Chapter 21

Urban agroecology in food and health: home production of sprouts

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ABSTRACT
The Sprouts are highly nutritious food and in their production no kind of fertilizer or pesticide is used, using only the reserves stored in the seeds for their growth. Thus, this study aimed to study the rate of accumulation of fresh biomass in the home production of sprouts of five species (*Medicago sativa, Trigonella foenum graecum, Vigna radiata, Vigna angularis* e *Lens culinaris)* in five evaluation times (1, 2, 3, 4 e 5 days after the start of the experiment). In the species *M. sativa* and *T. foenum graecum*, the method in the presence of light was used. In the species, *V. radiata, V. angularis* e *L. culinaris*, the method in the absence of light was used. In the method with the presence of light, the seeds after germination were transferred to a plastic tray where the sprouts were irrigated twice a day. In the method with no light, a glass pot with a capacity of 1 L was used for germination and growth of sprouts, and irrigation was performed once a day. In all species studied, it was observed that fresh biomass increased linearly with the adjustment of the linear regression model. It was found that *M. sativa* had the highest rate of biomass accumulation and *L. culinaris* showed the lowest rate of biomass accumulation. From the results obtained in the present study, it was found that the home production of sprouts has a high potential for the supply of quality food for the urban population and can be produced in consumers' residences with reduced transport costs.

Keywords: Urban Agriculture, Agroecology, Home production of sprouts, Fresh biomass.

1 INTRODUCTION

The interest in healthier food associated with population growth contributed to the expansion of urban and peri-urban agriculture. Small-scale productions from urban agriculture, in addition to contributing to subsistence and health through food diversification, can generate income for families, either by reducing food expenses or selling surpluses (Arruda, 2011; Aquino and Assis, 2007). However, it is necessary to develop new technologies applied to small-scale production from urban agriculture activities. In this context, the production of differentiated foods, with added value, short cycle, and good productivity, such as small vegetables, known as microgreens and sprouts, become potential alternatives for small spaces, fitting into the concept of urban agriculture with socio-environmental practices (Blasius, 2021; Benincassa et al., 2019).

The development of urban agriculture is directly linked to the demographic and economic growth of cities, contributing to the reconfiguration of urban spaces through land use, population structures, and social practices, among other factors. It seems to be consensual for some scholars that population density and its consequences have contributed to the expansion and diversification of this activity. Given this, urban and peri-urban agriculture has been considered one of the possibilities to alleviate some of the many problems of cities, especially those related to food, health, environment, and income generation (Ribeiro et al., 2015).

Sprouts have high nutritional indexes, rapid development (lasts about six to seven days), low financial investment and are versatile to compose food "in nature" and also in other forms, such as flour. Analyzing their yield is essential for the search for economically viable alternatives aimed at food security for the population and access to foods with high nutritional value (Bongiolo, 2008; Silva et al., 2019; Cantelli et al., 2020; Marques et al., 2020; Marques et al. al., 2017; Silva, 2017).

The production of sprouts can be carried out at any time of the year and region and no type of fertilizer or defensive and direct sunlight is used, using only the reserves stored in the seeds to germinate and reach the necessary size to be consumed. Sprouts are sources of vitamins, minerals, and amino acids, which supply any nutritional deficiencies. The presence of bioactive compounds in sprouts is associated with a reduced risk of cancer, cardiovascular diseases, and type II diabetes mellitus, in addition to strengthening the immune system (Vieira and Lopes, 2011; Baenas et al., 2016; Baenas et al., 2017; Xue et al., 2016).

Based on growth data and fresh biomass accumulation, knowledge about the biology of the plant can be expanded, allowing the development of species management techniques or estimating, in a very precise way, the causes of growth variation between genetically diverse plants. Therefore, the growth analysis indicates the differences between cultivars of the same species or between different species, to select those that best meet the proposed objectives of economic exploitation (Castro et al., 2006).

Considering the lack of information regarding the analysis of growth based on fresh biomass in the production of sprouts and that the species can present different patterns associated with the yield of biomass, this study aimed to investigate the rate of accumulation of fresh biomass in the homemade production of shoots of five plant species (Medicago sativa, Trigonella foenum graecum, Vigna radiata, Vigna angularis, and Lens culinaris) in five data collection periods.

2 MATERIAL AND METHODS

This work was carried out by members of the Professional Training project of the Federal University of Juiz de Fora "Urban Agroecology in Food and Health". Due to the pandemic period and restrictions on face-to-face activities, this work was carried out in the homes of project members. The sprouts were produced without the use of substrate and for their growth, the reserves stored in the seeds are used.

The experimental design adopted was completely randomized with two replications. Two methods were used (in the presence of light and the absence of light) and five plant species were evaluated: alfalfa (Medicago sativa), fenugreek (Trigonella foenum graecum), moyashi bean (Vigna radiata), adzuki bean (Vigna angularis) and lentils (Lens culinaris).

In species that have smaller seeds (alfalfa and fenugreek) the indicated method is with the presence of light, an adaptation of the species itself in natural conditions. In species with larger seeds (moyashi beans, adzuki beans, and lentils) sprouts were produced in total darkness. The production of shoots of species with larger seeds, if carried out in the presence of light, they become etiolated, hard, and greenish, which is not desirable (Vieira and Lopes, 2011).

The alfalfa and fenugreek seeds were supplied by the company "broto Fácil" from Curitiba-PR and the moyashi bean, adzuki bean, and lentil seeds were acquired in the local market of Juiz de Fora-MG.

In the presence of light, a plastic tray from the kit for producing sprouts was purchased from the company "Broto Fácil" (Figure 1) and a manual sprayer was used to irrigate the sprouts. In seed germination, water immersion was performed using 500 mL glasses for 8 hours. After germination of the seeds, which lasted 48 hours, the seeds were transferred to the plastic tray and the sprouts were irrigated twice a day. The evaluations were carried out at regular intervals of twenty-four hours with five data collection times (1, 2, 3, 4, and 5 days after the beginning of the experiment). To obtain the fresh mass of the shoots, a digital kitchen scale with a capacity of 5 kg was used.

Figure 1. Plastic tray.

In the method with no light, a glass pot with a capacity of 1 L was used, where the sprouts germinated and grew. A mosquito net was placed in the mouth of the glass to allow oxygen to enter and fixed with the aid of an elastic band (Figure 2). Seed germination was immersed in water for 12 hours. Irrigation (wetting) was performed by immersing the shoots in water once a day, and pouring water into the glass until the shoots were covered. The evaluations were carried out at regular intervals of twenty-four hours with five data collection times (1, 2, 3, 4, and 5 days after the beginning of the experiment).

Figure 2. Glass with mosquito screen.

Data were interpreted using regression analysis. The regression equations were adjusted based on the “t” test of the coefficients at 5 or 1% of probability and on the coefficient of determination (r2).

3 RESULTS AND DISCUSSION

Initially, it should be emphasized that the lack of published works related to the rate of accumulation of fresh biomass in shoots was a limitation in the discussion of the results found.

In all species studied, it was observed that fresh biomass increased linearly as a function of time with the adjustment of the linear model (Table 1) (Figure 3). Under the conditions in which this study was carried out, it was observed that alfalfa and fenugreek had a higher rate of biomass accumulation, 53.05 and 27.8 grams/day, respectively. On the other hand, lentils had the lowest rate of biomass accumulation, 13.25 grams/day (Table 1).

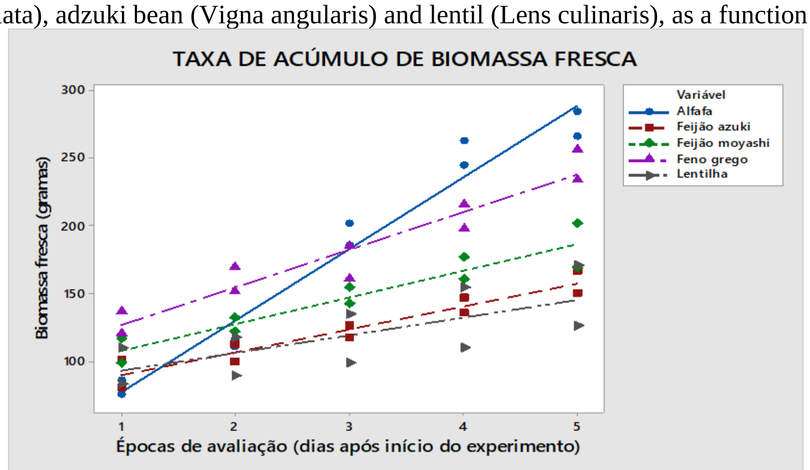
In alfalfa, which obtained the highest rate of sprout biomass increment, there was an increase of 1100.00% in the initial mass of seeds. In lentils, where the lowest rate of biomass increment was observed, there was an increase of 188.24% and in moyashi beans, the increment was 330.36%.

Table 1. Average values of sprout production (fresh mass in grams) of alfalfa (Medicago sativa), fenugreek (Trigonella foenum graecum), moyashi bean (Vigna radiata), adzuki bean (Vigna angularis) and lentil (Lens culinaris), in five evaluation epochs (days).

	Data collection times (days after the beginning of the experiment)						
Species	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Regression Equations**	**r^2 (%)**
Alfafa	80	112,5	193	253	275	$Y = 23,55 + 53,05\ EP^{**}$	96,05
F. grego	128	160	172	206	244	$Y = 98,6 + 27,8\ EP^{**}$	91,88
Moyashi	107	126,5	148	168	185	$Y = 87,65 + 19,75\ EP^{**}$	89,19
Azuki	90,5	105,5	121,5	140,5	158	$Y = 72,20 + 17,00\ EP^{**}$	91,37
Lentil	96	103	116	131,5	148	$Y = 79,2 + 13,25\ EP^{*}$	50,59

r2 = coefficient of determination; ** = significant at 1% probability by the “t” test; * = significant at 5% probability by the “t” test.

Figure 3. Estimate of fresh biomass accumulation rate of alfalfa (Medicago sativa), fenugreek (Trigonella foenum graecum), moyashi bean (Vigna radiata), adzuki bean (Vigna angularis) and lentil (Lens culinaris), as a function of five evaluation epochs



Translation:
BIOMASSA FRESCA (GRAMAS) (FRESH BIOMASS (GRAMS)
TAXA DE ACÚMULO DE BIOMASSA FRESCA (FRESH BIOMASS ACCUMULATION RATE)
EPÓCAS DE AVALIAÇÃO (DIAS APÓS DO EXPERIMENTO) (EVALUATION TIMES (DAYS AFTER THE EXPERIMENT))

The yield of sprout production (proportion sprout/seed) is high, normally one kilogram of seeds produces from 5 to 12 kilograms of sprouts, depending on the species used and the time of sprouting (Marques et al., 2017, Oliveira, 2015). According to Vieira and Lopes (2011), with one kilo of moyashi bean seeds, around 6 kg of sprouts can be produced. In the case of radish, broccoli, and clover, one kilo of seeds can give rise to between 8 and 12 kg of sprouts.

Blasius (2021) studied the production of sunflower sprouts and observed that the average yield was 1:3 (seed mass: sprout mass). Lima (2006) who studied the yield of moyashi bean sprouts concluded that 1 kg of the germinated seed of this species will provide an average of 4.9 kg of sprouts.

The low yield in the production of shoots obtained in this work, about the values cited in the literature, may be related to the quality of the seeds and the number of daily irrigations. The development of genotypes or varieties adapted to the production of shoots is essential to obtain a higher yield (Shewry et al., 2010; Benincassa et al, 2019; Lin and Alves, 2002; Duque et al., 1987).

The alfalfa and fenugreek seeds (which obtained the highest rate of biomass increment) were purchased from a company specialized in the production of edible sprouts, while the moyashi bean, adzuki bean, and lentil seeds were purchased from a market that did not specialize in the production of sprouts.

Another factor that must be considered is related to the period of cultivation of the sprouts, which can reach 7 days, and only the period of 5 days after germination was analyzed in this study.

According to Vieira and Lopes (2011), for germination to continue, seeds need adequate moisture. This condition is achieved by wetting the shoots at intervals of four to twelve hours, depending on the species and the ambient temperature. For moyashi beans, for example, the interval between irrigations of four to six hours is ideal. In the production of sprouts of alfalfa, clover, radish, and broccoli, the recommendation for wetting the sprouts is with a six-hour interval between irrigations. In the present study, an interval of 24 hours between irrigations was used in the method of producing shoots in the absence of light and 12 hours in the method with the presence of light.

Urban agriculture has high production potential even with area restrictions. In this approach, the production of sprouts can be a great alternative and can be carried out in small spaces with a controlled environment or the homes of consumers, regardless of weather conditions (Marques et al, 2017; Silva and Krewer, 2016; Valent et al., 2017).

4 CONCLUSION

In all species studied, it was observed that fresh biomass increased linearly as a function of time with the adjustment of the linear model. It was found that alfalfa (method in the presence of light) had the highest rate of biomass accumulation, 53.05 grams/day. Duckweed (darkness method) showed the lowest rate of biomass accumulation, 13.25 grams/day.

The domestic production of sprouts presents good productivity, but it is still not widespread in the context of urban agriculture and sustainable development. From the results obtained in the present study, it was found that the production of sprouts has a high potential for the supply of quality food and can be implemented in the homes of consumers with a reduction in the cost of transportation and food expenses by the population urban.

The rate of accumulation of fresh biomass in the domestic production of sprouts requires further studies, considering that the biomass production of sprouts can be influenced by the quality of the seeds, types of containers used in the growth of sprouts, number of daily irrigations, among others. other factors.

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