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The Effects of Mother-Plant Irrigation Schedule on the Quality Of Tomato (*Lycopersicum esculentum*) Seed

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ABSTRACT: A study was carried out to examine the quality of seeds of two tomato cultivars ('Ibadan Local' and 'Ife 1') produced under irrigation intervals of 2, 4, 6 and 8 days at the Federal University of Technology, Minna. Fruits were harvested when fully ripe and the seed/juice mixture (pulp) was removed immediately and left to ferment for four days after which the seeds were washed under running tap water and dried at room temperature. Seeds of the two cultivars were spread in open plastic Petri dishes and stored in a growth chamber at 30°C and about 70% relative humidity to accelerate ageing for 16 weeks. Seed samples were drawn and tested for germination, seedling emergence, seedling height and number of leaves per seedling, at 0, 2, 4, 6, 8, 10, 12, 14 and 16 weeks of storage. Results showed that seeds of "Ibadan Local" were significantly heavier than those of "Ife 1" but the trait was not significantly affected by irrigation interval. Seed viability declined as storage period increased irrespective of irrigation treatment in both cultivars. There was no consistent superiority of one irrigation interval over the other in respect of seed longevity over time. A general increase in seedling height and number of leaves per seedling was recorded as storage period progressed before a decline sets in at different ages. Generally, performance was best with seeds produced under 4 and 6 days irrigation intervals in both cultivars. @JASEM

Key words: Mother-plant, irrigation schedule, seed quality, tomato

According to Fenner and Kitajima (1999), the growing condition of a parent plant may affect the degree of dormancy of its seeds. This has been demonstrated in numerous wild and cultivated species of tomato. Fenner (1991) reported that lower dormancy is generally associated with high temperature, short days, red light, drought and high nitrogen levels. Variations in seed quality among populations in some plant species have been attributed to differences in environmental conditions of the mother-plant (Gutterman, 1992; Uniyal *et al*., 2011). High temperature during seed development has been reported to reduce seed quality in soybean (Siddique and Goodwin,1980; Spears *et al*., 1997), peanut (Craufurd *et al*., 2002), watermelon (Demir *et al*., 2004) and other plant species (Steadman *et al*., 2004; Swain *et al*., 2006; Hoyle *et al*., 2008).

Irrigation plays a very significant role in maintaining a sustainable growth of every crop. However, excessive water for long periods of time has been reported to reduce the yield and quality of crops (Mateen *et al*., 2005). It has been reported by Kenan *et al*. (2007) to reduce the yield and quality of fruits and seeds of bell pepper. Plants grown in environment with reduced soil moisture conditions are also known to produce less dormant seeds (Steadman *et al*., 2004; Swain *et al*., 2006; Hoyle *et al*., 2008; Scholten *et al*., 2009).

Ageing of seeds is also indicated by reduced germination percentage, slow growth and increased susceptibility to environmental stress and reduced resistance to storage under adverse condition (Mwai *et al*., 2005). Seedling growth is affected as seed ages (Mwai *et al*., 2005). It is a normal phenomenon for seed to lose viability as storage progresses and the two most important post-harvest factors that affect longevity are seed moisture and the temperature of the store. The viability of an orthodox seed declines as any of these factors increases in value (Adebisi *et al*., 2008). The environment under which a seed lot matures has also been shown to affect its longevity. The production of rice under warmer condition has been shown by Ellis, *et al*. (1993) to result in poorer longevity than in cooler environment. Demir *et al*. (2004) also reported the same trend for water melon.

Most farmers in developing countries produce tomato under rainfed condition. Comparatively less tomato production is done during the dry season and when done, it is normally irrigated. The amount of water available in dams, rivers, wells and other sources is always limited during the dry period of the year. According to Daniel and Adetumbi (2000), inadequacy of water supply for vegetable production results in poor fruit and seed yields. Information is scarce concerning the effect of irrigation interval on the quality of tomato seeds. This study was therefore conceived to examine the quality of the tomato seeds

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produced when plants were grown under different irrigation intervals.

MATERIALS AND METHODS

The experiment was conducted in the laboratory of the Department of Crop Production Federal University of Technology, Minna (9°40'N and 6° 30'E), in the Southern Guinea Savannah region of Nigeria. Seeds of 'Ibadan local' and 'Ife1' varieties of tomato were obtained from the fruits of the two tomato varieties which were grown under 2, 4, 6 and 8 days irrigation intervals and at the rate of 90 litres per $9m^2$ during the plants growth. The accelerated ageing technique was used to determine the relative longevity of the seeds from the different treatments. This involved the spreading of seeds of the various treatments in open plastic plates placed in an incubator at 30^O C and relative humidity of 70% for 16 weeks. Seed samples were drawn and tested for germination and seedling emergence at 0, 2, 4, 6, 8, 10, 12, 14 and 16 weeks of storage. Seed germination was tested by placing four replicates of 50 seeds of each of the treatments on distilled-water-moistened absorbent paper in Petri-dishes carefully arranged in a germination chamber running at 30^O C. Germination counts were taken every other-day while the set up was moistened with distilled water from time to time as found necessary. Incubation period was 28 days. For seedling growth study, four replicates of 10 seeds were sown into 5 kg of soil in plastic pots on each sampling day in a completely random design (CRD). The plastic pots were watered a day prior to sowing and following sowing as found necessary. Data were collected on seedling emergence, height and number of leaves per stand. Data collected on all parameters were subjected to analysis of variance (ANOVA) and means were separated using Least Significant Difference (LSD) method where significant differences occurred. All data in percentages were transformed to arcsin values before statistical analysis were conducted.

RESULTS

Irrigation interval had no significant effect on 100-seed weight. However, seeds of "Ibadan Local" were significantly heavier than those of "Ife1" (with 0.24 and 0.21g/100 seeds respectively). Figures 1 and 2 show the germination percentages of the seeds of the two tomato cultivars before and during storage. Seed viability declined as storage period increased irrespective of irrigation treatment. Statistical analysis revealed that there was no consistent superiority of one irrigation interval over the other in respect of seed longevity over the storage period in the two cultivars. However storability of "Ibadan Local" seeds was best at six days irrigation interval and poorest at eight days interval. In both tomato cultivars, seedling height increased as seed aged (Figures 3 and 4). The increase however, peaked at 8 WAS in 'Ibadan Local' and from between 4 to 10 WAS in 'Ife 1 with subsequent decline in performance. Plant performance was generally poorest when seeds were produced under two days irrigation interval and best in seeds produced under four or six days intervals. The number of leaves per seedling also shows an initial increase from 4 to 8 WAS in 'Ibadan Local' and 6 to 8 WAS in 'Ife 1' (Figures 5 and 6). 'Ibadan Local' seeds produced under two days irrigation interval performed poorest, especially as from 8 WAS. The differences amongst the other irrigation intervals were not significant. However in "Ife 1", performance was best at four and six days of irrigation. Irrigation interval did not significantly affect seed weight in the current study. Champolivier and Merrien (1996) and Ghanbari *et al*. (2007) reported the same observation in *Brassica napus* and pumpkin (*Cucurbita pepo* L.) respectively. Xia (1994) was of the opinion that seed weight of fababean (*Vicia faba* L.) might be a relatively stable yield component in an environment of water stress. The progressive decline in germination as storage period progressed irrespective of irrigation treatment in both cultivars in this study may be due to ageing of seeds. Palm *et al*. (1995) observed that as age of *Acacia senegalensis* seed increased, seed germination percentage reduced. Bewley and Black (1994) also reported that ageing of seed is generally indicated by reduced germination. According to Chetri *et al*. (1993), ageing slows growth rate, it will also affect plant height and plant biomass. Coin *et al*. (1996) indicated that seed age increases susceptibility to environmental stress and reduces resistance to storage and fungal infection. Dormancy is known to occur in some varieties of tomato and it is reported to be caused by abscisic acid (Groot and Karsen 1992; Hilhorst and Downie, 1996). Hilhorst and Downie (1996) also implicated the involvement of the seed testa.

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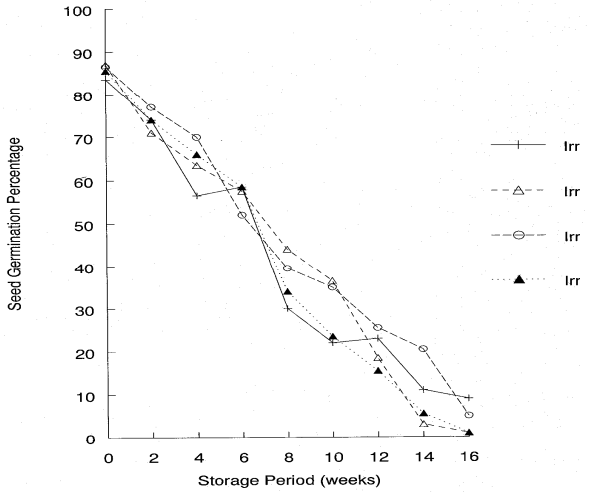

Fig.1. Survival curves of stored 'Ibadan Local' seeds produced under 2, 4, 6 and 8 days irragation intervals

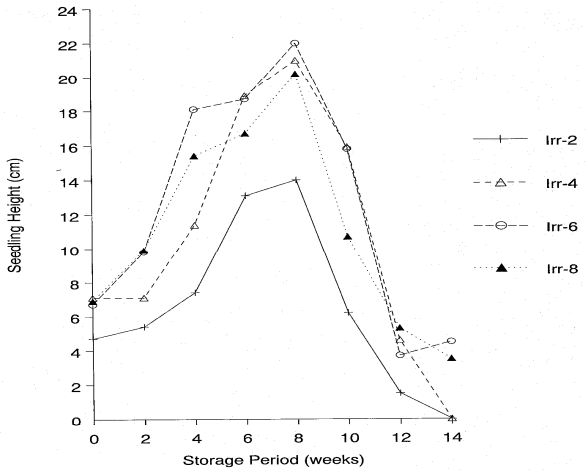

Fig.3. The effect of irrigation interval on the height of seedlings from stored 'Ibadan Local' seeds produced under 2, 4, 6 and 8 days irrigation intervals

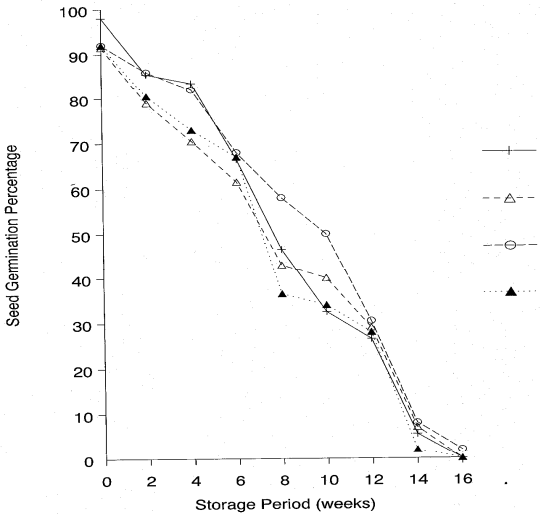

Fig. 2. Survival curves of stored 'Ife1' seeds produced under 2, 4, 6 and 8 days irrigation intervals

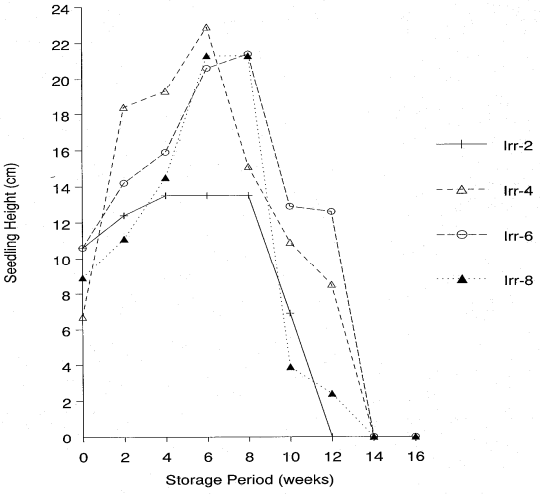

Fig.4. The effect of irrigation interval on the height of seedlings from stored 'Ife1' seeds produced under 2, 4, 6 and 8 days irrigation intervals

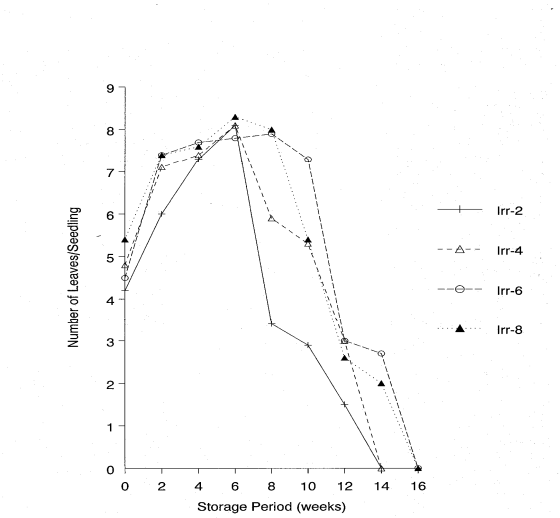

Fig.5. The effect of irrigation intervals of 2, 4, 6 or 8 days under which 'Ibadan Local' fruits were produced on the number of leaves per seedling obtained from stored seeds

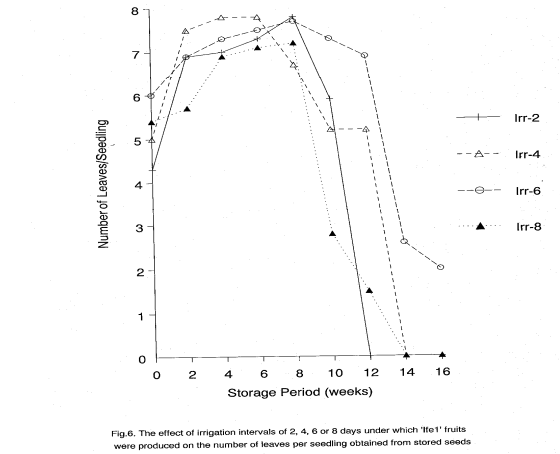

Fig.6. The effect of irrigation intervals of 2, 4, 6 or 8 days under which 'Ife1' fruits were produced on the number of leaves per seedling obtained from stored seeds

The initial improvement in seedling height and the number of leaves per plant as storage progressed in this study might have been due to the depletion of absicisic acid with time which allowed for better growth. The significantly poor performance of seeds produced under two and eight days irrigation intervals over others might be connected with the reason that two days irrigation interval might have resulted in the flooding of the soil pores resulting in poor aeration and subsequently poor plant growth and poor quality of the seeds produced. The irrigation interval of eight days must also have caused a reduction in plant growth and poor seed development due to inadequacy of water supply. Ghanbari *et al*. (2007) also reported that the irrigation interval to which fababean mother-plants were treated with, subsequently affected seed performance with seven days irrigation interval being superior to 14 and 21 days. Plants of *Goodenia fascicularis* with reduced soil moisture have been reported to be shorter, lower biomass and produced fewer seeds than plants watered adequately (Hoyle *et al*., 2008).

*Conclusion***:** It is concluded that irrigation intervals of four and six days intervals produced seeds of greater vigour and therefore recommended for tomato seed production in this ecological zone of Nigeria.

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