



## EFFECT OF FRUIT AGE AND POSITION ON MOTHER-PLANT ON FRUIT GROWTH AND SEED QUALITY IN OKRA (*Abelmoschus esculentus* L. Moench)

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### ABSTRACT

The study was conducted at the Federal University of Technology, Minna, Nigeria. Okra (*Abelmoschus esculentus* L. Moench) seeds of variety NHAe47-4 were sown at a spacing of 40 cm along ridges constructed 75 cm apart. Following emergence, thinning was done to leave one plant per stand. Flowers were date-tagged at anthesis ( i.e. immediately they opened ). The fruits that developed in positions 1, 3, 5 and 7 were harvested at 14, 21, 28, 35, 42, 49, and 56 days after anthesis (DAA). Seed germinability was determined before and during storage. Except for the initial increase in fruit weight between 14 and 21 DAA in position 7, no increases were generally recorded with delay in harvesting. Generally, there were no significant increases ( $P>5\%$ ) in fruit diameter and length in all positions between 14 and 56 DAA. However, fruits of position 7 were significantly ( $P<5\%$ ) shorter and slimmer than those from other positions. There were significantly fewer seeds per fruit in position 7 than in the other positions at all the DAAs. A slight increase was recorded in the weight of wet seed between 14 and 21 DAA. This was followed by a decline as from 21 DAA or 28 DAA depending on fruit position. Seed moisture content declined generally with DAA and one hundred-seed weight increased between 14 and 35/42 DAA. However, position did not influence 100-seed weight generally. Prior to storage, germination of seeds harvested earlier than 35 DAA was poor. Germination of up to 97% and the ability of the seeds to maintain viability for long, were obtained at 42 DAA when fruits were straw-coloured, ridges completely split and the seeds were black in colour. Across DAAs, seed weight and survival ability were best in fruit positions 1, 3 and 5.

**KEY WORDS:** Anthesis fruit position; seed quality; vigour; longevity; okra.

### INTRODUCTION

Okra (*Abelmoschus esculentus* L. Moench) is widely grown as a vegetable. The immature fruit is eaten green, either fresh or prepared by boiling or frying and used in soups and stews (Bleasdale, 1984). Its nutritional value lies in its high amount of calcium and phosphorous. It also contains protein, carbohydrate and fibre and some amounts of vitamins (Tindall, 1983). Because of the nutritional and economic importance of okra, it is imperative that adequate attention be given to ways of producing the seed in such a way that high quality is ensured. The major aim of a gene bank curator is to conserve seeds in a way that would ensure high quality for a long time. Even if storage condition is ideal, seed longevity is still known to be affected by the crop production procedures which are adopted by the farmer. The physiological state at which a seed is harvested and the position of fruit on the mother-plant are two of such pre-storage factors.

The stage during seed development at which seeds attain maximum quality is subject of some controversy. Harrington (1960) reported that seeds attain maximum quality at the end of the seed filling period and that thereafter viability and vigour declines. In some other species however, the best quality may not be obtained until some times afterwards (Kameswara *et al.*, 1991). In tomato, Demir and Eilis (1992) reported that mass maturity (end of the seed-filling period) occurred 41 and 39 days after anthesis in the first and second trusses respectively. Their results also revealed that the ability of seeds to germinate was not detected until after mass

maturity and that the onset of germinability occurred 35, 45 and 55 days after anthesis in the first, second and third trusses respectively. In general, seeds germinated more rapidly the later they were harvested and when first dried. Agrawal (1980) stated that okra seed pod should be harvested when they are dry (i.e. about 35 days after anthesis). Delayed harvest may lead to low germination and vigour due to adverse weather conditions in okra (Agrawal, 1980; TeKrony *et al.*, 1980) and pepper (Dias *et al.*, 2006). Mugnisjah and Nakamura (1984) reported that early harvest may result in poor germination and vigour in soyabeans. The common practice in okra is the harvesting of fruits from all positions at the end of the rains. Thomas *et al.* (1979) stated that the position at which a carrot or celery seed is produced on the plant can markedly affect its size, germination characteristics and size of the ensuing seedling. In both species the lowest percentage seed germination and seedling emergence were obtained from seeds produced on primary umbels (first formed seeds). A similar result was also recorded in tomato by Dias *et al.* (2006). Fruit size is also known to vary with position on mother-plant. Ho and Hewit (1986) reported that during rapid growth in tomato, both the rates of maximum growth and of starch accumulation of proximal fruits are higher than those of distal fruits. However, when the assimilate supply is abundant, the proximal fruit could gain more weight than the distal ones. The objective of this study therefore, was to examine the effects of position and age on okra fruit growth and seed development.

**MATERIALS AND METHODS**

The research was conducted at the Teaching and Research Farm of the Federal University of Technology, Minna (9° 0'N; 6°30'E), Niger State, Nigeria. The average rainfall and temperature during the study period were 1011.9 mm and 31.3°C respectively. Seeds of okra (*A. esculentus* L. Moench) variety NHAe 47-4 were sown on the flat 75 cm apart between rows and 40 cm apart along the rows. Thinning was done to leave one plant per stand two weeks after emergence of the seedlings. Atrazine and pendimetaline (1.32 and 2.05 kg a.i/ha) were tank mixed and applied to control weeds. The plots were subsequently weeded at four and nine weeks after sowing. Opening of the flowers is normally used to index anthesis on the field and flowers were date-tagged immediately they opened. Fruits that developed from tagged flowers were harvested at 14, 21, 28, 35, 42, 49, and 56 days after anthesis (DAA) from positions 1, 3, 5, and 7. Soon after harvest, fruit weight, length and diameter were taken. For 100-seed weight determination, four replicates of 100 seeds each were counted and weighed on a Metler balance to index

seed vigour. Determination of moisture content (on wet-weight basis) of seeds was done by the oven method at 130°C for one hour. For the storage studies, seeds of the different treatment combinations were placed in small open plastic containers and then positioned in an incubator running at 30°C and at a relative humidity of about 70% to accelerate ageing (Delouche and Baskin, 1973). Prior to and at four-weekly intervals during storage which lasted for 18 weeks, germination was determined by counting seeds from the different lots on to moist absorbent paper in Petri dishes. There were four replicates of 50 seeds each and the paper was normally moistened with distilled water as found necessary. The dishes were arranged inside an incubator running at 30°C. Germination counts were taken every-other-day for 28 days and the final count was expressed as a percentage of the total number of seeds incubated. The fruit and germination data generated were subjected to analysis of variance (ANOVA) based on completely random design. Means were separated by LSD where significant differences between treatments were obtained.

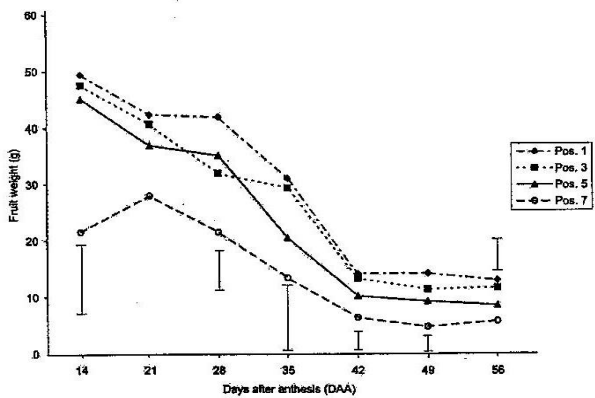


Fig. 1: Fruit weight (g) as affected by DAA and position on mother plant in variety NHAe 47-4  
 LSD 5% to compare weights from different positions

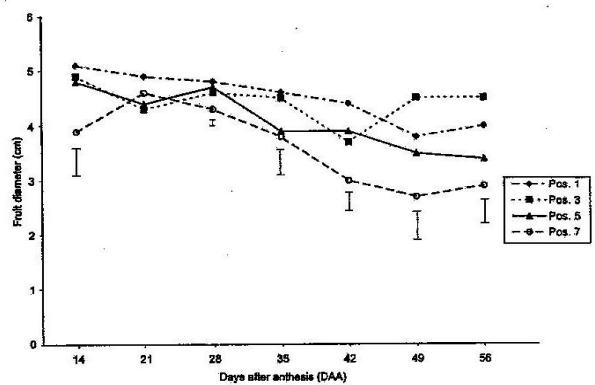


Fig. 2: Fresh fruit diameter (cm) as affected by DAA and position on mother plant in variety NHAe 47-4  
 LSD 5% to compare fruit diameter from different positions

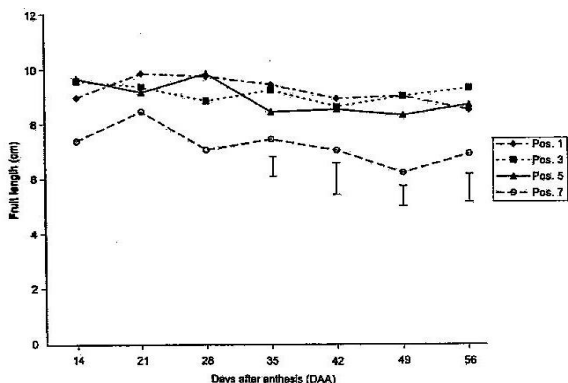


Fig. 3: Fruit length (cm) as affected by DAA and position on mother plant in variety NHAe 47-4  
 LSD 5% to compare fruit lengths from different positions

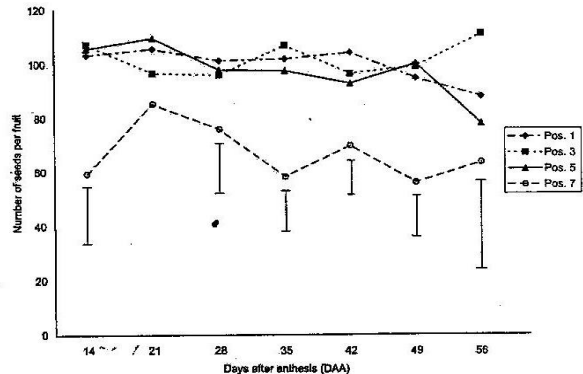


Fig. 4: Number of seeds per fruit as affected by DAA and position on mother plant in variety NHAe 47-4  
 LSD 5% to compare number of seeds from different positions

**RESULTS**

Fruits from positions 1, 3 and 5, declined in fresh weight from 49.3, 48 and 46.2 g respectively at 14 DAA to 10.5,

10.4 and 10.1 g at 42 DAA (Fig. 1). The weights remained almost constant thereafter. An initial increase in weight was recorded between 14 and 21 DAA in fruits harvested

from position 7, followed by a decline at later harvests. Fruits harvested from position 7 were generally significantly lower in weight than in the other positions, more especially when compared to positions 1 and 3. They were also generally slimmer and shorter than those from other positions (Figs. 2 and 3). Fruits from positions 1, 3 and 5 generally contained significantly more seeds than those from position 7 (Fig. 4). The study further revealed that there was a general decline in the weight of fresh seeds per fruit after 21 DAA in position 7 and after 28 DAA in positions 1, 3 and 5 (Fig. 5). Seeds extracted from fruits in position 7 weighed significantly lower compared to those from other positions except at 56 DAA when the difference between positions 5 and 7 was insignificant ( $P>5\%$ ). A general decline in seed moisture content was

recorded from 14 to 42 DAA with little or no changes thereafter (Fig. 6). Seeds from fruits in positions 5 and 7 stabilized at significantly lower moisture level (22 and 25% respectively) than positions 1 and 3 (27 and 26% respectively). An increase in 100-seed weight was recorded up till 42 DAA for positions 3, 5 and 7 whereas in position 1, no further increase was recorded after 35 DAA. A general decline in weight was recorded at later harvests in all the positions. After the maximum seed weights were attained at 35/42 DAA, the values for position 7 seeds were significantly lower than those of positions 1 and 3. Though a significant difference was recorded between positions 5 and 7 at 49 DAA, the difference between these positions was not significant at 56 DAA.

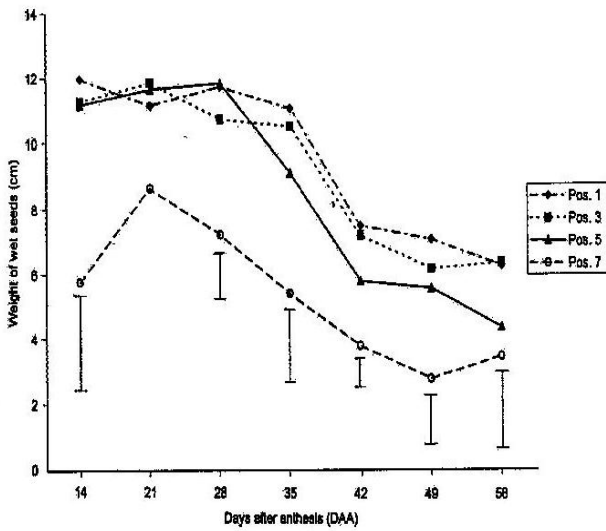


Fig. 5: Weight of wet seeds (g) as affected by DAA and position on mother plant in variety NHAe 47 - 4

┆ LSD 5% to compare weight of wet seeds from different positions

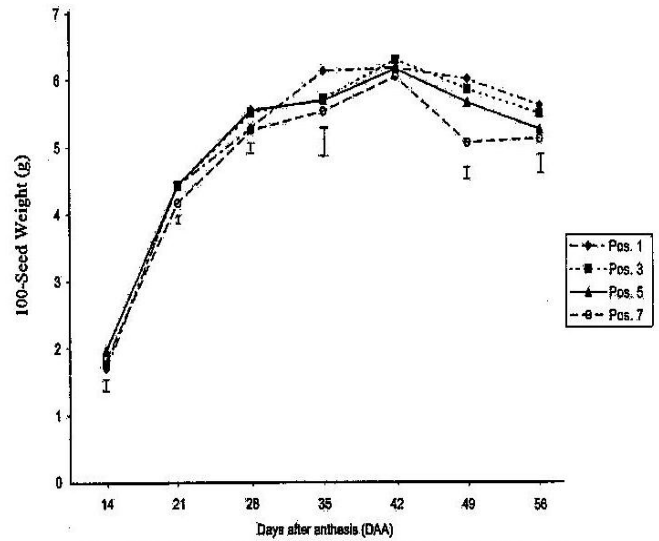


Fig. 7: 100 Seed weight (g) as affected by DAA and position on mother plant in variety NHAe 47 - 4

┆ LSD 5% to compare 100 seed weights from different positions

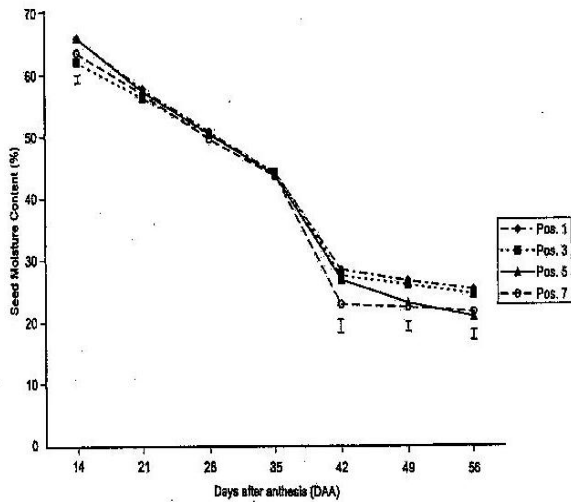
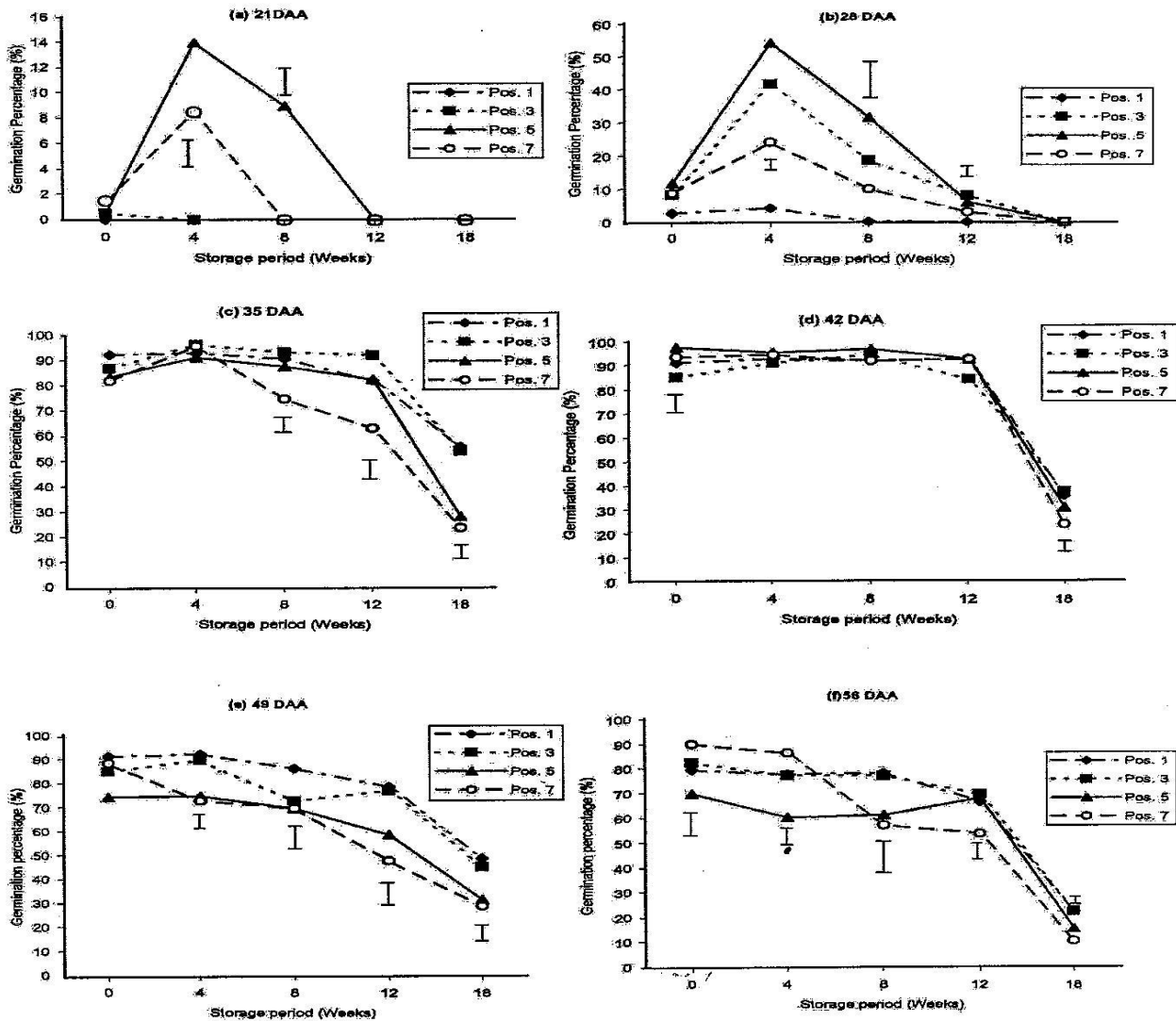


Fig. 6: Seed moisture content (%) as affected by DAA and position on mother plant in variety NHAe 47 - 4

┆ LSD 5% to compare seed moisture content from different positions



**Fig. 8 (a-f): The germination percentages of aged and unaged NHAe 47-4 seeds harvested at different DAAs from different positions (1, 3, 5 & 7) on the mother plant**

┆ LSD 5% to compare germination percentages of aged and unaged NHAe47-4 seeds from different positions and at different DAAs

The onset and level of seed germination depended upon DAA and fruit position. No germination was recorded in all seed lots at 14 DAA. When seeds were freshly harvested and their viability tested prior to storage, it was observed that germination was still poor at 21 DAA (Fig. 8a). A further delay of one week (i.e. 28 DAA), resulted in germination of 2.5 to 12% prior to storage depending on fruit position (Fig. 8b). Maximum germination percentage of freshly harvested seeds was generally attained by 35/42 DAA (Figs. 8c and d). Except for position 5, high germination values of freshly harvested seeds were still recorded prior to storage when fruits were harvested at 49 and 56 DAA (Figs. 8e and f). Following storage, there was a significant improvement in the germination of positions 5 and 7 seeds harvested at 21 DAA and of positions 3, 5 and 7 seeds harvested at 28 DAA after storing for four weeks (Figs. 8a and b). Following storage beyond four weeks, seeds harvested at 21 and 28 DAA recorded a sharp decline in germinability. For seeds harvested at 35 DAA, following a general slight improvement in

germination between zero and four weeks of storage, a general decline in viability was recorded. The decline was, however, not sharp until after 12 weeks of storage. Seeds harvested at 42 DAA generally maintained viability at maximum for 12 weeks. Beyond this point, loss of viability was sharp. When harvest was delayed beyond 42 DAA, a general decline in germinability was recorded as from four weeks of storage and this was much more so with position 7 seeds. At the end of the longevity studies, seeds extracted from fruits of position 7 at 35, 49 and 56 DAAs generally germinated significantly lower than those of positions 1 and 3. The overall picture was that seeds stored better in order: position 1>3>5>7.

**DISCUSSION**

The initial general increase between 14 and 21 DAA in fresh fruit weight, fruit diameter, fruit length and number of seeds per fruit in position 7, a trend that is generally absent at lower positions, may be an indication that fruit and seed development was slower at higher fruit positions.

Ho and Hewit (1986) reported that during rapid growth in tomato, both the rates of maximal growth and of starch accumulation of proximal fruits are higher than those of distal fruits. However, when the assimilate supply is abundant, the proximal fruit could gain more weight than the distal ones. Demir and Ellis (1992) also reported that the duration of seed filling was two days longer within the later former apical fruits than in the earlier formed fruits in marrow. The general significantly bigger seeds in the earlier positions than in later ones (position 7) might have been due to the fact that less nutrients were made available to the developing fruits and seeds of later position a plant aged. This agrees with the view expressed by Oladiran and Agunbiade (2000) who also reported that seed weight declined with later harvests in tomato. The subsequent declines in seed moisture content at increasing DAA in all positions must have been due to maturation drying. The work of Nkang and Umoh (1996) in soyabean also showed that seeds water content declined as the fruit ripened.

The poor germination of early-harvested seeds could have been due to the large proportion of immature seeds in these sets of seeds. Gordon *et al.* (1979) reported that immature wheat seeds are known to germinate poorly. In this study, high level of germination was attained at 35 DAA irrespective of fruit positions, a period which corresponds with about 45% moisture content. Chien and Ching (1997) also recorded high germination of 97% when the moisture content of seeds of lien-hua-chi declined to 47%. The increase in the germination levels of some seeds lots as storage progressed in this study agrees with what was reported for pepper seeds by (Oladiran and Agunbiade, 2000). The poor germinability recorded for all the seeds harvested at 21 and 28 DAA throughout the storage period confirms that they were poor in vigour (as a result of immaturity). The general decline in viability as storage period progressed at all the DAAs irrespective of the seed position could be attributed to seed deterioration. This agrees with the earlier work of Oladiran and Agunbiade (2000).

The superior longevity of seeds harvested at 42 DAA over those at 35 DAA suggests that though seeds might have attained physiological maturity at 35 DAA, occasioning high germination percentages, more seed filling was still needed for maximum vigour which must have occurred at 42 DAA. Further increase in longevity has also been reported to occur after physiologic maturity (Kameswara *et al.*, 1991). Poor longevity of the seeds harvested at 49 and 56 DAA in this study must have been due to weathering. Delayed harvest is known to result in reduced quality due to adverse weather condition such as high rainfall and temperature, drought etc that seeds are exposed to on the field following maturation (Agrawal, 1980; TeKrony *et al.*, 1980). Seeds from position 7 fruits had poor storability because they were of poorer vigour at harvest despite the fact they germinated well before storage. The general poor performance of seeds from position 7 fruits might have been due to the fact that they were generally significantly smaller compared to seeds from fruits at lower positions.

#### CONCLUSION AND RECOMMENDATION

It is concluded from the study that seeds germinated best both before and during storage when fruits were harvested

at 35 and 42 DAAs and that seed longevity was best when harvesting was done at 42 DAA irrespective of the fruit position on mother-plant. Delayed harvest resulted to reduced quality due to weathering. Furthermore, seeds from fruits that developed at higher positions may be of poor quality. Based on the result of this study, it is recommended that for the production of quality seed, fruits should be harvested at about 42 DAA from the first five positions on the mother-plant. At this stage, the fruits are straw-coloured and the ridges completely split.

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Effect of fruit age and position on mother-plant on fruit growth and seed quality in OKRA

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