Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.8, No.24, 2018

Phenotypic stages of some improved varieties of groundnut (*Arachis hypogaea L)* in the humid South Western Nigeria

F. G. O. Oni[1] and K. O. Oluwasemire[2*]
[1] Department of Crop and Environmental Protection, LAUTECH, Ogbomoso, Nigeria
[2] Department of Agronomy, University of Ibadan, Nigeria
[*]Corresponding author (kooluwasemire@yahoo.com)

Abstract

Background: Groundnut is an important legume crop of tropical and semiarid tropical countries, where it provides a major source of edible oil, vegetable protein and source of raw materials for agro-allied industries. To aid in groundnut research planning, varietal development, crop modeling and for extension workers in recommending time of cultural practices, standard descriptions of some improved (SAMNUT 10, SAMNUT 22 and SAMNUT 23) and local (kampala) varieties of groundnut were recorded.

Methods: The descriptions were based on visually observable vegetative (V) and reproductive (R) events. The V stage recorded was V_E (Emergence: Cotyledons near the soil surface with the seedling showing while some part of the plant visible). The R stages recorded are R_1 (beginning flowering), R_2 (beginning peg), R_3 (beginning pod), R_4 (full pod), R_5 (beginning seed), R_6 (full seed), R_7 (beginning maturity) and R_8 (harvest maturity). A growth stage is reached when 50% of the plants or seeds sampled have achieved or exhibiting the specified the specified trait.

Results: V_E of 7 days after sowing (DAS) was recorded for the improved varieties and 6 DAS for kampala. R_1 was 28 DAS for all the varieties, R_2 of 33 and 35 DAS was recorded for the improved varieties and kampala respectively. R_3 of 43 DAS, R_4 of 56 DAS, and R_5 of 63 DAS for the four varieties. R_6 (76, 74, 75 and 77 DAS for SAMNUT 10, SAMNUT 22, SAMNUT 23 and kampala respectively) and R_7 (93, 93, 92 and 94 DAS for SAMNUT 10, SAMNUT 22, SAMNUT 23 and kampala respectively) varies for the varieties. Harvest maturation, R_8 varies within the varieties; 135 DAS, 120 DAS, 100 DAS and 120 DAS for SAMNUT 10, SAMNUT 22, SAMNUT 23 and kampala respectively.

Conclusions: The stages apply to both improved varieties and the local variety and could be used to schedule cultural practices including irrigation, herbicides, insecticides, fungicides, growth regulators, and harvest.

Key Words: Groundnut, Growth stages, Vegetative events, Reproductive events, Standard descriptions.

Introduction

Description of crop growth stages have facilitated better communication among educators, producers, and researchers concerned with crop development. Growth stages have been defined for crops like soybean (*Glycine max* L. Merr.), corn (*Zea mayz*), sorghum (*Sorghum bicolor* L. Moench), wheat (*Triticum aestivum* L.) and cotton (*Gossypium hirsutum* L.), in order to propose precise, objective descriptions of discrete, visual

phenological events in the morphological and physiological development of a plant (Boote,1982). Growth stages have also been used successfully on some crops to better schedule a variety of cultural practices, including irrigation, herbicides, insecticides, fungicides, growth regulators, and harvest.

Groundnut is one of the most popular commercial crops in the tropics (Misari *et al*., 1988) and the third major oil seed of the world next to soybean and cotton (FAO, 1990). According to the Food and Agriculture Organization of the United Nations (FAO), in 1990 groundnut was grown on approximately 17.5 million hectares worldwide. Seventeen years later, groundnut was reported to be grown worldwide on 26.4 million hectares (FAO, 2007). While Nigeria is the largest groundnut producing country in West Africa, accounting for 51% of production in the region with average productivity of about 964 kg/ha, production is still poor when compared to the US and other developed countries where the productivity is close to 3500 kg/ha (Vara *et al*., 2009).

The main yield limiting factors in semiarid regions are drought and high temperature stress. While water requirement for groundnut growth varies through the cycle, the stages of reproductive development prior to flowering, at flowering, and at early pod development, are particularly sensitive to these constraints. Proper planning to tackle the constraints as required for different stages is therefore necessary.

This study was carried out to determine stages of development for some improved varieties (SAMNUT 10, SAMNUT 22, SAMNUT 23) and local variety (kampala) groundnut. The stages were determined using Boote (1982) description. The study will build capacity for data generation towards sustainable groundnut production in the humid South Western Nigeria.

Methods

Data collection and study setting

Experimental data was obtained from four sowing date trials conducted ot the Teaching and Research Farm of the Ladoke Akintola University of Technology, LAUTECH Ogbomoso (8º07′N; 4º14′E; altitude 341m) in the derived guinea savanna zone of Nigeria. Ogbomoso is located in forest savanna transitional vegetation area (derived savanna) in Nigeria. The climate is hot, humid, and tropical with two distinct seasons; the dry season spans between November and February, and rainy season, which usually occurs from March to November. The rainy season has two peak periods referred to as bimodal rainfall pattern in June and September marked with short period of harmattan in between the seasons.

The soil of the site is an udic paleustalf with surface of sandy loam texture with the following chemical properties: pH (H_2O) of 6.4; organic C 0.65%, N 0.06%, P 3.74 mg kg^{-1}; exchangeable Ca, K, Mg of 0.48, 0.19 and 0.33 cmol kg^{-1}, respectively. Land is mainly used for arable farming (fallow) and the parent material is basement complex. The slope of the land is 0-5% straight, depth of water table >190 cm, soil surface form is flat with effective soil depth of >190cm (Olatunji, 2011).

Experimental details

Groundnut varieties used were SAMNUT 10, SAMNUT 22, SAMNUT 23 and *Kampala* (local variety). The SAMNUT varieties were sourced from the Institute of Agricultural Research, Ahmadu Bello University, Zaria, Nigeria, while kampala was bought from Waso (a local market in Ogbomoso). Four sowing dates (SD) between

April and May at 7 day intervals were used (SD1= 19/04/2010, SD2 = 26/04/2010, SD3 = 03/05/2010, SD4 = 10/04/2010).

The experiment was laid in a split-plot arrangement in a Randomised Complete Block Design (RCBD), with sowing date as the main plot factor and groundnut as the sub-plot factor and replicated three times. Beds of 2.5 m x 2 m were made for each treatment plot with an inter-row spacing of 50 cm and intra-row spacing of 25 cm. Each treatment plot was replicated thrice and each replicate has 16 plots (5 m^2) x 3 to include 1 m spacing between treatments, giving 135 m^2. 1.5 m space was between replicates giving a total land area of 486 m^2.

Growth stage descriptors for groundnut based on visual observations, as described by Boote (1982), based on visually observable reproductive (R) and vegetative (V) events listed below was adapted for this study:

Table 1: **Reproductive and vegetative growth of stages of groundnut**

Stage	Stage title	Description
VE	Emergence	Cotyledons near the soil surface with the seedling showing some part of the plant visible.
R1	Flowering	One open flower at any node
R2	Pegging	One elongated peg (gynophores)
R3	Podding	One peg in soil with swollen ovary at least twice the weight of the peg
R4	Full pod stage	One pod fully expanded to dimensions characteristic for the cultivar
R5	Beginning seed	One fully expanded pod with which seed cotyledon growth is viable when the fruit is cur in cross-section
R6	Full seed	One pod with cavity apparently filled by the seed when fresh
R7	Beginning maturity	One pod showing visible natural colouration or blotching of inner pericarp or testa
R8	Harvest maturity	66 – 75% of all developed pods have testa or pericarp colouration

Adapted from: *Vara et al., 2009.*

Results and discussion

Vegetative growth stages

The emergence stage, V_E is defined as cotyledons near the soil surface with some part of the plant visible in half of the seedlings.

All the improved groundnut varieties used regardless of their sowing dates reached V_E at 7 days after sowing, however, there was variation in V_E of kampala, the local variety used (Table 2). Kampala planted on

April 19 reached VE at 6 (days after sowing) DAP, Kampala planted on April 23 reached VE at 5 DAP, Kampala planted on April 30 reached VE at 10 DAP, and / planted on May 10 reached VE at 7 DAP.

The rate of progression seeding to V_E is primarily dependent on soil temperature, although modified by soil water and seed dormancy mechanisms (Boote, 1982).

Reproductive stages

As defined in Table 1, reproductive stages (R) was determined based upon visually observable events related to flowering, pegging, fruit growth, seed growth, and maturity. R stages are given in Table 2 for SAMNUT 10, SAMNUT 22, SAMNUT 23 AND kampala.

Days to flowering from emergence day were an average of 28 days after emergence for SAMNUT 10, SAMNUT 22 and SAMNUT 23 and Kampala, for SD1, SD2, SD3 and SD4. The number of days between the first flower and first pod had an average of 14 days after the first flower was recorded for SAMNUT 10, SAMNUT 22, SAMNUT 23 and Kampala for SD1, SD2, SD3 and SD4.

SAMNUT 10 showed reduction in number of days to first seed appearance after flowering from SD1 to SD4. First seed in SAMNUT 10 for SD1 was 28 days after flowering, 21 days after flowering for SD2, 17 days after flowering for SD3, and 16 days after flowering for SD4. The earliest pod filling for this experiment was observed in SAMNUT 22 for SD1 with 15 days after flowering. First seed in SAMNUT 22 for SD2 was 23 days after flowering while 28 and 29 days after flowering was recorded in SAMNUT 22 for SD3 and SD4 respectively. First seed in SAMNUT 23 and Kampala for the four sowing dates was between 27 and 29 days after flowering which were statistically the same.

Days to physiological maturity from first seed was 37 days for SAMNUT 23 for all the four sowing dates which make SAMNUT 23 the first to reach physiological maturity after first seed. Kampala matured between 54 and 59 days after first seed which shows no significant difference in days to maturity across the four sowing dates. SAMNUT 22 matured between 57 and 71 days after first seed. This showed that there was a significant difference in maturity of SAMNUT 22 with sowing date. SD1 for SAMNUT 22 was the latest maturing (71 days after first seed), 57 days (SD3 and SD4) after the first seed was the earliest for SAMNUT 22. SAMNUT 10 was the latest maturing of them all with days to maturity after first seed ranging from 72 (SD1) to 84 (SD4).

The days to emergence, flowering and pod formation were not different from each other across the four varieties used. However, days from sowing to pod first seed and maturity varies significantly. Pod weight at harvest varies from the variety and sowing dates. Apart from kampala, other varieties emerged by 7 DAP across the kampala dates. The flowering of the selected varieties from the emergence day across the used varieties was an average of 28 days while pod formation was about 14 days after flowering (35 DAP). Pod filling varies and was affected by sowing date especially in SAMNUT 10 and SAMNUT 22. Days to pod filling for SAMNUT 10 in SD1 was the highest number of days from flowering (28 days), but the days to maturing of same variety was the least (72 days), also for SD1, but days to pod filling for SAMNUT 10 in SD14 was the least number of days from flowering (16 days). The days to maturing of SAMNUT 10 for the same sowing date (SD4) was the highest (84 days). The reverse was the case with SAMNUT 22 where its highest days to maturing (71 days after flowering for SD1) was associated to the least no of days to pod filling of 15 days after flowering.

However, pod filling was not affected by sowing date in kampala and SAMNUT 23. There was a varietal influence on the maturity; SAMNUT 23 can be classified as early maturing (37 days after initiation of pod filling), SAMNUT 22 and kampala medium (60 days and 56 days respectively) while SAMNUT 10 is late maturing (80 days). Early podding does not affect maturing date and the stages followed the same pattern across the sowing date. The difference in performance observed was therefore as a result of varietal difference and not sowing date.

Table 12: Days from sowing to specific growth stages for SAMNUT 10, SAMNUT 22, SAMNUT 23 and Kampala groundnut cultivars at Ogbomoso, Nigeria in 2010

Stages	SAMNUT 10				SAMNUT 22				SAMNUT 23				KAMPALA			
	DAP															
	SD1	SD2	SD3	SD4	SD1	SD2	SD3	SD4	SD1	SD2	SD3	SD4	SD1	SD2	SD3	SD4
V_E	7	7	7	7	7	7	7	7	7	7	7	7	6	5	10	7
R_1	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
R_2	34	32	33	33	33	33	33	33	33	33	33	33	35	35	35	33
R_3	44	45	45	43	42	45	43	44	42	45	43	42	42	45	43	42
R_4	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
R_5	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63
R_6	77	77	76	74	72	76	77	74	73	77	73	76	77	78	77	76
R_7	93	92	94	93	92	93	95	94	91	93	94	92	95	93	93	94
R_8	135	135	135	135	120	120	120	120	100	100	100	100	120	120	120	120

VE= Emergence, R1= Flowering, R2= Pegging, R3= Podding, R4= Full pod, R5= Beginning seed, R6= Full seed, R7= Beginning of maturity, R8= Harvest maturity, SD1= 19/04/2010, SD2= 26/04/2010, SD3=03/04/2010

Conclusion

A study to determine the vegetative and reproductive growth stages of some improved varieties (SAMNUT 10, SAMNUT 22, SAMNUT 23) and local variety (kampala) of groundnut was carried out in Ogbomoso, a Southern guinea savanna of Nigeria.

The phenological stages determined should be beneficial in several ways because they are based on discrete, and visually-identifiable events in the plant's life cycle and will provide a more precise basis of development for improved groundnut cropping systems and scheduling cultural practices thus, increasing pod yield and sustainability of groundnut production.

These growth stages are potentially beneficial to expedite a mutual understanding between researchers and extension workers when considering the groundnut crop.

Data availability

Data underlying this study is available for Dataverse: http://dx.doi.org/10.7910/DVN/OI7WJG (Oni, 2018)

Competing interests

No competing interests were disclosed

REFERENCES

Boote, K. J. 1982. Growth Stages of Peanut (*Arachis hypogaea* L.). *Peanut Science*, 9: 34-40. Online copy available at https://doi.org/10.3146/i0095-3679-9-1-11.

Food and Agricultural Organisation of the United Nations (FAO). 2007. The State of Food and Agriculture. Food and Agriculture Organization of the United Nations Rome, 2007

Food and Agricultural Organisation of the United Nations (FAO). Food Outlook 1990. Rome Italy.

Olatunji, O. O. 2011. Forms and Distribution of sexcoxide and effects on phosphate sorption in some soils on basement complex of south western Nigeria. PhD thesis LAUTECH, Ogbomoso, Nigeria.

Oni, Funmilayo Grace, 2018, "Replication Data for: PHENOTYPIC STAGES OF SOME IMPROOVED VARIETIES OF GROUNDNUT (Arachis hypogaea L) IN THE HUMID SOUTH WESTERN NIGERIA", doi:10.7910/DVN/OI7WJG, Harvard Dataverse, V1, UNF:6:vFLTiF516ZCCkH5j+HzSGQ==

Vara Prasad, P.V., Kakani, V. G., Upadhyaya, H. D. (2009). Growth and production of groundnut, in Soils, Plant Growth and Crop Production, [Ed. Willy H. Verheye], In Encyclopedia of Life Support Systems (EOLSS), Developed under the Auspices of the UNESCO, Eolss Publishers, Oxford, UK, [http://www.eolss.net] [Retrieved January 15, 2018].