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Research Application Summary

Influence of fruit type and seed fermentation durations on seed germination and seedling vigour in pumpkin (*Cucurbita pepo* L.)

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Abstract

Pumpkin (*Cucurbita pepo* L.) is an important fruity vegetable belonging to the family cucurbitaceae and it is cultivated for its nutritional and medicinal purposes. Rural farmers usually harvest the fruits of pumpkin purposely for food after which they use the extracted seed at planting before the pulp and gelatinous material surrounding the seed has been removed, thus hindering seed germination and seedling vigour. Therefore, a study was conducted to evaluate the effect of pumpkin fruit type and seed fermentation durations on seed germination and seedling vigour in pumpkin. The round and oval pumpkin fruits were harvested at 60 Days After Anthesis (DAA) and then their seeds were fermented for a period of 0, 2 and 4 days. This was done by adding 250ml of distilled water to the pumpkin seeds and stored in air tight polythene bags for a period of 2 and 4 days at 25ºC. Germination percentage of seeds fermented for zero, two and four days was significant at $P \leq 0.05$ level of significance. The seeds fermented for a longer period of time (four days), showed a higher germination percentage of 90.2% for the round type and 87% for the oval type, compared to those seeds that were fermented for a period of 2 days and those not fermented (control) which showed a low germination percentage of 39.7% for the round type and 32.7% for the oval type. Seeds harvested from round shaped fruit and those harvested from oval shaped fruit, and fermented for four days, showed higher germinability than those fermented for two days period. This shows that fermentation does not only facilitate seed extraction but also improves seed viability. Therefore seeds should be fermented for longer, four days, at 25ºC.

Key words: *Cucurbita pepo,* fermentation, germination, vigour, type

Résumé

La citrouille (*Cucurbita pepo* L.) est un légume fruité important appartenant à la famille des cucurbitacées et elle est cultivée à des fins nutritionnelles et médicinales. Les agriculteurs ruraux récoltent généralement les fruits de la citrouille à dessein pour se nourrir, après quoi ils utilisent les graines extraites lors de la plantation avant que la pulpe et la matière gélatineuse entourant les graines aient été retirées, ce qui entrave la germination des graines et la vigueur des semis. Par conséquent, une étude a été menée pour évaluer l'effet du type de fruit de la citrouille et des durées de fermentation des graines sur la germination des

graines et la vigueur des semis chez la citrouille. Les fruits de citrouille ronds et ovales ont été récoltés 60 jours après l'anthèse (JAA), puis leurs graines ont été fermentées pendant une période de 0, 2 et 4 jours. Cela a été fait en ajoutant 250 ml d'eau distillée aux graines de citrouille et stocké dans des sacs en polyéthylène hermétiques pendant une période de 2 et 4 jours à 25 C. Le pourcentage de germination des graines fermentées pendant zéro, deux et quatre jours était significatif au niveau de signification P 0,05. Les graines fermentées pendant une plus longue période (quatre jours), ont montré un pourcentage de germination plus élevé de 90,2% pour le type rond et 87% pour le type ovale, par rapport aux graines qui ont été fermentées pendant une période de 2 jours et celles non fermenté (témoin) qui a montré un faible pourcentage de germination de 39,7% pour le type rond et de 32,7% pour le type ovale. Les graines récoltées à partir de fruits de forme ronde et celles récoltées à partir de fruits de forme ovale, et fermentées pendant quatre jours, ont montré une germinabilité plus élevée que celles fermentées pendant une période de deux jours. Cela montre que la fermentation facilite non seulement l'extraction des graines mais améliore également la viabilité des graines. Par conséquent, les graines doivent fermenter plus longtemps, quatre jours, à 25°C.

Mots-clés: Cucurbita pepo, fermentation, germination, vigueur, type

Introduction

The pumpkin seeds are important because of their high nutritive value, since they have minerals (Mg, Ca, Zn, P and Fe), proteins, lipids, fibres and carbohydrates (Kwiri *et al*., 2014). Pumpkins have several uses, great diversity in their cultivars and the potential to be cultivated in a wide range of environments (Ondigi *et al*., 2008). It is regarded as a traditional crop, yet it has a potential as food and vegetable for human consumption and commercial purposes.

The yield of pumpkin fruits and seeds varies with climate, variety/cultivar, production system, weed competition, plant diseases and management practices. Poor post-harvest handling and inadequate on-farm storage facilities have been singled out as some of the major bottlenecks affecting the quality and quantity of pumpkin produced in the country.

The major goals of post-harvest handling on the fruits are to avoid moisture loss, to slow down undesirable chemical changes and to avoid physical damage such as bruising or cutting, so as to delay spoilage (Basu, 2005). Therefore, fermentation, as a post-harvest handling technique is done on pumpkin seeds to remove the persistent placental material encasing pumpkin seeds. Water is mixed with seeds and left for 1 to 2 days at a temperature of 20-35 ºC. Fermentation is complete when the seeds settle to the bottom of the container and the placental material floats (ECPGR, 2011).

Materials and Methods

Site description. The research was conducted in three sites, that is, AIC Cheptebo farm (0 26′ 34″ North and 35 36′ 52″ East), Kaiboi Technical Training Institute farm (00 19′ 00″ North and 35 10′ 00″ East) and University of Eldoret farm (0 31' 0" North, 35 17' 0" East)

respectively, of the North Rift Region of Kenya.

Experimental method. Two local pumpkin seeds from round shaped fruit characterized by bulged seeds and oval-shaped fruit characterized by relatively flattened seeds obtained from the farmers were planted during the rainfall season (from May to August 2015).

The pistillate flowers that were tagged at anthesis and the fruits which developed from them were harvested at 60 Days After Anthesis (DAA). The seeds were extracted, then mixed with 250 ml of water and put in sealed plastic tins for a period of 0, 2 and 4 days at room temperature so as to remove the seed pulp around the seed. Those seeds that were not fermented were a control treatment. After fermentation, the seeds were thoroughly washed with tap water (pH 6.8) and then sundried at ambient air (22-32°C) for a period of one week until constant weight. Seed moisture content was then determined by the high constant temperature oven (130°C, 1 hour) method according to ISTA methods (ISTA, 1999).

Experimental design. The seed testing was done at the laboratory using Completely Randomized Design. The experiment was carried out in the seed science laboratory, using a substratum made of sand. A sub-sample of 100 well-mixed pure seeds from each treatment were planted in seed germination boxes at 25 seeds per replicate and placed in the incubator at 25ºC.

Data collection and analysis. The data collected were seed germination percentage and seedling vigour by measuring the seedling height daily to determine the rate of growth. The data obtained for each parameter were subjected to ANOVA using General Linear Model procedure for (SAS, Version 9.1.3). The treatment means for each test was compared by protected Fischer's test Least Significant Difference (LSD) at $P \leq 0.05$ level of probability. Standard errors of means were presented in the figures throughout the study.

Results

Effect of seed fermentation duration on seed germination. Germination percentage of seeds fermented for zero, two and four days was significant at P 0.05 level of significance. The seeds fermented for a longer period of time (four days), showed a higher germination percentage of 90.2% for the round type and 87% for the oval type, compared to those seeds that were fermented for a period of 2 days and those not fermented (control) which showed a low germination percentage of 39.7% for the round type and 32.7% for the oval type. The seeds extracted from fruits harvested at UOE, Kaiboi and Cheptebo showed a significant difference in germination percentage at $P \leq 0.05$ level of significance, with seeds from Cheptebo showing the highest seed germination percentage compared to those harvested from UOE and Kaiboi. There was no significant difference between the two pumpkin types (Figure 1).

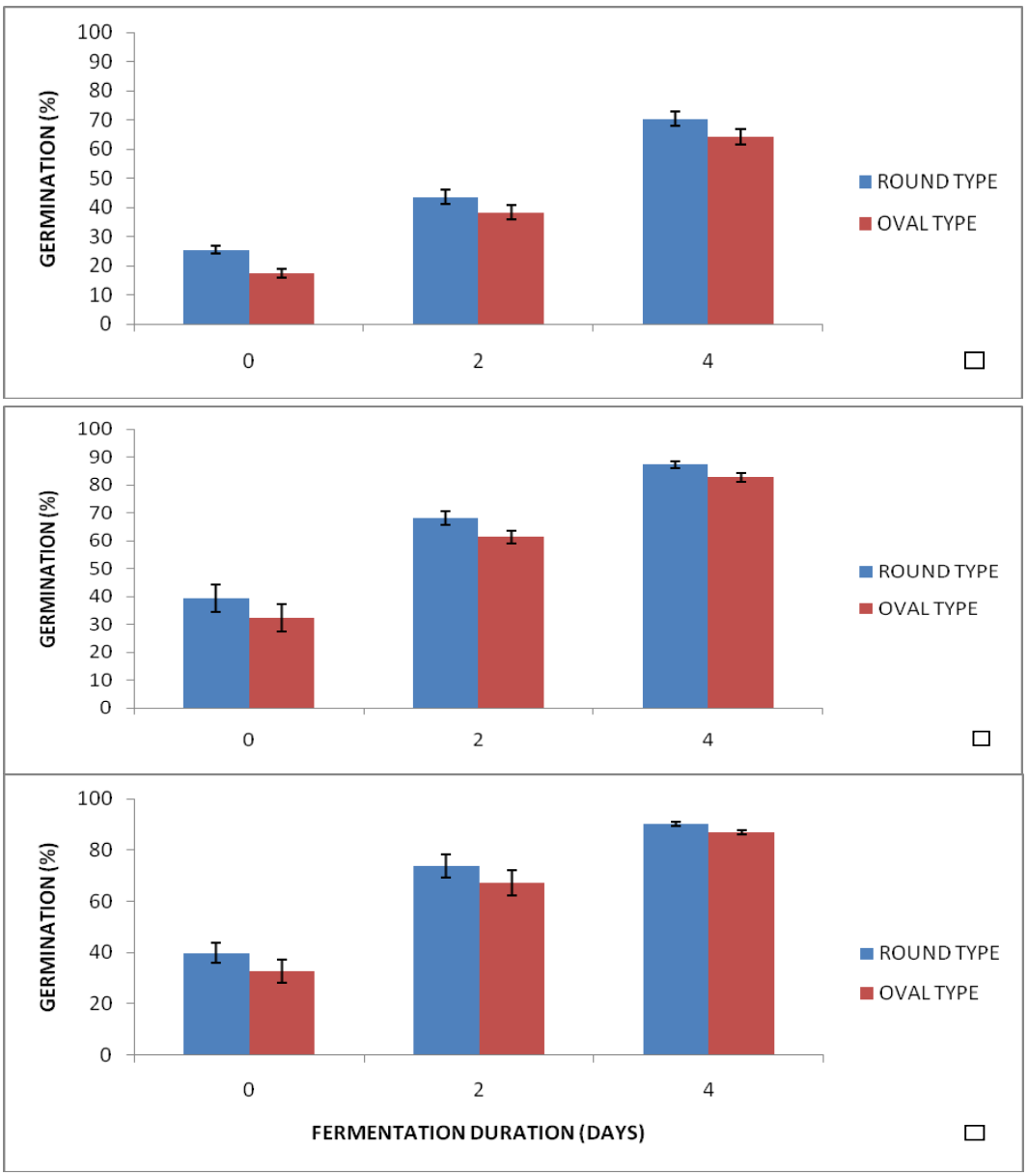

Figure 1. Germination percentage of seeds harvested at 60 DAA and fermented for 0, 2 and 4 days. The seeds were extracted from fruits harvested at UOE (A), Kaiboi (B) and Cheptebo (C) respectively. Error bars represent Standard Error (SD), n=12

Effect of fermentation duration pumpkin seed vigour. The seedling height for seeds fermented for two and four days was significant at P<0.05 level of significance. The seeds that were fermented for a longer period (4 days) showed a higher seedling height which was significantly different from seeds not fermented and those fermented for a period of two days. The seeds extracted from fruits harvested at UOE, Kaiboi and Cheptebo showed a significant difference at P<0.05 level of significance, with seeds from Cheptebo showing the highest

seedling height compared to those harvested from UOE and Kaiboi. The round and oval types of pumpkin showed no significant difference (Figure 2, 3).

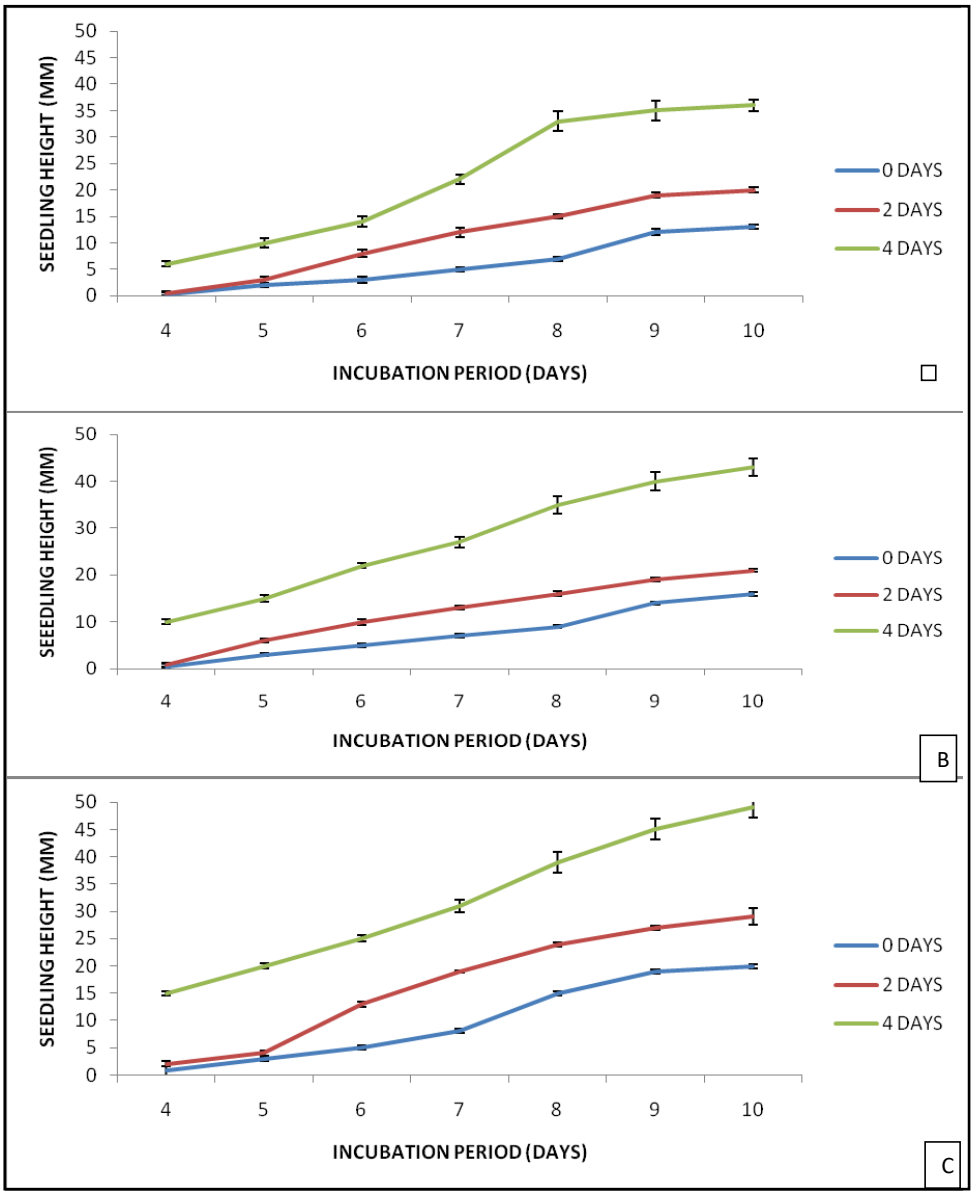

Figure 2. The seedling height of round type of pumpkin harvested at 60 DAA from UOE (A), Kaiboi (B) and Cheptebo (C) then fermented for 0, 2 and 4 days. Error bars represent Standard Deviation (SD), n=5

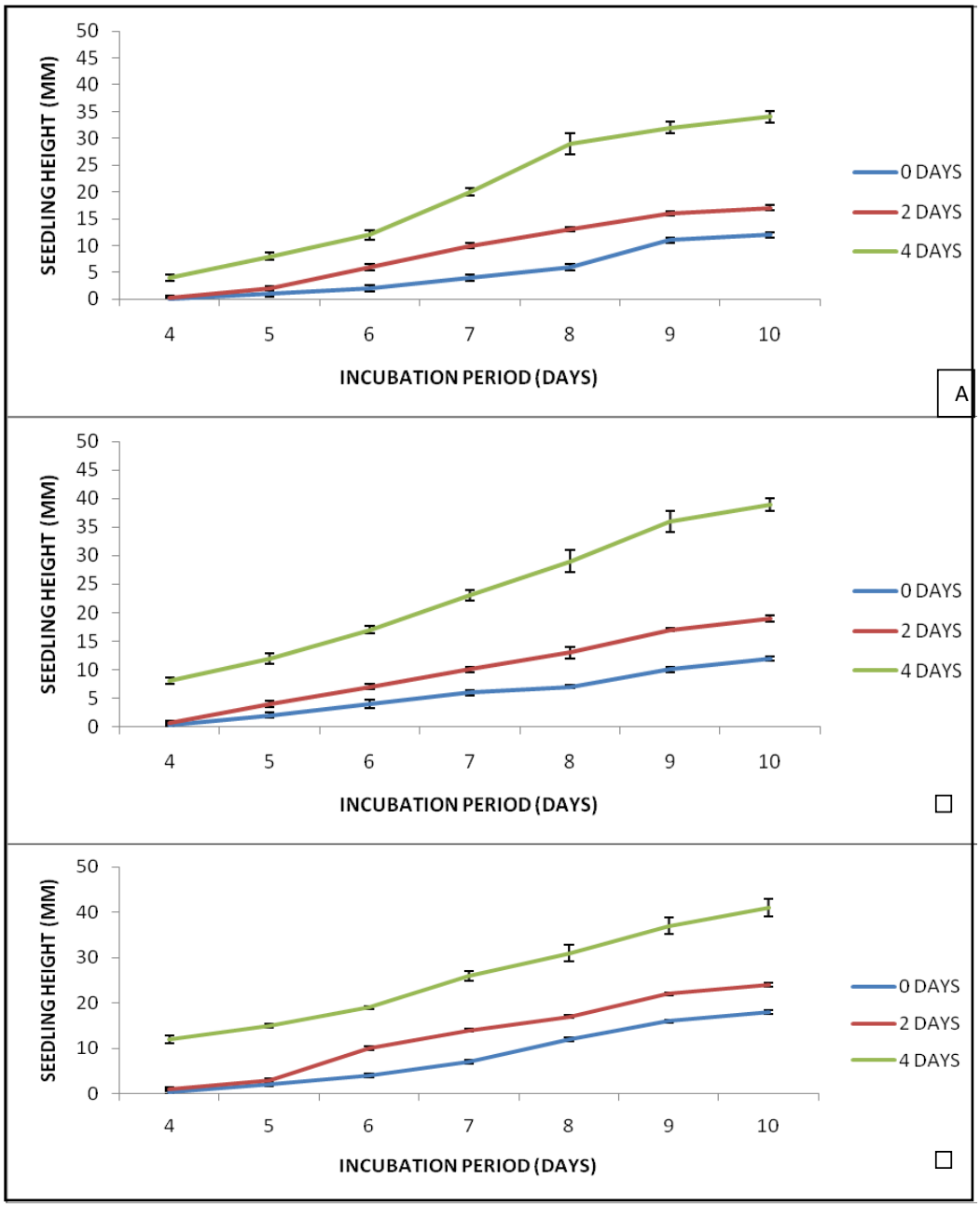

Figure 3. The seedling height of oval type of pumpkin harvested at 60 DAA from UOE (A), Kaiboi (B) and Cheptebo (C) then fermented for 0, 2 and 4 days. Error bars represent Standard Deviation (SD), n=5

Discussion

The germination percentage and seedling growth rate for seeds fermented at different durations was significant at P 0.05, with the seeds fermented for a period of four days giving

the highest germination percentage of 90%, compared to those seeds fermented for two days, or not fermented. This is in concurrent with Yao *et al*. (2012) who found out that fermentation improves seed germination and vigour since all the fermented seeds showed better germination and vigour, compared to the unfermented seeds. Amazon (2016) found out that the fermentation process breaks down the gelatinous material that encases the seed. These jelly sacks contain a germination inhibitor which needs to be removed so as to boost seed germination percentage. Fermentation is also helpful in eliminating seed-borne diseases.

The rate of fermentation depends on the concentration of microorganisms, cells, cellular components and enzymes, pH and temperature for anaerobic respiration. Pumpkin seeds are usually harvested when wet and they need to be cleaned by washing the seeds so as to separate them from pulp. The process of fermentation improves seed quality but depends on the condition it takes for it to be efficient (Nerson, 2002, 2007).

Conclusion

Pumpkin seeds harvested from Round shaped fruit and those from oval shaped fruit, and fermented for four days, showed higher germinability than those fermented for two days period. This showed that fermentation does not only facilitate seed extraction but also improves seed viability. The round-shaped fruits gave seeds that showed a higher level of germination and seedling vigour compared to the seeds obtained from the oval fruits, although there was no significant difference between the two pumpkin types.

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