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Final Report

Name of student: Klara Bretschneider
University: University of Kassel
Supervisor at University: Mariko Ingold
International Agricultural Research Center: CIAT - International Center for Tropical Agriculture
Country: Brazil
Supervisor at IARC: Luis Verchot
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Abstract

Jambú (*Acmella oleracea*) is a leafy vegetable of cultural and economic relevance in the Brazilian Amazon. With increasing demand, jambú cultivation represents an important source of income for small vegetable producers in the region of Belém. There is still considerable lack of research about jambú cultivation and production potential in humid tropical conditions. In the region of Belém, soils are predominantly sandy and acidic. Daily heavy rainfalls lead to high leaching and nutrient losses, requiring constant fertiliser application. Fertiliser purchase is a significant cost in vegetable production and a limiting production factor for low-income smallholders. Alternatively, biochar is a soil amendment with the potential to retain nutrients and, increase the pH of soils. This study investigates the effects of biochar amendment on the growth parameters and development of jambú in Belém. Two pot trials were executed in a randomised block design with six replicates for each treatment. Biochar was produced from coconut shell and bamboo (*Guadua ssp*.) in a conical earth pit. In the first pot trial, biochar treatment (3g per kg soil) was combined with different doses of chicken manure (0, 6, 12 g per kg soil). In the second experiment, doses of biochar (0g, 1g, 3g, and 5g per kg soil) were combined with the same amount of chicken manure (12g per kg soil) on two different soils (soil from fallow land and soil from a vegetable production area with intensive compost applications). Preliminary results of the first experiment show a slightly positive effect of the biochar treatments on plant growth and biomass of jambú compared to the treatments with only chicken manure. In the second trial, a slight increase in fresh and dry biomass could be observed for biochar treatments on soil from fallow land but no difference for biomass was observed for the farmland soil. This could be due to the fact that the farmland soil had a higher pH value (6.2) and was richer in nutrients than the soil from fallow land (4.1). The work concludes that biochar application might increase jambú production on marginal land but does not impact production on more fertile soils.

Overall, no negative impact of biochar application on plant development and growth was observed.

Personal experience

For producing biochar, I used the earth pit method. This method was chosen to represent a low-tech option that is easy to reproduce at any place at low costs. Originally, I planned to produce biochar from Acai (*Euterpe oleracea*) seeds which is a local waste product in the city of Belém. Unfortunately, I was unable to burn the seeds with the earth pit method. Due to their small size, the airflow and combustion were hindered. Therefore, I had to choose another feedstock for the biochar. As I wanted to stick to a local waste product, I chose coconut shell, which is sold and wasted in large quantities at the local markets. I sundried the coconut shells and added dry bamboo as an additive to burn faster. After three trials, I could finally produce biochar from bamboo and coconut shells with the desired alkaline pH value.

Feedstock, pyrolysis process and quenched biochar made of coconut and bamboo

The first experiment, I set up at the vegetation house with nets protected area under a roof. At the beginning of my first experiment, I got to know that farmers sow the plants themselves. Thus, I sow the seeds direct in a seedbed to see if biochar had any inhibiting effect on germination. It is important to mention that seeds are not available at agricultural stores because farmers usually produce jambú seeds themselves. I acquired jambú seeds at the university because there are several ongoing research projects about jambú in Hydroponics. Within the projects, there is a small seed production from where I could collect seeds. Because jambú was not bred for uniform field emergence, the germination rate of jambú seeds is very low. Therefore, I had to transplant some seedlings after the first two weeks. Twelve days after sowing, plants were infested by caterpillars. Due to the lack of alternatives, I used the insecticide (pyrethroids), commonly used during experiments at the university for caterpillar

control. Luckily the plants recovered quite fast, a fact that enabled me to continue with my schedule as planned and harvest the plants in the beginning of January.

Seed emergence of jambú is quite irregular: One the left side jambú emergence (10 seeds per pot) of the first experiment. Right side jambú on cultivation plate for the second experiment.

In the beginning of January, a strong coronavirus wave hit the entire city. By then, almost all students got sick and in quarantine. It was not different for me, I got sick for three weeks which jeopardized my second experiment. As almost all university members got infected with the coronavirus, it was hard to find a representation to water the seedlings I had sowed for my second experiment. After various infestations of plagues (mole crickets, larvae), I had to repeat the sowing three times.

Finally, I could set up my second pot experiment by mid of February. To avoid irregular seed germination, as observed during the first experiment, I used seedlings in the second experiment. I selected seedlings of the same height and growth stage to start the experiment. This time I used insecticide as soon as I detected eggs on the plants. With this method, I could successfully avoid larvae infestation. Nevertheless, some plants were infested with broad mites (*Polyphagotarsonemus latus*), which led to the malformation of two plants in the experiment. Apart from that, the experiment was successful. I benefited from the experience of the first experiment and could refine my research question and experiment set up.

Already at the beginning of my stay in Belem, I was eager to speak to jambú producers to get to know the local production personally, as well as to better understand producers' realities and needs. Unfortunately, the greenhouse experiment took so much time that I could not realize the farm visits till February. During the pandemic outbreak in January, I was not sure

if I could conduct the second experiment because the university decided to close its facilities temporarily. Therefore, I designed a questionnaire that I could apply to conduct interviews among jambú producers in Belém. This was done to collect more data in case I could not conduct the second experiment.

In the end, I could start the second experiment, but I still interviewed some producers. Because of time constraints, the number of producers I interviewed was limited, but I got valuable insights.

Visit of jambú producers in the surroundings of Belém

My first attempt at the field experiment failed because of heavy rainfall events. Because the prevalent soil in this region is very sandy, the freshly dug beds collapsed, and the biochar was washed away even though the parcels were built with boundaries made of bamboo. This was facilitated by a slight inclination of the experiment area. I asked permission to use the area of another institute for the second attempt of the field experiment. This time I used a covered area to avoid the impact of extreme weather events. Luckily, I had no problems with plagues, and the plants developed well.

Field experiment in the covered area

In general, I had a great experience at the university, and I got a lot of help and support from other students and university employees. Nevertheless, it took some time to figure out that to obtain anything, I needed to address my social network within the university. In the beginning, I often had difficulties accessing rooms or materials. After two months, I got more familiar with and knew whom to ask to obtain materials or permission to use the laboratory. All troubles I had with my first experiment helped me to improve the design and execution of my second experiment. Despite some drawbacks that prevented me to research as planned, I was able to complete all experiments. I learned to be flexible and adapt my research agenda according to the local circumstances, and with every attempt, I deepened my knowledge about potential risks in plant experiments. Overall, I had a very good experience, and the students and staff were very supportive and cooperative. In exchange, I was also able to help other students with their research and I built a huge network that remains in active exchange.

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