Assessment of Growth Media for Vegetable Seed Germination Test for Aquaponic System

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Abstract
*Aquaculture has been a sustainable source of food security and poverty alleviation for Nigerian families but can be more profitable if upgraded to aquaponics systems. Aquaponics is relatively new in Nigeria although vegetable and fish consumption has been a regular part of Nigerian diets. Therefore, a study was carried out to assess the potentials of some growth media for vegetable - aquaponics culture system in Nigeria. Twenty seeds each from two selected vegetables (lettuce var. grace lakes and amaranth var. Bunchy) were grown on different media namely; Luffa cylindrical, tissue paper, cotton wool and soil which served as the control. These were laid out in a 4*2 factorial design on a flat germination tray. The experiment was repeated twice. The seed germination rate from each medium was compared to the control. Data were analyzed using descriptive and inferential statistics. Increase in length, shoots and roots of germinated seedlings were observed at 4, 10 and 14 days after sowing (DAS). Amaranthus + Luffa, Amaranthus + cotton wool, Amaranthus + tissue paper, lettuce + cotton wool recorded 100% germination; with a 90% germination in lettuce + Luffa, Lettuce + tissue paper, Amaranthus + soil, while Lettuce + soil gave the lowest germination rate of 80.7% at 10 DAS. Luffa cylindrical is an effective and efficient growth medium for vegetable - aquaponics system in Nigeria and it should be encouraged because of availability.*
Keywords: Vegetable - aquaponics, Lettuce, Amaranthus, food security, farming system, horticulture.

INTRODUCTION

Horticulture and fisheries can play vital roles in ameliorating food insecurity and nutrition situations. According to Oladimeji *et al*., (2018), horticultural crops production alongside fisheries can effectively combat global food and nutritional insecurity which is caused by population explosion and urban agglomeration(Consulting, 2013). In many countries, the current rates of expansion of urban agglomeration are accompanied by the challenges of food and nutrition security.

Aquaponics system is one of the most effective ways of conserving fish pound waste water as well as recycling fish wastes by growing vegetables.Urban areas are also confronted with the problem of inadequate land for agricultural activities but with the combination of vegetable production and fish enterprise, more food will be available for the urban population, that is why the right to adequate food is universal and good nutrition is essential for all(Silva*et al*., 2017). Good nutrition is the source of energy to live an active life. However, the problem of malnutrition such as under-nutrition, micro-nutrient deficiency and obesity exist in all countries and cut across socio-economic classes (Cattaneo *et al*., 2008) and emerging challenges of climate change, environmental sustainability, and rapid technological shift are transforming the food systems; giving rise to the question on how to feed the ever-growing population sustainably (Consulting, 2013), could be tackled if more farmers adopts aquaponics systems. Aquaponic is simply a system designed to combine Aquaculture and hydroponics. It can be utilized for horticultural crops production to enhance yield.This allows the nutrients produced by fish in a form of waste water be used by the plants which in turn help to purify the pound water making it suitable for fish production as it serves as a recycled concept, (Bruce *et al*., 2016). Yang and Kim (2016), reported that tomatoes, lettuce

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and basil are among the horticultural crops suitable for aquaponics system. Some of the advantages of aquaponics system include the use of soilless medium where small space needed to produce more outputs (Geisenhoff *et al*., 2016), all year round production and availability of organic fertilizer fromfish waste thus discouraging the use of agro-chemicals (Saha *et al*., 2016;Orsini *et al*., 2013).

Agriculture is one of the largest non-oil sectors with high potential to revive the Nigerian economy as it can serve as an aspect of urban agriculture,(Bryld, 2003). Aquaponics is a clear solution like the recommendation in Bangladesh for urban farming as reported by

Farmers in the urban centers sometime utilize polluted soil and water that are not healthy and environmentally friendly for fresh vegetable production, hence it will really serve as a major relief to urban farmers, (Alaimo*et al*., 2008). Aquaponics system posits an economically advantageous symbiotic Saha*et al.*, 2016) hence; vegetables can be raised alongside fish in the compound which is an advanced form of compound farming or home gardening in Urban Agriculture (UA). In Nigeria, aquaculture and horticulture are practiced singly within the UA system. Both can be integrated into aquaponics system with associated benefits of maximum resources utilization and conservation. Production of seedlings in appropriate media before transplanting into the permanent field is an integral part of horticultural production practice.

The technique of aquaponics-seedling production essence is to make transplanting easier and prevent injury or lesion during transplanting operation. Therefore, theobjective of this study was to assess different germination media for vegetable seedling production for aquaponics system.

MATERIALS AND METHODS

This study was carried out at the National Horticultural Research Institute Ibadan, Oyo state, Nigeria (Latitude $7^0$24'47.07" N and Longitude $3^0$51'27.906" E; 218.6masl). Soilless media used were locally available materials such as cotton wool, tissue paper and fibrous sponge (*Luffa cylindrical* (*L*) with soil as control. The fibrous sponge was cut into three (3) portions. The middle portion was immersed in a bowl of waterhalf of the fibrous sponge submerged while half portion of the material was above the water surface. As a result, the fibre allowed water to permeate from the portion in the water to the portion above the water, hence remained moistened. The cotton wool and tissue paper were folded length wise in a square shape with a thickness of five centimeter (5cm) each and moistened. Twenty seeds each of *Amaranthus* and Lettuce were sown on each of the media on the same day and kept under shade. The water level was maintained to avoid desiccation. The four (4) media and two (2) vegetable seeds were laid in a completely randomized design (CRD) in three (3) replicates in a 4*2 factorial arrangement. Data collected were number of days to germination and germination count at 4 and 10 Days after Planting (DAP). Data was subjected to analysis of variance and means were separated using LSD test at 5% probability level using statistical Analysis System (SAS 9.4 version).

RESULTS AND DISCUSSION

Rate of vegetable seeds germination as influenced by different media

The result in Table 1 shows the effect of different growth media on germination of *Amaranthus* and Lettuce, there was no significant difference between the number of seeds germinated at 4DAP and 10DAP in the four-growth media for both crops at ($p>0.05$) . However, the highest number of seeds germinated was recorded for seeds sown in growth media containing cotton

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wool, followed by tissue paper and *Luffa.* Growth media containing soil had the least mean value. Looking at the overall mean results, *Luffa,* cotton wool and tissue paper influenced 100% germination at 10DAP while soil gave the least germination using *Amaranthus* as the test crop seed. These results can be attributed to low aeration in soil medium than other media used. Lettuce had 100% mean germination value only on cotton wool growth medium while tissue paper and *Luffa* gave 90% mean germination. The top soil consistently gave the least (80.7%) mean germination count. However,*Luffa*occurs naturally, but has little or no economic value at present hence can be exploring as germination media.

Results of the interactions between the germination media and the test crop seeds is presented in Table 2. The interaction showed that, *Amaranthus* + *Luffa*, *Amaranthus*+ cotton wool, *Amaranthus* + tissue paper and lettuce + cotton wool had 100% germination. Lettuce + *Luffa*, Lettuce + tissue paper, *Amaranthus* + soil had 90% germination while Lettuce + soil gave the lowest germination (80.7%) at 10 DAP. All the soilless media supported germination of the test crops better than soil. Looking at this result from cost perspective; both tissue paper and cotton were purchased while *Luffa* was obtained at no cost because it is a volunteer crop growing in the wild without any appreciable economic value at the moment. The *Luffa*, therefore be considered a medium for aquaponics system for the cultivation of vegetables.

CONCLUSION AND RECOMMENDATION

All the tested soilless media supported higher germination of *Amaranthus* and lettuce than top soil. Cotton wool and tissue paper had financial cost implication while *Luffa* did not have. Therefore, local materials such as Luffa are recommended for aquaponics and hydroponics-basedseedlings production in the nursery.

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Table 1: Effect of nursery growth media on germination of vegetables

Treatment	4DAP	10DAP	Overall
Amaranthus			
Luffa	19.33	0.67	20.00
Cotton wool	20.00	0.00	20.00
Tissue paper	20.00	0.00	20.00
Soil	19.67	0.00	19.67
LSD (0.05)	1.22	1.09	0.54
Lettuce			
Luffa	16.33	2.67	19.00
Cotton wool	19.33	0.67	20.00
Tissue paper	18.33	1.33	19.67
Soil	14.33	4.33	18.67
LSD (0.05)	6.41	7.43	1.80

DAP =Days after Planting

Table 2: The interactions between the germination media and crop seeds

Treatment	4DAP	10DAP	Overall
Crop+growth media			
Amaranthus+Luffa	19.33	0.67	20.00
Lettuce+Luffa	16.33	2.67	19.00
Amaranthus+cotton wool	20.00	0.00	20.00
Lettuce+cotton wool	19.33	0.67	20.00
Amaranthus+tissue paper	20.00	0.00	20.00
Lettuce+tissue paper	18.33	1.33	19.67
Amaranthus+soil	19.67	0.00	19.67
Lettuce+soil	14.33	4.33	18.67
LSD (0.05)	4.24	4.88	1.22

DAP =Days After Planting

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