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Effectiveness of vermicompost from cow manure on agronomic parameters of tomato

Issa Alé NDIAYE*, Mamadou DIATTE, Babacar LABOU, Amadou BALDE, Etienne TENDENG, El Hadji Serigne SYLLA, Omar SEYDI, Pape DIOP, El Hadji Omar SENE and Karamoko DIARRA

UCAD, Integrated Production and Protection in Agroecosystems Laboratory L2PIA, Faculty of Science and Technology, Cheikh Anta Diop University, Dakar, Senegal.

** Corresponding author ; E-mail : issaale.ndiaye@ucad.edu.sn; Tel : +221 77 499 35 82*

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ABSTRACT

Chemical fertilization inputs for micro-gardens in Senegal increase production costs and decrease the quality of vegetables. Vermicompost could be positioned as an alternative to chemical fertilizers. This study aimed at evaluating the effectiveness of vermicompost from cow manure on agronomic parameters of tomato. Six treatments were compared. They are a mixture of sand and vermicompost constituted of four doses (D_1, D_2, D_3 and D_4) and chemical (T_r) and neutral (T_n) controls. The vermicompost treatments D_1, D_2 and D_3 gave the highest germination percentages. The highest germination percentage was noted on the D_3 dose. On flowering, the D_4 dose gave a higher number of flowers compared to the controls. The treatments (D_2, D_3 and D_4) were more efficient compared to the controls on fruiting and fruit weight. The highest weights were obtained with D_4. Vermicompost is an alternative to the use of synthetic chemical fertilizers.

Keywords: Micro gardening, fruit vegetables, urban agriculture, horticulture, vermicompost, Dakar, Senegal.

INTRODUCTION

Increasing urbanization favors the concentration of populations in cities. Around the world, 50% of the population lives in urban areas (Ba and Aubry, 2011). The reduction of arable land due to urbanization has favored the development of urban agriculture (Mainoo and al., 2008). Micro-gardening has an important role in food supply (Ba and al., 2014). The availability of chemical fertilizer inputs is a constraint to the development of microgardening (González and al., 2010). The supply of chemical fertilizer inputs to microgardens in Senegal increases the cost of production and decreases the shelf life of vegetables (Lema and al., 2014). The use of organic fertilizers is considered an alternative that will gradually solve the problem of access and cost of mineral fertilizers (Coulibaly and al., 2021). The Compost could be positioned as an alternative to chemical fertilizers (Toundou et al., 2016 ; Upite et al., 2019).

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Vermicomposting is a decomposition process involving the combined action of earthworms and microorganisms (Edwards and al., 2010). The use of vermicompost improves soil properties and makes nutrients available in the soil (Ferreras and al., 2006). The effectiveness of vermicompost depends on the type of organic matter and the dose of use. The aim was to propose a sustainable solution in order to progressively limit the use of chemical fertilizers. This study aimed at determining the effectiveness of vermicompost from cow manure on agronomic parameters of tomato.

MATERIALS AND METHODS

Study site

These experiments were carried out under greenhouse between October 2019 and June 2020 at the Laboratory of Research in Integrated Production and Protection of Horticultural Agroecosystems (L2PIA) of the Cheikh Anta Diop University of Dakar (14°41'05.14"N et 17°27'43.28"O).

Production of substrates

Vermicompost from cow manure was obtained using the local worm species *Eudrilus eugenia*. The vermicompost was obtained after a vermicomposting period of 10 weeks.

Evaluation of agronomic parameters

Germination percentage

Five treatments consisting of a mixture of sand and vermicompost were used, D_1 (25% vermicompost + 75% sand), D_2 (50% vermicompost + 50% sand), D_3 (75% vermicompost + 25% sand), D_4 (100% vermicompost). For the germination percentage, the vermicompost based treatments were compared only to the neutral control T_n (100% sand). For each treatment, fifty tomato seeds (variety: Mongal) were sown in pots (2.5 L). Each treatment was repeated 5 times. The germination percentage, evaluated at the 7th, 10th and 15th day after sowing, was calculated by dividing the number of germinated seeds out of the 50 sown. The result of this operation was be multiplied by 100.

The parameters of reproduction

The plants resulting from the germination were transplanted after 20 days in the corresponding treatments. A reference control (T_r) consisting of sand fertilized with NPK (10-10-20) at a dose of 2.56 g is added at the time of transplanting from the plants resulting from the neutral treatment. Parameters such as number of flowers, number of fruits and fruit weight were evaluated.

Statistical analysis of the data

The data obtained were analyzed using XLstat software. An analysis of variance is performed and the means were compared using the Student Newman-Keuls (SNK) test at the 5% threshold.

RESULTS

Evaluation of the effectiveness of vermicompost on germination percentage

The evaluation of the germination percentage was done by comparing the different doses of vermicompost to the neutral control (Figure 1). The germination percentages of the doses D_1, D_2 and D_3 are higher. The highest germination percentage was noted at dose D_3.

Evaluation of the efficiency of vermicompost on the number of flowers

The evaluation of the number of flowers was done by comparing the different doses of vermicompost to the controls (Figure 2). The vermicompost treatments are comparable to the chemical control on tomato flowering. The D_4 dose gave a higher number of flowers compared to the controls. The doses D_1, D_2 and D_3 have the same number of flowers as the chemical control.

Evaluation of the effectiveness of vermicompost on the number of fruits

The evaluation of the number of fruits was done by comparing the different doses of vermicompost to the controls (Figure 3). The vermicompost treatments (D_2, D_3 and D_4) were more effective compared to the chemical control on tomato fruiting. The D_1 dose gave a

number of fruits comparable to the chemical control.

Evaluation of the effectiveness of vermicompost on fruit weight

The evaluation of fruit weight was done by comparing the different doses of vermicompost to the controls (Figure 4). The vermicompost treatments (D_2, D_3 and D_4) were more effective compared to the controls on the weight of tomato fruits. The highest weights were obtained with the D_4 dose. The D_1 dose was comparable to the chemical control.

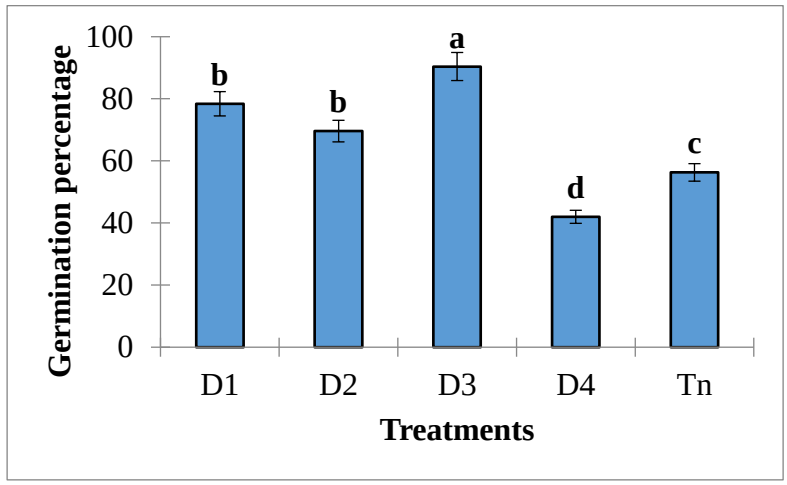

Figure 1: Evaluation of the effectiveness of vermicompost on germination percentage.
Histograms with the same letters are not significantly different at the 5% threshold, SNK test (ddl = 4, F= 31.351, P< 0.0001). D_1 : (25% vermicompost); D_2: (50% vermicompost), D_3: (75% vermicompost), D_4: (100% vermicompost), Tn: neutral control.

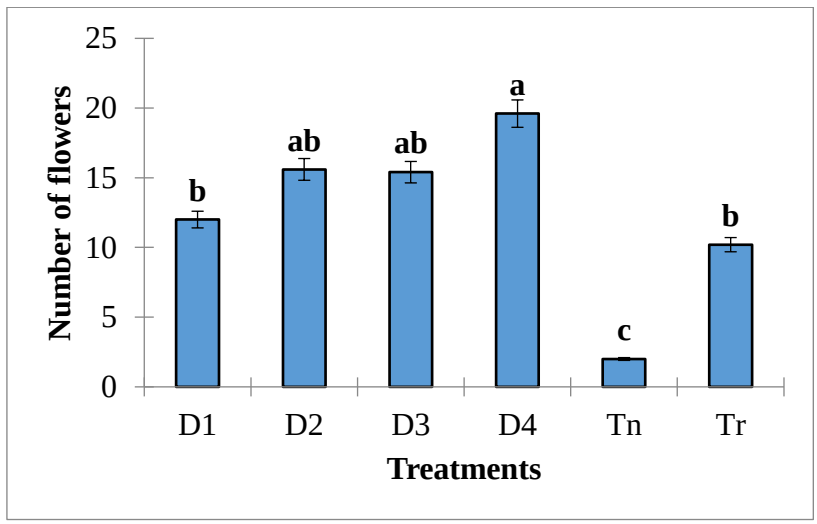

Figure 2: Evaluation of the effectiveness of vermicompost on the number of flowers.
Histograms with the same letters are not significantly different at the 5% threshold, SNK test (ddl = 4, F= 31.351, P< 0.0001). D_1 : (25% vermicompost); D_2: (50% vermicompost), D_3: (75% vermicompost), D_4: (100% vermicompost), Tn: neutral control.

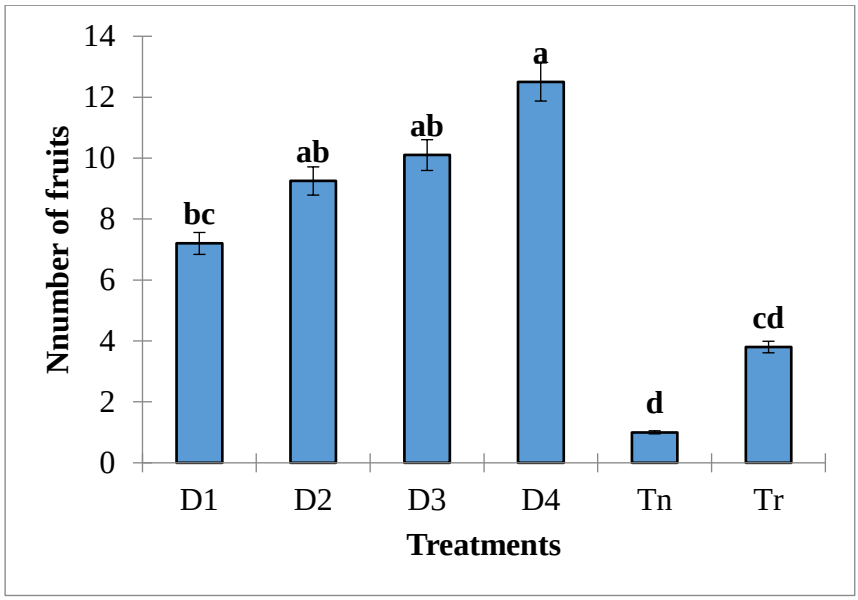

Figure 3: Evaluation of the effectiveness of vermicompost on the number of fruits.
Histograms with the same letters are not significantly different at the 5% threshold, SNK test (ddl = 4, F= 31.351, P< 0.0001). D_1 : (25% vermicompost); D_2: (50% vermicompost), D_3: (75% vermicompost), D_4: (100% vermicompost), Tn: neutral control.

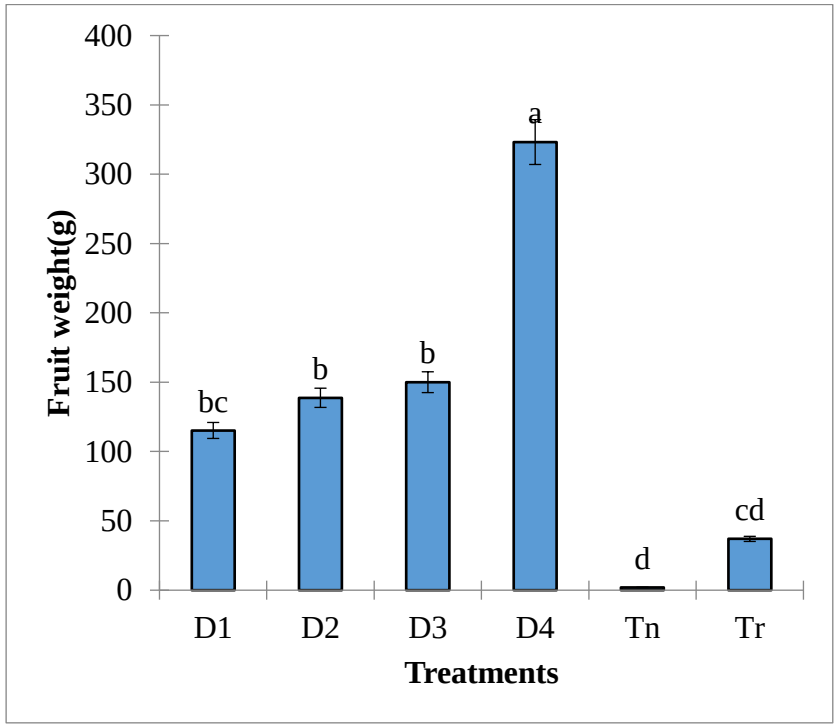

Figure 4: Evaluation of the effectiveness of vermicompost on fruit weight.
Histograms with the same letters are not significantly different at the 5% threshold, SNK test (ddl = 4, F= 31.351, P< 0.0001). D_1 : (25% vermicompost); D_2: (50% vermicompost), D_3: (75% vermicompost), D_4: (100% vermicompost), Tn: neutral control.

DISCUSSION

The cow manure based vermicompost gave a high germination percentage. The germination percentages of doses D_1, D_2 and D_3 were higher. The highest germination percentage was noted at dose D_3. High doses inhibit germination as observed with D_4. The high doses of vermicompost would have a high concentration of nutrients which made the pH of the substrate acidic and therefore impacts emergence (Lim and al., 2015). Vermicompost treatments were effective on flowering and fruiting. Higher doses produce higher flowering and fruiting. Micronutrients play an important role in flowering and fruiting (Gutiérrez-Miceli and al., 2007). Vermicompost has a higher amount of micronutrients than chemical fertilizer (Alidadi and al., 2014; Şimşek Erşahin and al., 2017). The research of Zucco and al. (2015) showed that soils with high vermicompost (0.4 and 0.8 g/g) produced a higher number of flowers than in soils with low vermicompost (0.05, 0.1 and 0.2 g/g). The vermicompost treatments were effective on fruit weight. Fruit weights increased with increasing doses (Anguessin et al., 2021). High doses produced the highest weights. Hyder and al. (2015) confirm that high doses of vermicompost gave better yields.

Conclusion

This study aimed at evaluating the effectiveness of vermicompost from cow manure on agronomic parameters of tomato. The vermicompost based on cow manure gave a high germination percentage. The highest germination percentage was noted at D_3. Vermicompost treatments are effective on flowering and fruiting. The high doses give higher flowering and fruiting. Fruit weights increased with higher rates. The high doses gave the highest weights. The results obtained through this study showed that vermicompost based on cow manure is effective and an alternative to chemical fertilizers.

COMPETING INTERESTS

The authors declare that they have no competing interests.

AUTHORS' CONTRIBUTIONS

IAN contributed to the definition of the experimental protocols, the data collection, the statistical analysis of the data and the writing of the article. MD contributed to the definition of the experimental protocols, the statistical analysis of the data and the writing of the article. BL contributed to the definition of the experimental protocols, the statistical analysis of the data and the writing of the article. KD contributed to the coordination of activities, definition of experimental protocols, statistical data analysis and correction of the manuscript. ET, ESS, AB, OS, PD, EOS contributed to the correction of the manuscript.

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