trial was laid out in randomized complete block design (RCBD) with three replications. The path coefficient analysis of the yield attributes showed that number of pods plant^{-1} exhibited the highest percentage yield contribution of 41.46% to kernel yield. This was followed by 100 kernel weight which contributed 13.80%. The highest combined contribution of 6.23% came from 100 kernel weight and haulm yield. The residual contribution was 23, 24%.*
Key words*: Groundnut, Path-coefficient analysis, Yield contributions.*

I. INTRODUCTION

Groundnut is one of the most important oil seed crop in the Nigerian Savanna. It was one of the major export commodities in Nigeria especially during the pre-independence era. However, most of the present production is consumed locally by indigenous industries. The pods and kernels are boiled or roasted and consumed as snacks locally. Cooking oil is extracted from the kernels, while the residue is further processed into cakes and used as human food or used for formulation of livestock feeds. It serves as one of the easily accessible cheap source of protein to the local population [1]. The composition of the kernel is 5.4% water, 30.4% protein, 47.7% fat and 2.3% ash. It also contains 52mg/100g calcium, 19mg/100g iron, 0.8mg/100g thiamine, 0.12mg/100g riboflavin (and 16mg/100g niacin [2].

The analysis of yield components serves as a framework for identifying the useful traits for yield improvement [3]. Also it serves in assessing the magnitude of the influence of various yield components on yield. In crop production, the foliage serves as the site for production of assimilates. However, under severe infestation of the parasitic weed *Alectra*, defoliation of leaves occur in groundnut, which could have significant consequence in reduction of kernel yield [1]

Therefore the path coefficient analysis of the various yield attributes on groundnut kernel yield could provide useful information as to identifying the components that have significant influence on groundnut kernel yield. This analysis was carried out with the objective of assessing the contribution of different components to the kernel yield of groundnut.

II. MATERIALS AND METHODS

A field trial was undertaken at the experimental research farm of the Institute of Agricultural Research (IAR), Samaru (11^o 11' N, $07^0$38'E) in the semi-arid ecological zone of Nigeria in 1999 and 2000 cropping seasons. The soil of the area is categorized broadly as alfisol. The soil of the experimental site has loamy texture with pH of 5.8, total N 0.2g kg; P 10.1 mg kg, 2.35 c mol kg^{-1}, Thirty-six groundnut genotypes were evaluated, out of this six were from IAR and thirty from International Research for Semi-Arid Tropics (ICRISAT). The treatments were replicated thrice and laid out in randomized complete block design (RCBD). The research field had natural *Alectra* infestation.

Sowing was carried out in the first week of July in 1999 and mid-June, in 2000. Each plot consisted of four ridges that were 75cm apart and 3m in length (9m^2). Two seeds were sown per hill at intra-row spacing of 25cm. Phosphorus was applied at the rate of 22 kg Pha^{-1} as side placement at two weeks after sowing (WAS) using single superphosphate (SSP) as source of material. Weed control was affected using hand weeding at 2, 5 and 8 WAS. Weeds were hand pulled during the last two weeding to avoid destroying the un-emerged and emerged *Alectra* shoots.

The number of emerged *Alectra* shoots from the net plot area (4.5m^2) of each plot was taken weekly from the time the first emerged *Alectra* shoot was observed in the research field. The yield was determined from the net plot area of each plot. Data collected were subjected to statistical analysis and the means separated using Duncan Multiple Range Test [4] Correlation was run for the various groundnut characters using SAS package, while scientific analyzer was used for computing the P values (direct contributions).

III. RESULTS

The direct and indirect contributions of groundnut yield attributes to groundnut kernel combined for 1999 and 2000 cropping seasons are presented in Table 1. Direct contribution of groundnut pod number to kernel yield was 0.6439, while indirect contribution via shelling percentage, 100-kernel weight and haulm yield were 0.0182, 0.0202 and 0.0124 respectively; giving a total contribution of 0.6947. Direct contribution of shelling percentage was 0.1857, whereas indirect contribution through pod number, 100 kernel weight and haulm yield were 0.0630, 0.0942 and -0.0109 respectively with resultant total contribution of 0.3320. Direct contribution of 100 kernel weight was 0.3715, while indirect contributions via pod number, shelling percentage and haulm yield were 0.0350, -0.0137 and 0.0838 respectively; giving a total contribution of 0.5374. Direct contribution of haulm yield was 0.1479, with indirect contribution through pod number, shelling percentage and 100 kernel weight were 0.0542, -0.0137 and 0.2106 respectively; while the total contribution was 0.3990.

The direct and combined percentage yield contributions of the yield characters to the kernel yield are presented on Table 2. The direct contribution from various yield attributes showed that the highest direct yield contribution of 41.46% came from pod number plant^{-1} followed by 100 kernel weight giving 13.80% and shelling percentage which contributed 3.45%, while haulm yield gave the least contribution of 2.19%. The combined effect had 100 kernels weight x haulm yield giving the highest contribution of 6.23%, followed by shelling percentage x 100 kernels weight with 3.50%, while pod number x shelling percentage came third with 2.60%. Other combined contributions were pod number x shelling percentage, then pod number x haulm yield which gave 2.34% and 1.60% respectively. However, the combined contribution of shelling percentage and haulm yield was negative (-0.41%). The residual value was 23.24%.

IV. DISCUSSION

The path coefficient analysis showed that number of pods plant^{-1} gave the highest direct contribution and percentage yield contribution to kernel yield, which was more than the contributions of all the other yield components put together. Similarly it was reported that the highest yield contribution in soybeans came from number of pods per plant^{-1} [5]. Therefore from the present study it can be implied that the greatest yield determinant in groundnut is number of pods plant^{-1}. The second best contribution came from 100 kernel weight. This shows the significant influence of seed size on yield. Plump and heavy seeds can enhance crop yield in contrast to shriveled and light seeds. The lowest direct contribution came from haulm yield. However, when combined with kernel weight, it gave the highest combined percentage yield contribution. This shows the positive impact of foliage on kernel weight working together to enhance yield [6, 7] Similar observation of different variables working together to increase yield in lablab and pea cultivars respectively. An investigator [8] remarked on yield as being the outcome of several quantitative characters. The negative contributions of shelling percentage through haulm yield and haulm yield through shelling percentage can account for the negative and least combined contribution (-0.41%) of the two yield characters. Although some appreciable level of vigorous foliage is required for meaningful yield since plant foliage is the site of assimilate production [9, 10, 11], profuse foliage especially in legumes such as groundnut and cowpea can be detrimental to kernel production. Therefore beyond certain optimum level of foliage vigour, high foliage production can have negative effect on kernel production in groundnut. The residual value (23.24%) of percentage yield contribution implies that there are other contributory factors that have not been included in the present analysis. Similar remark was made by [12].

V. CONCLUSIONS

The path analysis has shown that in groundnut number of pods plant $^{-1}$ exerts the greatest impact on kernel yield on groundnut. This is followed by 100 kernel weight. Therefore, breeding work that could enhance the number of pods plant^{-1} could increase groundnut kernel yield.

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Table 1: The direct and indirect contributions of groundnut yield attributes on yield of groundnut grown under *Alectra* infestation at Samaru during 1999 and 2000 rainy seasons combined.

Yield	Effect through				
Attributes	1	2	3	4	5
1	**0.6439**	0.0182	0.0202	0.0124	0.6947
2	0.0630	**0.1857**	0.0942	0.0109	0.3320
3	0.0350	0.0471	**0.3715**	0.0838	0.5374
4	0.0542	-0.0137	0.2106	**0.1479**	0.3990

Direct effects are in bold characters in contrast to indirect effects.
1 = Pod numbers plant^{-1} 2 = shelling percentage.
3 = 100 Kernels weight. 4 = Haulm yield.
5 = Total contributions.

Table 2: Percentage contributions of various yield attributes to the combined kernel yield of groundnut grown under *Alectra* infestation at Samaru during 1999 and 2000 rainy seasons.

Yield Attributes	**Percentage Contribution (%)**
A. **Individual direct contribution**(pi^2)	
Podnumberplant^{-1}	41.46
Shelling percentage.	3.45
100 kernels weight.	13.80
Haulm yield.	2.19
B. **Combined contribution** (2 PiPjrij)	
Pod number plant and shelling percentage.	2.34
Pod number plant^{-} and 100 kernel weight.	2.60
Pod number plant and haulm yield.	1.60
Shelling percentage and 100 kernel weight.	3.50
Shelling percentage and haulm yield.	-0.41
100 kernel weight and haulm yield.	6.23
Residual	23.24
Total	100.00