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Original Article

THE QUALITY OF 'GBOMA' EGGPLANT (*Solanum macrocarpon* L.) SEEDS EXTRACTED FROM SERIALLY HARVESTED FRUITS

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ABSTRACT

The study was conducted at the Federal University of Technology, Minna, Nigeria to determine the most appropriate stage at which to harvest 'Gboma' eggplant (*Solanum macrocarpon* L.) fruits to obtain high quality seeds. Flowers were date-tagged on the field at anthesis and serially harvested at four days intervals from 14 to 66 days after anthesis (DAA). Records were taken on fruit internal and external features, seed dry matter, germination percentage (GP), germination rate index (GRI) and germination index (GI) at each harvest. GP, GRI and GI were also determined at an interval of seven days during a 42-day storage period at 37 ºC and 75% relative humidity. Fruit colour changed from green to yellowish green at about 30 DAA and later turned brown. By 58-66 DAA fruit mesocarp and locular cavity were dry and fruits were prominently shrunken at 62 and 66 DAA. Seed dry matter increased significantly ($P \leq 5\%$) from about 0.06 g/50 seeds at 22 DAA to 0.16 g at 42 DAA with no further significant increases thereafter. Non-stored seeds harvested earlier than 58 DAA germinated significantly ($P \leq 5\%$) poorer (0 to19%) compared to those harvested at 58 to 66 DAA with germination of 52-58%. A range of 0-34% germination was recorded at 14-54 DAA; about 86, 75 and 76% at 58, 62 and 66 DAA respectively. GRI and GI increased significantly ($P \leq 5\%$) from about $0.1\%^{-day}$ to about $5.7\%^{-day}$ and about 3.0 to 272.5 respectively at 38 to 66 DAA in non-aged seeds with increases during storage. A decline in the values of all parameters was generally recorded beyond 14 days of storage which is an indication of seed deterioration. It is concluded that "Gboma' eggplant seed attained maximum quality at about 58 DAA when fruits were left to dry completely on the mother-plant and still retained high quality at 62 and 66 DAA when fruits had become shrunken.

Keywords: 'Gboma', germination percentage, germination index, quality seed, fruit colour
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INTRODUCTION

About 25 Solanum species are reported to be indigenous in Nigeria (Gbile and Adesina, 1988). "Gboma' eggplant (*Solanum macrocarpon* L.) is said to have African ancestory and its local cultivars grown for the leaves are commonly found in West and Central Africa (Bukenya-Ziraba and Bonsu, 2004). It is reported to be cultivated in many parts of Nigeria (Chinedu *et al.*, 2011). Joseph (2009) reported that the crop is also grown in India, Malaysia and China. It is rich in protein, fibre, calcium, iron, potassium, magnesium, phosphorus and sodium (Agoreyo *et al.*, 2012; Nyadanu and Lowor, 2014). The leaf is used as soup condiment in Nigeria (Oboh *et al.*, 2005; Ijarotimi *et al.*, 2010) and the protein contained in the leaf and fruit is reported by Adeyeye and Adanlawo (2011) to be of high quality.

Seed is the starting point for most crop plants and the success of any crop production venture depends largely on the quality of seeds started off with. The use of high quality seeds will not only ensure the attainment of the potential yield of a crop, it will also increase the returns on farmer's labour (Hamdollah, 2012). According to Ghassemi-Golezani and Mazloomi-Oskooyi (2008) the use of high quality seeds results in high percentage , rapid and uniform seedling emergence, coupled with the production of vigorous plants, all contributing to high crop yield. One of the factors known to affect seed quality is the developmental stage at which they are harvested which has been determined for several vegetable crops. In *Solanum marcrocarpon* Demir *et al.* (2002) recorded maximum seed quality at 50/60 days after anthesis (DAA). The 50 DAA reported for the same species by Franquera (2015) and 55 by Passam *et al.* (2010) are within that reported by Demir *et al.* (2002). Martins *et al.* (2012) recorded 70 days after pollination (DAP) for the same species. Between 60 and 65 DAA was recorded to be the best for 'Egusi-Ito' (*Cucumeropsis mannii* Naudin) by Kortse and Oladiran (2012), 75 DAA for pepper (Vidigal *et al.*, 2011), 50 to 60 DAA for pumpkin (Neto *et al.*, 2015) and 60 DAP for tomato (Singkaew *et al.*, 2017). No information is presently available on the age range at which the fruits of *Solanum macrocarpon* should be harvested in other to obtain seeds of high quality. Most farmers extract seeds from 'Gboma' fruits that have been left to weather on the field without paying much attention to seed quality which in turn results in poor germination. Earlier work by Oladiran (1989) and recent one by Mustapha (2016-unpublished) on *Solanum macrocarpon* used fruit colour to index seed quality. The aim of the study was therefore to determine the changes in some fruit external and internal features and the variation in the quality of seeds extracted from serially harvested fruits of Gboma eggplant.

MATERIALS AND METHODS

The study was conducted at Federal University of Technology, Gidan Kwano, Minna, Nigeria from 2016 rainy season to 2017 dry season. Seedlings were raised from seeds of FUTM Sm-2 in the nursery for five weeks and then masstransplanted at spacing of 50 cm x 75 cm on 1 m wide beds. The plots were hoe-weeded at four and eight weeks after transplanting and then supplemented with regular hand-pulling of weeds. N (with urea as source), P_2O_5 (from single superphosphate) and K_2O (from muriate of potash) were applied at 80 kg, 20 kg and 40 kg respectively. The whole of P and K and half of the N dose were applied at four weeks after transplanting while the remaining half dose of N was applied four weeks later.

Flowers were date-tagged as they opened (used as a visible indication of anthesis) and the resultant fruits were harvested at 14, 18, 22, 26, 30, 34, 38, 42, 46, 50, 54, 58, 62 and 66 days after anthesis (DAA). At each harvest fruits were randomly divided into three replicates and cut open with knife. The content was then squeezed into a sieve and washed with water to obtain clean seeds. The dry matter of a sample of freshly extracted seed was determined on four replicates of 50 seeds each using the hot oven method. The rest of the seed was air-dried in ambient condition for 14 days and then packaged in screw-cap plastic bottles stored at room temperature (30 ºC).

To determine the longevity of the different seed lots, seed samples were placed in aluminum containers, stored at 37 ºC and 75% relative humidity and tested for germination at 0 (unaged), 7, 14, 21, 28, 35 and 42 days after storage (DAS). Germination test was done by counting four replicates of 50 seeds each of each of the different lots on to distilled water-moistened filter paper in plastic Petri dishes and incubated at 30 ºC for 16 days. Germination counts were taken every-other-day and the results were expressed in percentage. Germination rate index (Kader, 2005) and germination index (GI) were determined to assess seed vigour. Data in percentages were transformed to arcsin values before statistical analysis and all obtained data were analysed using the Minitab 17.0 version. Where significant differences were recorded between treatments, the Duncan multiple range test was employed to separate the means at 5% level of probability.

RESULTS AND DISCUSSION

Changes in some fruit external and internal features are presented in Plate 1. Fruits remained green up to 26 DAA (Plate 1). By 30 DAA fruits had turned yellowish green, the locular cavities were dense with gel and several seeds were cut through during sectioning perhaps because of less dry matter content (as reported above) that would have offered some resistance to cutting. Fruit had ripened further at 34 DAA with few visible cracks; some seeds were still cut through at sectioning. Colour change from yellowish green to brown became more obvious from 38 DAA with less damage to seeds during sectioning. The locular cavity had less gel and cracks became more prominent. By 50 DAA, dent had started forming on the fruits and cracks had become more pronounced. Fruit wrinkling and drying as well as the disorganization of the locular cavities became noticeable at 54 DAA. By 58-66 DAA the fruit mesocarp and locular cavities were dry; the latter was at this point more of seed. Fruits were drier and more wrinkled at 62 and 66 DAA than at 58 DAA. Statistical analysis revealed that significant differences existed among fruit weights at 58, 62 and 66 DAA (about 18, 15 and 10 g/fruit respectively). Figure 1 shows the seed dry matter changes that occurred from 22 to 66 DAA. Seed dry matter increased significantly from 0.06

g/50 seeds at 22 DAA to 0.16 g/50 seeds at 42 DAA. The differences in the values recorded from 42 to 66 DAA was insignificant, suggesting that the latter marked the end of the seed-filling period and therefore the point of mass maturity.

Prior to storage, seed germination was not recorded in fruits harvested earlier than 38 days after anthesis (DAA) when a germination of 1% was obtained. This is contrary to the report of Agbo and Nwosu (2009) in which seeds of 'Ngwa Local Large' cultivar of *Solanum melongena* already developed the capacity to germinate even when fruits were still green. This suggests that eggplant seeds of different species developed at different rates. In this study, germination percentage subsequently increased progressively to about 58% at 58 DAA (Table 1). The germination values of about 58%, 52% and 56% recorded at 58, 62 and 66 DAA respectively were statistically similar. Likewise, the germination percentages of about 86, 75 and 76 obtained for the three fruit ages respectively at 14 days of storage were statistically similar but significantly different from those recorded for earlier harvests. The 58 to 66 DAA being the time at which maximum germination percentage occurred in this study is close to the 50-60 DAS recorded for *Solanum melongena* by Demir *et al.* (2002). Yogeesha *et al.* (2008) also recorded maximum germination and vigour at 57 DAA also in *S. melongena*. Passam *et al.* (2010) likewise recommended that *S. melongena* fruits should be ripened on the plant for at least 55 days to achieve good seed quality. Maximum germination of about 86% was obtained in seeds harvested at 58 DAA whereas significant increase in dry matter terminated at 42 DAA. This suggests that maximum physiological maturity was attained about 16 days after mass maturity in this crop. This trend is similar to what was reported by Demir *et al.* (2002) that maximum quality occurred between 8 and 24 days after maximum dry weight in aubergine (*Solanum melongena*) seeds. Kortse and Oladiran (2002) also recorded the highest germination percentage 10-25 days after seed-filling phase in 'Egusi-Ito' melon (*Cucumeropsis mannii* Naudin.). Neto *et al.* (2015) reported that pumpkin seeds may require additional 30 days after reaching maximum dry weight to allow for tissue restructuring and differentiation to ensure maximum germination potential.

Table 2 shows that germination rate index (GRI, $\%^{-day}$) increased significantly from about $0.1\%^{-day}$ at 38 DAA to about $5.7\%^{-day}$ at 58 DAA beyond which there were no more consistent changes. Slight increases in GRI were generally recorded for all seed lots for the first 14 day of storage followed by a general decrease. The values for 58-66 DAF were similar almost all through the storage period except at 28 and 35 days after storage when the values for 58 DAF lagged behind those of 62 and 66 DAF. Statistically similar germination index (GI) values of about 249.5, 240.0 and 272.5 were recorded at 58, 62 and 66 DAA when seeds were freshly harvested. This agrees with the report of Agbo and Nwosu (2009) who also recorded higher GI in tomato hybrid seeds harvested at 60 and 70 days after pollination (DAP) than in those harvested at 45 and 50 DAP an indication of higher germination percentage and greater speed (vigour) of the former (Kader, 2005). However, the trend in the GI values among the superior seed lots of 58 to 66 DAA in the current study was inconsistent. Seeds of *Solanum* species including 'Gboma' (*S. macrocarpon*) are known to be dormant when freshly harvested (Ibrahim *et al.*, 2001; Bonsu *et al.*, 2002; Bithell *et al.*, 2003; Agbo and Nwosu, 2009). This was the case in the present study and had been reported to be broken during storage in some other species of eggplant (Bithell *et al.*, 2003; Hayati *et al.* 2005; Agbo and Nwosu, 2009). The subsequent decrease in seed germination percentage, GRI and GI must have been due to seed deterioration which is a normal phenomenon.

CONCLUSIONS AND RECOMMENDATION

It is concluded that 'Gboma' seed attained maximum quality at 58 DAA (16 days after time to occurrence of maximum dry matter accumulation) when fruits were left to dry completely on the mother-plant. The maximum germination of about 86% attained at this fruit age was however not significantly different from the maximum of 75/76% recorded at 62 and 66 DAA when fruit had become wrinkled. Seeds from fruits harvested earlier than 58 DAA were of very poor quality. It is recommended that 'Gboma' fruits be harvested at 58 to 66 DAA when the fruits are brown, completely dry and shrunken to obtain seeds of high quality.

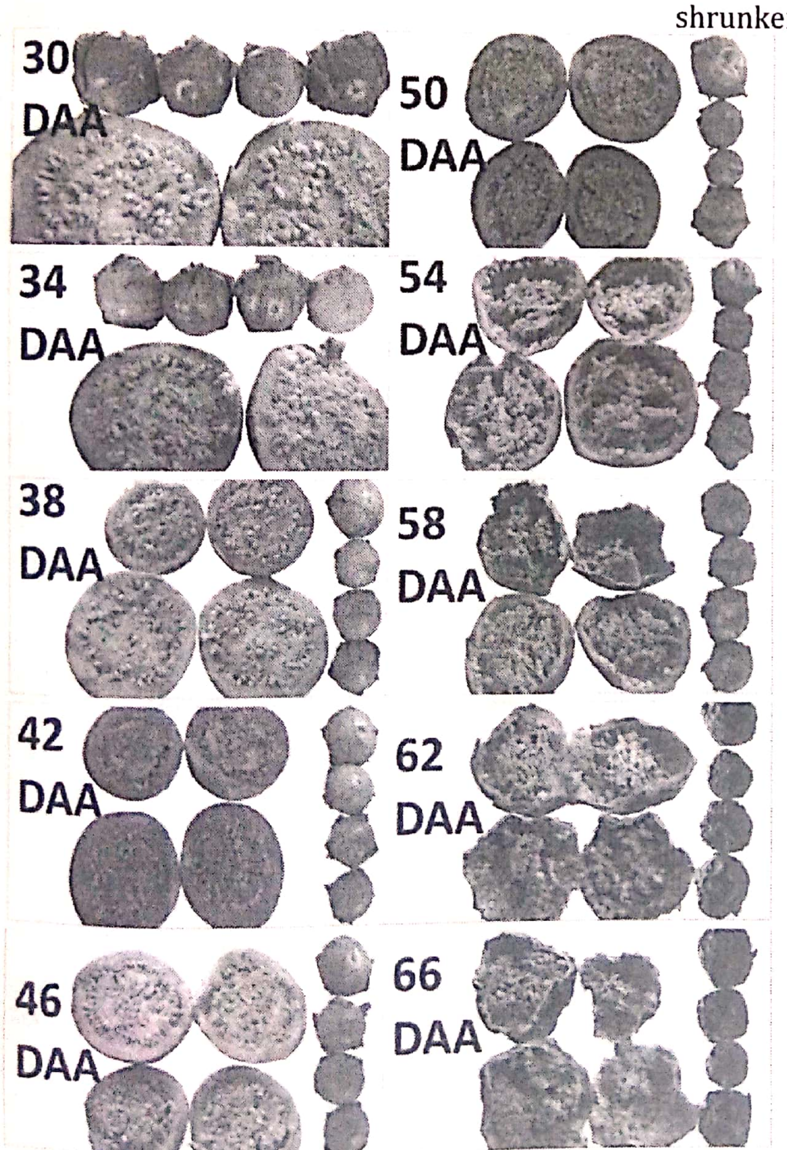

Plate 1: External and internal features of fruits harvested at 30-66 days after anthesis

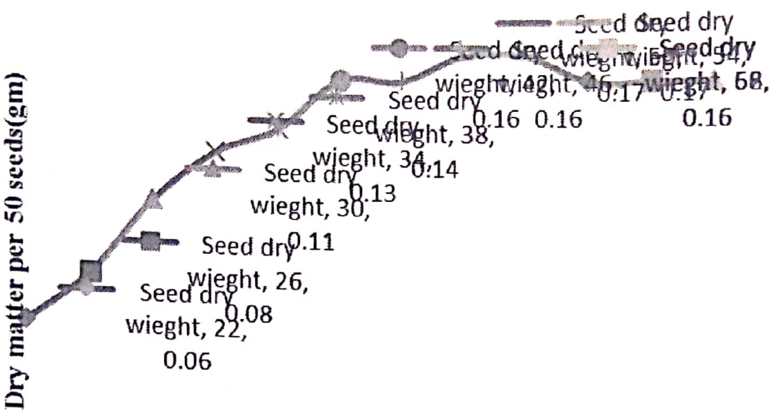

Figure 1: Seed dry matter at different fruit ages.

Table 1: Germination percentage of different seed lots at different storage periods

	Storage periods						
DAA	0	7	14	21	28	35	42
14	0.000d	0.000e	0.000f	0.000e	0.000c	0.000c	0.000c
18	0.000d	0.000e	0.000f	0.000e	0.000c	0.000c	0.000c
22	0.000d	0.000e	0.000f	0.000e	0.000c	0.000c	0c.000
26	0.000d	0.000e	0.000f	0.000e	0.000c	0.000c	0.000c
30	0.000d	0.000e	0.000f	0.000e	0.000c	0.000c	0.000c
34	0.000d	0.000e	0.000f	0.000e	0.000c	0.000c	0.000c
38	1.000cd	0.000e	0.000f	0.000e	0.000c	0.000c	0.000c
42	1.000cd	1.000e	16.000ed	0.500de	0.000c	0.000c	0.000c
46	2.500c	5.000d	23.000e	1.500cd	0.000c	0.000c	0.000c
50	19.000b	2.000e	27.000d	4.500c	0.000c	0.000c	0.000c
54	14.500b	18.500c	34.000c	34.000b	3.500b	0.000c	0.000c
58	57.500a	84.000a	85.500a	68.500a	41.500a	15.500b	15.000a
62	51.500a	70.500b	75.000b	72.500a	46.500a	32.000a	13.000a
66	56.000a	75.500ab	76.000b	70.000a	45.000a	28.000a	8.000b

Values followed by the same letter on each column are not significantly different ($p > 0.05$). DAA= Days after anthesis

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