International Scholars Journals

African Journal of Crop Science ISSN 2375-1231 Vol. 6 (6), pp. 001-003, June, 2018. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Short Communication

Floral biology of Bambara groundnut [*Vigna subterranea* (L.) Verdc]

N. C. Onwubiko[1]*, M. I. Uguru[2], A. A. Ngwuta[1], E. T. Inyang[1] and O. J. Nnajiemere[1]

[1]Department of Crop Science and Technology, Federal University of Technology, Owerri, Imo State, Nigeria.
[2]Department of Crop Science University of Nigeria, Nsukka, Enugu State, Nigeria.

Accepted 07 March, 2018

Investigation on floral biology of twelve accessions of Bambara groundnut [*Vigna subterranea* (L.) Verdc] was carried out in the greenhouse of the School of Agriculture and Agricultural Technology, Federal University of Technology, Owerri, Nigeria, in a completely randomized design with three replications. Significant varietal differences (P<0.05) were observed among the accessions in all characters investigated except for age of germination (P>0.05). Typical of flowering plants, the crop consists of vegetative and reproductive organs. The initiation of flower buds was between 30 and 48 days after planting (DAP) while the maturity of the flowers was between 34 and 52 DAP (3 to 5 days from flower bud initiation). Matured flowers for hybridization should be 2 to 3 days old from bud initiation and observed to be yellow or creamy in colour. The time taken for matured flower bud to open (anthesis) ranged between 12 to 20 h (which occurred between 07:00 and 10:00 h). Emasculation should be carried out on mature flower buds within 12 h of flower bud maturity as pollination takes place after this period.

Key words: Floral biology, bambara groundnut, *Vigna subterranea*.

INTRODUCTION

Bambara groundnut [*Vigna subterranea* (L.) Verdc] is a popular pulse grown mainly by subsistence women farmers in drier parts of sub-Saharan Africa (Goli, 1995). Investigators interested in the origin of Bambara groundnut (Dalziel, 1937; Goli, 1995; Happer, 1963) all agreed that the crop originated from the African continent. Bambara groundnut is ranked the third most important legume in Africa after groundnut (*Arachis hypogea*) and cowpea (*Vigna unguiculata*). In many traditional farming systems, Bambara groundnut is intercropped with many cereals and root crops (Ntunda, 1997).

The crop has several agronomic values which include: drought tolerant and ability to produce some yield in soils that are too poor for cultivation of other leguminous crops like common beans and groundnut (Anchirinah et al., 2001; Azam-Ali et al., 2001). It contributes soil nitrogen for other crops by fixing atmospheric nitrogen through symbiosis with rhizobium bacteria and is therefore beneficial in crop rotation and inter-cropping (Mukurumbira, 1985; Karikari, 1971). Bambara groundnut also has high nutritional value. It serves as an important source of protein in the diet of greater percentage of the African population in Nigeria, Mali, Chad, Ghana, Niger, Burkina Faso, Ivory Coast, Togo, Benin and South Africa (Linnemann and Azam-Ali, 1993). Nutritionally, it contains 17.4% protein, 53.1% carbohydrate, 6.1% fat, 6.1% fibre, 3.4% ash, 0.098% calcium, 0.007% iron, 1.2% potassium and 0.003% sodium (Rowland, 1993; Amarteifio et al., 1997). However, despite the importance of Bambara groundnut as a food legume, it is still cultivated in the form of landraces.

Several workers reported that the improvement of Bambara groundnut through conventional breeding method is difficult (Goli, 1995; Marandu and Ntunda, 1995; Ntunda, 1997; Kone et al., 2007). *V. subterranea* is an extreme inbreeder; an autogamous crop with flowers that are cleistogamous in nature (Uguru and Agwatu, 2006), which gives rise to high percentage selfing since the floral structure is perfect resulting in extreme inbreeding. As a corollary, Massawe et al. (2005) carried out a study on how different strategies can be combined

*Corresponding author. E-mail: onwubikouche@yahoo.com.

Table 1. Mean values of agronomic and reproductive characteristics of Bambara groundnut.

Traits	Age at germination (Days)	Age at flower bud initiation (Days)	Age at anthesis (Days)	Plant height at flower bud initiation (cm)	Number of flower bud initiated per plant	Number of leaves at flower bud initiation	Time taken for mature flower bud to open (h)
Acc 01	8	46	50	28.17	13	37	20
Acc 02	8	35	40	22.27	15	32	12
Acc 03	9	45	49	33.00	10	35	18
Acc 04	10	37	42	25.73	13	36	14
Acc 05	7	32	37	26.00	12	36	12
Acc 06	9	47	50	32.50	12	38	19
Acc 07	8	38	41	24.00	13	31	18
Acc 08	8	36	40	28.05	10	28	20
Acc 09	9	37	40	22.33	10	35	20
Acc 10	9	38	42	24.33	10	32	18
Acc 11	9	35	39	22.35	10	32	19
Acc 12	9	40	42	25.85	11	30	18
Mean	8.58	38.83	42.67	24.55	11.58	33.5	17.33
LSD (0.05)	NS	1.64	1.38	1.97	1.88	4.42	1.09

to establish the basis of a strategic breeding programme in Bambara groundnut. Similarly, Uguru and Agwatu (2006) also worked on cytogenetics of Bambara groundnut to establish how cytogenetic information can be useful in achieving successful hybridization in Bambara groundnut. Also Oyiga et al. (2010) carried out studies on pollen behavior and fertilization impairment in Bambara groundnut. However, the knowledge of floral biology is crucial and has been observed to be a pre-requisite to a successful hybridization (Kehinde, 1999). Unfortunately there is paucity of information on floral biology of Bambara groundnut. This study was therefore set up to gain pertinent information on the floral biology of Bambara groundnut in quest to overcome the barrier in producing new combinations resulting from hybridization.

MATERIALS AND METHODS

The experiment was carried out in the green house of the School of Agriculture and Agricultural Technology of Federal University of Technology, Owerri, Imo State located between longitudes 70° 00'E and 07° 05'E, and latitudes 05° 20'N and 05° 25'N.

Seeds of twelve accessions (Acc) of Bambara groundnut obtained from International Institute of Tropical Agriculture (IITA), Ibadan, Oyo State, were used for the study. Three seeds per pot were sown in 20 cm diameter pot bags containing 10 kg sandy loam top soil and later thinned down to one. The pots were placed in rows 30 cm apart and 20 cm within rows, arranged in a completely randomized design (CRD). Each accession was replicated three times.

Data were collected on days to germination, days to flower bud initiation, days to anthesis, plant height at flower buds initiation, number of flower bud initiated per plant, number of leaves at flower bud initiation and time taken from flower bud maturity to opening of the flower. For each accession, visual observations, counting add stop watch were used in recording some parameters while measurements were made with meter rule with respect to quantitative characters on three plants, and the means were recorded.

RESULTS

Analysis of variance for the plant characteristics studied showed significant ($P<0.05$) differences between the accessions except for age at germination ($P>0.05$). Mean values obtained for the traits (Table 1) showed that age for germination ranged from 7 (Acc 05) to 10 days (Acc 04), while that of flower bud initiation was between 32 (Acc 05) to 47 days (Acc 06). The mean plant height at flower bud initiation ranged from 22.27 to 33.00 cm, while the number of flower buds initiated per plant was from 10 to 15. The number of leaves at flower bud initiation was between 28 (Acc 08) and 38 (Acc 06), and time taken for matured flower buds to open was between 12 to 20 h. Mature flower buds turned from deep green colouration to light green and to yellow as the flower matures. Blooming occurred in the morning between 07:00 and 10:00 h in all the accessions studied unlike other characters where varietal differences were observed among the accessions.

DISCUSSION

The significant differences obtained among the accessions in most of the plant traits points to the presence of genetic variation in the germplasm. Availability of genetic variation in a crop is crucial for its improvement. The life cycle of *V. subterranea* from this study can be categorized into vegetative, flowering and pod development stages. These three distinctive stages

in the life cycle of the crop have been observed in the life cycle of other flowering crop plants. The vegetative phase is the longest and often considered to be the most critical phase in the life cycle of the crop; when cells differentiate to form various organs. This phase extends from germination to flower bud initiation and takes about 30 to 48 days in Bambara groundnut. Similarly the flowering stage between flower bud initiation and anthesis was completed in about 4 to 6 days in this crop.

The number of flower buds initiated ranged from 10 to 15. Comparatively, Acc 02 initiated the highest number of buds, 15 buds per plant, and by implication has the highest yield potential than the other accessions. However, this can only be if Acc 02 has the ability to develop all the buds into edible pods. Kehinde (1999) observed that the expressed yield potential of a crop is in its ability to develop its flower buds into edible pods.

In hybridization programme, of particular interest is the understanding of the interval between flower bud initiation and anthesis. Pollen and ovary maturity occur within this period and it is important also to observe if their maturity time synchronize or not. This will enable the breeder determine the appropriate time to carry out emasculation before crossing is carried out. In cleistogamous crops, it is normal that pollination occurs before flower opening and for *V. subterranea*; the time of blooming is usually between 07.00 to 10.00 h. From this study the average interval between flower bud initiation, 39 days and anthsis, 43 days was 4 days (Table 1). Consequently, mature flower buds that can be used for hybridization should be 2 to 3 days old from flower bud initiation. Apparently, for a successful crossing in this crop, emasculation should be carried out on mature flower buds within 12 h of flower bud maturity as pollination takes place after this period. Mature pollens used for crossing can be sourced from freshly opened flowers and applied on the emasculated buds immediately. It has been reported that emasculation in the evening preceding anthesis and pollination of emasculated flower carried out the same time or early in the morning of the following day is ideal for successful crossing (Kehinde, 1999).

Conclusion

Improvement of Bambara groundnut has been largely difficult due to the autogamous nature of the crop. Understanding its floral biology is crucial to understanding the appropriate time for emasculation and pollination in order to achieve a successful cross. From this study, it was observed that it took between 4 to 6 days for initiated flower buds to mature and open. Consequently, flower buds intended for hybridization should be 2 to 3 days old from bud initiation. Furthermore, emasculation should be carried out on mature flower buds within 12 h of flower bud maturity as pollination takes place after this period.

ACKNOWLEDGEMENT

The authors are grateful to Dr. Dominque Dumet; Head Department of Genetic Resource Center of the International Institute of Tropical Agriculture (IITA) Ibadan, Nigeria, for providing us with the Bambara groundnut accessions used for the study.

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