Journal of Experimental Biology and Agricultural Sciences

http://www.jebas.org

ISSN No. 2320 – 8694

CHARACTERIZATION OF YIELD COMPONENTS IN CERTAIN GROUNDNUT (*Arachis hypogaea* L.) VARIETIES OF ETHIOPIA

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Received – October 08, 2014; Revision – November 26, 2014, Accepted – December 10, 2014
Available Online – December 20, 2014.

KEYWORDS

Yield components

Peanut

Kernel

Pod

Seed

Arachis hypogaea L.

ABSTRACT

Documentation of yield components (pod and seed characteristics) in the groundnut (*Arachis hypogaea* L.) varieties of Ethiopia has not been done so far and the same is not available in the literature. Such literature is required as it forms a platform for further studies in future on plant breeding programmes to improve the traits of this crop in Ethiopia. Hence, a study has been taken up to characterize the pods and seeds in certain important groundnut varieties released by Werer Agricultural Research Centre, Ethiopia. The parameters studied include individual seed weight, number of seeds per pod, 100 pods weight, 100 seeds weight and shelling percent. All the six varieties exhibited statistically significant variations in the studied parameters except shelling percent. Thus, a great extent of genetic diversity is found among the groundnut varieties in Ethiopia. Individual seed weight, 100 pods weight and 100 seeds weight were highest in the variety, Tole 2 while number of seeds per pod was highest in the variety, Werer 964. The parameters analyzed in this investigation were compared with previously available data on days to maturity, oil content and shelled seed yield. Correlation matrix of the studied parameters revealed some interesting relationships among them.

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Peer review under responsibility of Journal of Experimental Biology and Agricultural Sciences.

Production and Hosting by Horizon Publisher (www.my-vision.webs.com/horizon.html).

1 Introduction

Groundnut or peanut is one among the five extensively grown oil crops of Ethiopia (Wijnands et al., 2009). Under rain-fed conditions, it is generally grown and is utilized for extracting cooking oil, and also for confectionary in Ethiopia (Kudama, 2013). Besides, this crop helps small scale producers in getting significant revenue and also helps Ethiopia in getting foreign money earnings through export (Geleta et al., 2007). Plumpy' nut (groundnut nutritional product used for treating malnutrition in children below 2 years) marketing in countries like Ethiopia benefits groundnut producers (Pazderka & Emmott, 2010). Being a legume, groundnut improves soil by fixing nitrogen biologically without consuming non-renewable energies and without disturbing agro-ecological balance (Reddy & Kaul, 1986).

The economically important part of groundnut plant is the pod which encloses the seeds. Groundnut is an unpredictable crop due to the development of pods underground (Zaman et al., 2011). The size of the seed and the number of seeds per pod are important criteria that determine the market value of groundnut in general. In addition, the pod and seed characteristics (yield components) are important in selecting parent plants before a hybridization experiment is performed with an objective to get improved varieties with heterosis.

The harvest in groundnut can be augmented up to 30% - 89% if high yielding varieties are identified (Reddy et al., 1993). To get such improved varieties, the prerequisite is characterization of yield components (pods and seeds) of groundnut, which however, has not been carried out in Ethiopia so far and hence; such information is not available in literature.

Hence, a study has been carried out to characterize the yield components of certain important groundnut varieties of Ethiopia. The results of the study are expected to form a foundation for further studies in future on plant breeding/improvement programmes.

2 Materials and Methods

Six groundnut varieties namely, Roba, Werer 962, NC -4x, Fayo, Tole 2 and Werer 964 were collected from Werer Agricultural Research Centre, Ethiopia during April 2014. The six varieties selected for this study are the best performers among the various varieties released by Werer Agricultural Research Centre (personal communication). Parameters such as individual seed weight, number of seeds per pod, 100 pods weight, 100 seeds weight and shelling percent were studied in the present investigation in order to characterize the pods and seeds of these groundnut varieties.

Number of seeds pod^{-1} is calculated from the average number of seeds obtained from 10 randomly selected mature pods. 100 pods weight (g) and 100 seeds weight (g) are obtained from random sample of 100 pods and 100 seeds, respectively and weighed. Individual seed weight (g) was calculated from 100 seeds weight (g). Shelling percent is calculated using the following formula: Shelling (%) = [weight of all seeds from 10 randomly selected pods/weight of 10 randomly selected pods] X 100. All parameters were analyzed three times and the data were subjected to statistical analysis adopting randomized block design using WASP (WEB AGRI STAT PACKAGE Version 2.0), developed by Ashok Kumar Jangam and Pranjali Thali, ICAR Research Complex for Goa, India. Critical difference (CD) values were calculated at 0.05 and 0.01 levels to find out whether statistically significant differences exist among the varieties in terms of studied parameters. A correlation matrix of the studied parameters has also been worked out using the same application to find out relationship among them.

3 Results

The pods and seeds of the six groundnut varieties can be visualized in Figure 1 and 2. The figures illustrate clearly the size, colour and appearance of the pods and seeds of the studied groundnut varieties in comparison to each other. Data on days to maturity, oil content and shelled seed yield of these varieties are presented in Table 1.

Table 1Days to maturity, Oil content and Shelled seed yield in the Groundnut Varieties of Ethiopia.

Varieties	Days to Maturity*	Oil (%)*	Shelled seed Yield (qt/ha)**
Roba	125	49.0	23.20
Werer 962	130	47.8	28.58
NC-4x	150	46.0	23.62
Fayo	130-155	45.5	22.18
Tole 2	145-157	47.0	18.86
Werer 964	128	46.2	16.84

*Source: Werer Agricultural Research Centre

**Source: Average shelled seed yields across three districts (Dale, Dara & Loca-Abaya) in Ethiopia obtained from DCG Report No.74 (Alemayehu et al., 2014)

Table 2 Seed and Pod Characteristics in Various Groundnut Varieties of Ethiopia

Varieties	Individual seed weight (g)	No. of seeds/pod	100 pods wt.(g)	100 seeds wt. (g)	Shelling %
Roba	0.533 ^{bc}	2.0 ^{c}	144.0 ^{c}	53.33 ^{bc}	74.0 ^{a}
Werer 962	0.400 ^{d}	2.8 ^{b}	154.3 ^{c}	40.00 ^{d}	72.5 ^{a}
NC-4x	0.570 ^{b}	1.9 ^{c}	144.3 ^{c}	57.00 ^{b}	75.2 ^{a}
Fayo	0.570 ^{b}	2.0 ^{c}	145.7 ^{c}	57.00 ^{b}	78.4 ^{a}
Tole 2	0.910 ^{a}	2.0 ^{c}	254.3 ^{a}	91.00 ^{a}	71.7 ^{a}
Werer 964	0.473 ^{cd}	3.3 ^{a}	210.3 ^{b}	47.33 ^{cd}	74.2 ^{a}
Statistical Significance:					
CD (0.05)	0.075	0.48	12.3	7.65	NS*
CD (0.01)	0.109	0.69	17.5	10.90	NS
CV (%)	7.30	11.50	3.86	7.30	14.38

In a column, values followed by same alphabet are not significant at 0.05 level.

There is vast variation in the number of days to maturity (DTM) among the groundnut varieties studied (Table 1). DTM ranges from 125 to 157. Among the varieties studied, Roba matures early and Tole 2 matures late. Oil content in the seeds ranges from 45.5 % (Fayo) to 49 % (Roba). The shelled seed yield (qt/ha) is highest in the variety, Werer 962 (28.58) and lowest in Werer 964 (16.84) (Table 1).

There were statistically significant differences among the varieties in terms of individual seed weight, number of seeds pod^{-1}, 100 pods weight and 100 seeds weight. Individual seed weight is highest in the variety Tole 2 (Table 2) and lowest in the variety Werer 962.

100 seeds weight which is a measure of seed size (Zamurrad et al., 2013), also followed the same trend as individual seed weight because individual seed weight was calculated from 100 seeds weight. Therefore, there was a correlation coefficient of 0.999 between individual seed weight and 100 seeds weight, which was significant at 0.001 level (Table 3).

100 pods weight was highest in Tole 2 and lowest in Roba (Table 2). A higher shelling percent indicates less seed case (pod) weight and more seed weight and so, it is preferable. Shelling per cent was not statistically different among the different varieties studied although it ranged from 71.7 % to 78.4 %.

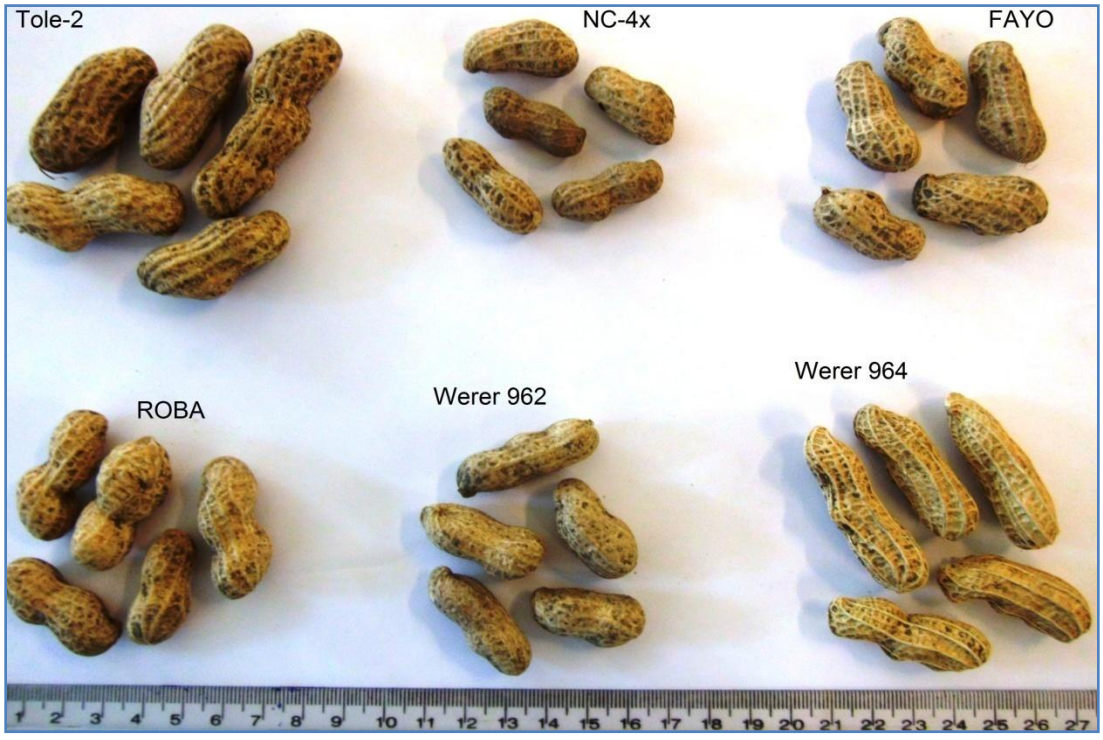

Figure 1 Pods of certain groundnut varieties of Ethiopia.

Table 3 Correlation Matrix of Studied Parameters in the Groundnut Varieties of Ethiopia

Parameters	DTM	Oil (%)	SSY	ISW	NSP	100P	100S
Oil (%)	-0.576						
SSY	-0.153	0.377					
ISW	0.715	-0.117	-0.486				
NSP	-0.601	-0.033	-0.178	-0.531			
100P	0.274	-0.106	-0.69	0.69	0.238		
100S	0.719	-0.114	-0.481	0.999*	-0.538	0.693	
Shelling (%)	0.109	-0.583	-0.024	-0.263	-0.255	-0.578	-0.265

* Significant at 0.001 level; n=6

DTM - Days to Maturity; SSY - Shelled seed yield (qt/ha); ISW - Individual seed weight (g); NSP - Number of seeds/pod; 100P - 100 pods weight (g); 100S - 100 seeds weight (g)

Table 3 shows some interesting relationships among the studied parameters although they are statistically insignificant. Days to maturity (DTM) positively correlated with individual seed weight and 100 seeds weight. DTM negatively correlated with oil content and number of seeds pod^{-1}. There was also negative relationship between oil content and shelling percent and also between shelled seed yield and 100 pods weight. Individual seed weight has positively correlated with 100 pods weight and negatively correlated with number of seeds pod^{-1}. 100 seeds weight had positive relationship with 100 pods weight and negative relationship with number of seeds pod^{-1}. Shelling per cent and 100 pods weight are negatively related.

Discussion

Some important and interesting characteristics of the groundnut varieties of Ethiopia were noticed in this study. The variety, Tole 2 which has the highest individual seed weight, requires the highest number (145-157) of days to reach maturity (Table 1 & 2). It can be understood that the production and translocation of photosynthates from the leaf to the seed will continue as long as the crop stays alive on the field and hence, Tole 2 must be able to gain more individual seed weight. The variety, Roba that had the lowest 100 pods weight, matures early (125 days) and has highest oil content (Table 1 & 2).

It is interesting to note that the variety, Werer 962 which has the lowest individual seed weight, gave the highest shelled seed yield (Table 1 & 2). Albeit number of seeds pod^{-1} was highest in Werer 964 (Table 3), it gave the lowest shelled seed yield. From these results, it can be inferred that yield in groundnut does not depend merely on individual seed weight and number of seeds pod^{-1}, but it depends on pod/seed yield plant^{-1}. Shah et al., 1993 reported that yield was positively correlated with pods per plant.

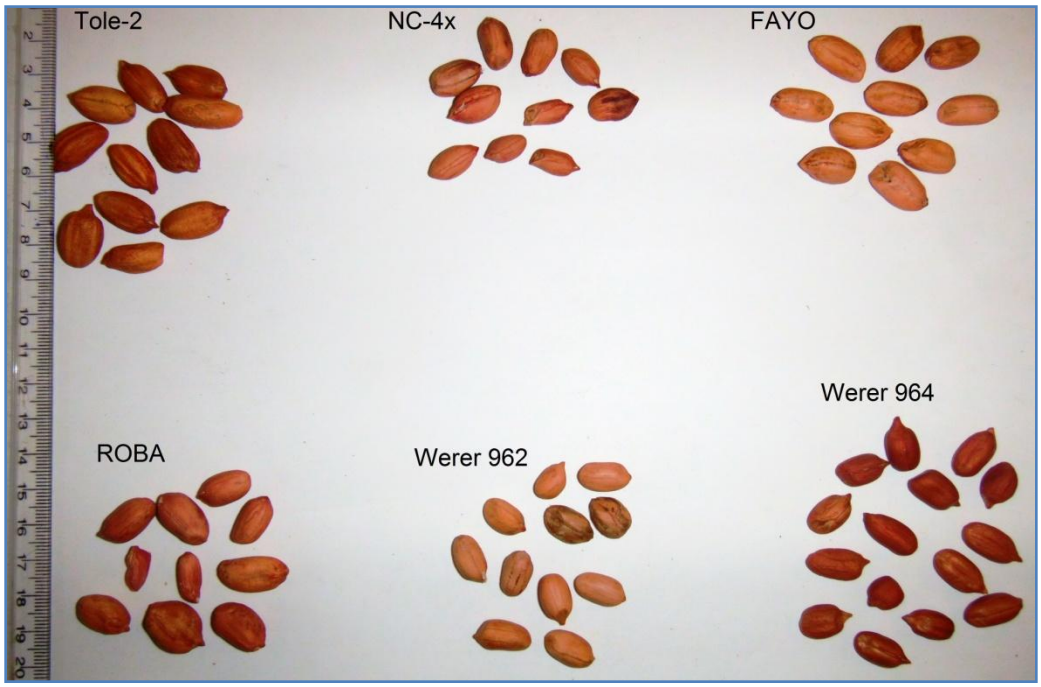

Figure 2 Seeds of certain groundnut varieties of Ethiopia.

Diversity and selection are two major principles of plant improvement program and selection has high efficiency when there is desired genetic diversity in studied characteristics (Sadeghi et al., 2011). Genetic diversity is one of basic requirements of development in plant breeding. Although groundnut is self-pollinating and possesses limited variability, the statistically significant differences among the studied groundnut varieties in terms of individual seed weight, number of seeds pod^{-1}, 100 pods weight and 100 seeds weight indicate that there is great extent of genetic diversity among the groundnut varieties in Ethiopia. This broader genetic diversity of Ethiopian groundnut can be used sufficiently in improvement programs to get new varieties with desired traits.

The early maturing variety, Roba has high oil content (Table 1). Tole 2 which has highest individual seed weight must be a desirable variety for abroad customers and hence, it can be exported as it can be a foreign exchange earner. In groundnut, large seeds have consumer and market preference, particularly for confectionery and value addition, in turn fetching premium prices in domestic and international markets (Nadaf et al., 2009).

Acknowledgements

Financial support by Arba Minch University (GOV/AMU/TH14/CNS/BIOL/01/06) is gratefully acknowledged. The authors thank Werer agricultural research center for providing the seeds.

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