Journal of Agricultural Sciences (Belgrade)
Vol. 67, No. 3, 2022
Pages 219-235

https://doi.org/10.2298/JAS2203219A
UDC: 635.64:631.87(669)
Original scientific paper

THE INFLUENCE OF SIAM WEED COMPOST AND INORGANIC FERTILISER APPLICATIONS ON TOMATO PERFORMANCE

Tajudeen B. Akinrinola* **and Hassan Tijani-Eniola**

Department of Crop and Horticultural Sciences,
University of Ibadan, Ibadan, Nigeria

Abstract: Tomato is an important vegetable crop with high soil nutrient requirements. Hence, improvement in soil fertility status must be met through the use of readily available nutrient sources. *Chromolaena odorata* is widely spread in the country, and its compost has the potential of improving tomato yield. However, there is a dearth of information on the response of tomatoes to *Chromolaena* Compost (CC) and NPK fertiliser interactions. In the 4 x 3 factorial arrangement, CC at 0, 6, 8 and 10 t/ha and NPK 15-15-15 at 0, 15 and 30 kg N/ha were evaluated in a completely randomised design and a randomised complete block design for pot and field studies, using 10 kg/pot soil and 33333 plants/ha, respectively, with 3 replicates. Data on growth and yield parameters were subjected to analysis of variances by using SAS version 9.0. In the pot, the interaction of 8 t/ha of CC and 30 kg N/ha of NPK 15-15-15 fertiliser gave a significantly higher number of leaves, number of branches, leaf area and the highest fruit set at 49 days after transplanting compared to other treatments. In the field, the number of fruits/plant (20.89) was significantly higher with the interaction of 10 t/ha of CC and 30 kg N/ha of NPK 15-15-15 fertiliser, while 8 t/ha of CC and 30 kg N/ha of NPK 15-15-15 fertiliser treatment gave the significantly higher fruit size (64.61 g) and yield (31.73 t/ha) compared to the control (11.33, 32.09 g and 9.66 t/ha, respectively). The application of 8 t/ha of CC with 30 kg N/ha of NPK 15-15-15 fertiliser was therefore recommended.

Key words: *Chromolaena* compost, NPK 15-15-15, fertiliser interactions, growth, fruit yield.

Introduction

Tomato (*Solanum lycopersicum* L.) is important in terms of diet and economy in Nigeria. It is a crop with high nutritional requirements, and its production is influenced by the availability of nutrients (Upendra et al., 2000), among other factors. Apart from varietal variations, tomato fruit quality and quantity are greatly

*Corresponding author: e-mail: tb.akinrinola@gmail.com

influenced by the nutrient levels and fertility of the soil. Tisdale et al. (2003) and Adeboye et al. (2009) have reported that a very high level of soil fertility is required for the successful production of tomatoes. These nutrient requirements are met with different nutrient sources, which vary depending on the cultural practices adopted by the farmer.

Tomatoes grow moderately over a wide range of soil types. However, besides nutrient levels, certain soil criteria must also be satisfied in terms of the soil structure and soil organic matter content to optimise its production. Soil factors like nutrient composition, soil pH, effective soil depth, compaction and water holding capacity have been reported to significantly influence the resulting yield (Nweke and Nsoanya, 2013).

Nigerian soils are reported to be mainly Alfisols and Ultisols, which are inherently of low-activity clays characterised by low nutrient content, low pH, low organic matter content and high susceptibility to erosion (Agboola and Omueti, 1982; Asadu et al., 2004; Ayeni, 2011). In order to achieve high yields of good quality, it is, therefore, essential to apply fertilisers to such soils (Upendra et al., 2000; Oyinlola and Jinadu, 2012). The use of organic or conventional sources of nutrients has influenced soils, yields and compositions of fruits in different ways. The effects of sole organic fertilisers or NPK 15-15-15 fertilisers, or when combined, on the growth and yield of tomatoes have been documented (Ayoola and Adeniyan, 2006; Nnabude et al*.,* 2014; AL-Kahtani et al., 2018). Similarly, their respective detrimental effects on soil qualities and bulkiness have also been documented (Agboola and Omueti, 1982; Rosen and Allan, 2007). However, reports have shown the advantages of the combined application of inorganic and organic fertilisers over their single application on the quality and yield of tomatoes (Kisetu and Heri, 2014; Ogundare et al., 2015; Islam et al., 2017) and okra (Fasakin et al., 2019). Siam weed is an invasive weed that spreads extensively in large areas of farmland in Southwest Nigeria (Uyi et al., 2014). The application of the Siam weed extract to increase *Celosia argentea* yield has been reported (Ilori et al., 2011). Similarly, the application of the Siam weed compost to improve tomato fruit yield has been documented (Akinrinola, 2018). However, there are few studies on how varying levels of Siam weed compost and NPK 15-15-15 affect the yield of tomatoes. Therefore, this study was carried out to determine the optimum level of the Siam weed compost and NPK 15-15-15 fertiliser application best for the growth and yield of tomatoes.

Material and Methods

A pot experiment was conducted before the rains on an open field beside the screenhouse of the Department of Agronomy, Faculty of Agriculture, University of Ibadan, Ibadan, Oyo State, Nigeria. In addition, the field experiment was conducted in 2017 at the Research Farm of the Department of Agronomy, Ibadan, Oyo State. The soil sample collected for the pot study was obtained from the Department of Agronomy Research Farm and was air-dried, crushed and sieved with a 2–mm sieve. Some of the sieved samples were used to determine the physical and chemical properties of the soil, while the remaining soil was used for the screenhouse study.

Soil analysis: Soil pH in water was determined using a glass electrode pH meter in 1:1 soil/water suspensions, while organic carbon was determined by the wet oxidation method of Walkley and Black (1934). Total N was determined using the Kjeldahl method, and Bray 1-P was used for available P extraction. Exchangeable bases (Ca, Mg, K and Na) were extracted using l M ammonium acetate solution at pH 7. Calcium and magnesium concentrations were determined with an atomic absorption spectrophotometer. Potassium and sodium were determined with a flame emission photometer. Micronutrients (Cu, Zn, Mn and Fe) were extracted using l M HCl solution, and the micronutrients in the solution were read using the atomic absorption spectrophotometer, according to Juo (1979). The hydrometer method, as described by Bouyoucos (1951), was used to determine the soil particle size distribution.

The results of the physical and chemical analysis are presented in Table 1. The texture of the soil used in the study was loamy sand soil, dominated by a sand fraction (868 g/kg). The soil pH value was 6.8 in H_2O. Values observed for organic carbon (2.85 g/kg), available phosphorus (3.04 g/kg) and exchangeable cations (Ca, Mg, Na, and K) are shown in Table 1. The exchangeable acidity and micronutrients are shown in Table 1. Concentrations of nutrient elements in the *Chromolaena odorata* compost used in this experiment are presented in Table 2.

The treatments consisted of four levels of the *Chromolaena odorata* compost (at 0, 6, 8 and 10 t/ha) and three levels of NPK 15-15-15 fertiliser (at 0, 15, and 30 kg N/ha) in a factorial arrangement. The experimental designs used were a completely randomised design for the pot study, and a randomised complete block design for the field study. Each experiment was replicated three times. Seeds of the tomato cultivar 'Ibadan local' used in the trials were obtained from the National Horticultural Research Institute, Ibadan, Oyo State, Nigeria.

Prior to pot and field experiments, the tomato seedlings were raised for four weeks in the nursery. Sieved soil (10 kg) was weighed into each pot of the polyethylene bag that had been perforated for free drainage in the pot experiment. In the field, tomato seedlings raised on nursery trays were transplanted into experimental plots, each measuring 1.2 m x 4.8 m, previously ploughed and harrowed. Tomato seedlings (Ibadan local cultivar) were transplanted at four weeks after planting at the rate of two seedlings per pot or per stand in the field at 60 cm x 50 cm spacing (33333 plants/ha). The seedlings were thinned down to one seedling per pot or per stand at 2 weeks after transplanting.

Table 1. The pre-planting physical and chemical properties of the soil used.

Properties	Values
Physical properties	
Gravel	27.2
Sand	868
Silt	60
Clay	72
Textural classification	Loamy sand
Chemical properties	
pH (1:1 H_2O)	6.8
Organic carbon (g/kg)	2.85
C/N ratio	12.81
Available P (g/kg)	3.04
Base saturation	98.6
Exchangeable acidity (g/kg)	0.08
Ca	5.17
Mg	1.15
K	0.38
Na	0.38
Exchangeable micronutrient (g/kg)	
Mn	125.6
Fe	15.1
Cu	3.2
Zn	13.5

Table 2. The concentration of nutrient elements in the *Chromolaena odorata* compost used in the study.

Elements	Concentration (% dry weight)
Organic matter	20.26
N	0.55
C/N ratio	21.31
P	0.13
K	1.60
Ca	0.49
Mg	0.29

The *Chromolaena odorata* compost was applied at 2 weeks before transplanting. The NPK 15-15-15 fertiliser was applied at 2 weeks after transplanting. Each pot was irrigated with water every other day to field capacity during the course of the experiment, while weeding was done manually at 4, 8, and 12 weeks after transplanting. Plants were sprayed fortnightly with Mancozeb 63% + carbendazim 12.5% @ 25 kg/ha for the control of fungi diseases using a knapsack sprayer.

Data collection: At 49 Days After Transplanting (DAT), data measured in the pot and field experiments included plant height, number of branches/plant, leaf area/plant using the formula of Carmassi et al. (2007) formula and days to 50% flowering. Also, the fruit set was recorded at 49 DAT for the pot experiment, while yield parameters such as the number of fruits/plant, fruit size and fresh fruit yield (t/ha) were measured for the field experiment. The data obtained in the field experiment were taken from three plants randomly selected within the middle row in a plot, tagged and used to determine the growth parameters and the yield (fruit number and weight) per plant. Harvesting of mature fruits was done twice weekly at the orange to the red stage from 49 DAT to 79 DAT. All the data determined were as reported by Akinrinola (2018).

Statistical analysis: To test for differences among treatments, data collected were subjected to analysis of variance (ANOVA) and the means that were significantly different were separated using LSD at a 0.05% level of probability.

Results and Discussion

Soil properties

The analysis of soil physical properties (Table 1) showed that the soil was very high in sand and low in silt and clay contents. This soil is likely to support tomato production, as reported by Oyinlola and Jinadu (2012). In addition, the soil chemical properties used in this study indicated low levels of nutrients as recommended for sustainable tomato production (Sainju et al., 2003). These implied that the soil water retention would be adequate, while the nutrient supply ability of soil to support tomato production would be poor. Hence, such soil will likely respond to a good level of organic matter improvement. The concentration of mineral elements in the *Chromolaena odorata* compost material used in this experiment (Table 2) was similar to that earlier reported by Akinrinola (2018). The ability of Siam weed compost to support the nutrient need for tomatoes has been reported by Akinrinola (2018), likewise its extract to support *Celosia argentea* production by Ilori et al. (2011).

Effects of the *Chromolaena odorata* compost on the growth and yield of tomatoes

In the pot experiment, the application of CC did not significantly increase tomato height (Table 3). There was a significant influence of different levels of CC application on the number of leaves of tomatoes. The highest number of leaves per plant was observed with the application of CC at 8 t/ha. On the other hand, the lowest number of leaves was observed in the control, but the value was not significantly different from the number of leaves observed at 6 t/ha of CC. The observed numbers of branches at 8 and 10 t/ha were significantly higher compared to those at 0 and 6 t/ha of CC, which did not differ significantly. Applying CC significantly increased leaf area in tomatoes. The highest leaf area was observed at 8 t/ha, while the lowest was observed in the control. The highest value was not significantly different from the leaf area obtained from the plants treated with 10 t/ha. Also, the lowest leaf area did not differ significantly from that obtained at 6 t/ha. The number of days to 50% flowering was not significantly improved by CC (Table 3). The fruit set was significantly improved with the application of 8 and 10 t/ha of CC compared to 6 t/ha, which was also significantly higher than the control.

Table 3. The influence of *Chromolaena odorata* compost on the growth and yield parameters of tomatoes under pot conditions.

Treatments (t/ha)	Plant height (cm)	No. of leaves/plant	No. of branches	Leaf area (cm^2)	50% flowering	Fruit set
0	51.30	17.05	1.77	346.53	41.25	1.22
6	62.97	22.38	2.00	450.89	37.17	1.99
8	64.86	42.78	4.66	748.13	32.92	3.22
10	67.07	33.55	4.22	600.32	33.33	3.78
LSD	ns	8.54	1.00	154.82	ns	0.76

ns = Not significant at the 0.05 probability level.

Table 4. The influence of *Chromolaena odorata* compost on the growth and yield parameters of tomatoes under field conditions.

Treatments (t/ha)	Plant height (cm)	No. of leaves/plant	No. of branches	Leaf area (cm^2)	50% flowering	No. of fruits/plant	Size/ fruit	Fruit yield (t/ha)
0	63.97	31.25	5.50	1459.49	35.65	10.57	41.98	14.18
6	80.04	40.94	6.32	2528.24	32.53	15.16	43.58	21.60
8	87.75	48.54	8.10	3363.78	32.87	13.76	47.18	21.62
10	93.32	59.97	7.81	4054.85	30.78	18.93	49.56	27.07
LSD	18.83	10.18	1.48	596.56	ns	3.46	ns	4.09

ns = Not significant at the 0.05 probability level.

In the field, the application of 8 and 10 t/ha of CC significantly increased tomato plant height compared to the control at 49 DAT (Table 4). The number of leaves in tomatoes was significantly improved by the application of 10 t/ha compared to 6 t/ha and the control. Also, the application of 8 t/ha of CC differed significantly from the control, but not from 6 or 10 t/ha of CC within treatments. *Chromolaema odorata* compost significantly improved the number of branches in tomatoes. The highest number of branches was observed under the application of 8 t/ha of CC, while the lowest was observed in the control. An increase in the CC application significantly increased leaf area with each successive increase in the level of application. Hence, the highest leaf area was observed at 10 t/ha, while the least in the control. The application of CC did not have a significant influence on days to 50% flowering in tomatoes. The number of fruits/plant was significantly enhanced by the application of CC (Table 4). The plants treated with 10 t/ha of CC had a significantly higher number of fruits compared to the other treatments. Similarly, 8 t/ha of CC significantly increased the number of fruits compared to the control. The application of CC had no significant influence on tomato fruit size. The use of CC improved the fruit yield in tomatoes. The application of 10 t/ha of CC significantly increased tomato fruit yield compared to the other treatments. Applications of 6 and 8 t/ha of CC did not differ significantly, but they were significantly higher than the control.

The observed pot and field data indicated that the application of the *Chromolaena odorata* compost, NPK 15-15-15 fertiliser or their interactions significantly affected most variables monitored in tomato plants. The observed responses of tomato variables to the application of the *Chromolaena odorata* compost were consistent with the responses observed by Akinrinola (2018) on the growth and yield variables of tomatoes. Similarly, the impact of crop waste as an organic-based fertiliser in improving crop performances was reported by several researchers (Fawole et al., 2016; Fasakin et al., 2019; Priyadarshani and Thayamini, 2020). The improvement in growth and yield can be attributed to the addition of soil organic matter, which is important for increasing soil nutrient supply, reducing soil loss, improving soil structure and water use efficiency, thereby maintaining soil health (Rosen and Allan, 2007; Bitew and Alemayehu, 2017; Koopmans and Bloem, 2018). The increase in tomato performance may also be associated with an increase in microbial activity by the compost that enhances nutrient availability for uptake (Rosen and Allan, 2007).

Effects of NPK fertiliser on the growth and yield of tomatoes

In the pot experiment, the application of NPK 15-15-15 did not significantly increase tomato height (Table 5). A significantly higher number of leaves was observed at 30 kg N/ha of NPK 15-15-15 fertiliser compared to the other treatments. Each successive increase in NPK 15-15-15 fertiliser application resulted in a significant increase in tomato number of branches, with the highest and lowest observed at 30 kg N/ha and the control, respectively. The application of NPK 15-15-15 fertiliser significantly improved tomato leaf area, 30 kg N/ha was significantly higher compared to other levels of application. The number of days to 50% flowering was not significantly improved by NPK fertiliser application. Also, applying 15 and 30 kg N/ha of NPK 15-15-15 significantly enhanced the fruit set in tomatoes compared to the control.

Table 5. The performance of tomatoes as influenced by NPK 15-15-15 fertiliser under pot conditions.

Treatments (kg N/ha)	Plant height (cm)	No. of leaves/plant	No. of branches	Leaf area (cm^2)	50% flowering	Fruit set
0	56.80	21.82	1.74	382.87	37.76	1.90
15	59.83	27.75	3.42	498.50	35.17	2.58
30	68.03	37.25	4.33	728.04	35.58	3.17
LSD	ns	7.39	0.86	134.08	ns	0.65

ns = Not significant at the 0.05 probability level.

Table 6. The performance of tomatoes as influenced by NPK 15-15-15 fertiliser under field conditions.

Treatments (kg N/ha)	Plant height (cm)	No. of leaves/plant	No. of branches	Leaf area (cm^2)	50% flowering	No. of fruits/plant	Size/fruit	Fruit yield (t/ha)
0	75.21	38.21	6.08	2327.36	33.62	14.26	36.87	17.84
15	81.74	47.78	6.86	3260.36	32.58	13.33	46.45	19.83
30	86.86	49.53	7.86	2967.05	32.67	16.23	53.41	25.69
LSD	16.30	8.82	1.28	516.64	ns	ns	8.04	3.55

ns = Not significant at the 0.05 probability level.

Under field condition, applying NPK 15-15-15 significantly enhanced plant height and it increased with the increase in the level of application (Table 6). Also, the application of 8 t/ha of CC differed significantly from the control, but not from 6 or 10 t/ha of CC within treatments. Applying NPK 15-15-15 fertiliser at 15 and 30 kg N/ha enhanced the number of leaves in tomatoes significantly compared to the control. Applying NPK 15-15-15 fertiliser significantly improved branching in tomatoes at 30 kg N/ha compared to the control. The effects of 15 and 30 kg N/ha of NPK 15-15-15 fertiliser within treatments on tomato leaf area did not differ significantly, but differed significantly from the control. Also, NPK 15-15-15 fertiliser had no significant effect on days to 50% flowering. Treatments involving NPK 15-15-15 did not increase the number of fruits significantly (Table 6). However, the lowest and highest numbers of fruits were observed in plants treated with 15 and 30 kg N/ha, respectively. Treatments involving NPK 15-15-15 significantly enhanced fruit sizes, with a significant increase at 15 and 30 kg N/ha compared to the control. Increasing the NPK 15-15-15 fertiliser application improved tomato fruit yield, with the significance observed between 30 kg N/ha and the other treatments. However, no significant difference was observed between 15 kg N/ha and the control.

The improvements in tomato height, number of branches, number of leaves, leaf area, number of fruits and fruit yield and yield components are attributed to the application of NPK fertiliser compared to the control, with the better influences observed at 30 kg N/ha. These were in support of earlier reports that the NPK fertiliser application improves growth and yield in tomatoes (Oyinlola and Jinadu, 2012; Ayoola and Adebayo, 2017; Akinrinola, 2018) and okra (Fasakin et al., 2019). The attributes of inorganic NPK fertilisers in crop improvement were associated with the supply of essential plant nutrients in forms that are soluble and easily assimilated by the plants for development. Hence, the application of inorganic fertiliser results in better crop performance, particularly in soil with a low fertility status (Tisdale et al., 2003).

The influence of *Chromolaena odorata* compost x NPK interactions on the growth and yield of tomatoes

In the pot experiment, the interaction of CC and NPK fertiliser had no significant influence on tomato height at 49 DAT (Table 7). The interaction of CC and NPK 15-15-15 fertiliser showed a significant influence on the number of leaves of tomatoes at 49 DAT. The highest and lowest values were observed at 8 t/ha of CC and 30 kg N/ha, and the control, respectively.

Table 7. The growth performance of tomatoes as influenced by the interactions of the *Chromolaena odorata* compost and NPK 15-15-15 fertiliser at 49 days after transplanting under pot conditions.

	Plant height (cm)	No. of leaves/plant	No. of branches	Leaf area (cm^2)	50% flowering	Fruit set
0 t/ha + 0 kg	44.48	14.16	1.64	286.15	44.09	0.32
0 t/ha + 15 kg N/ha	50.43	17.00	1.67	337.11	41.00	1.00
0 t/ha + 30 kg N/ha	59.00	20.00	2.00	416.34	38.67	2.33
6 t/ha + 0 kg	60.89	16.46	0.99	319.13	36.86	1.63
6 t/ha + 15 kg N/ha	55.70	19.00	2.00	375.20	37.33	2.00
6 t/ha + 30 kg N/ha	72.33	31.67	3.00	658.34	37.33	2.33
8 t/ha + 0 kg	58.82	30.33	1.65	492.25	35.10	2.65
8 t/ha + 15 kg N/ha	65.77	45.67	6.00	739.00	31.67	4.33
8 t/ha + 30 kg N/ha	70.00	52.33	6.33	1013.13	32.00	4.00
10 t/ha + 0 kg	63.00	26.33	2.67	433.94	35.00	3.00
10 t/ha + 15 kg N/ha	67.40	29.33	4.00	542.68	30.67	3.00
10 t/ha + 30 kg N/ha	70.80	45.00	6.00	824.33	34.33	4.00
LSD	ns	14.79	1.73	268.16	ns	1.31

ns = Not significant at the 0.05 probability level.

The interaction of CC and NPK 15-15-15 showed a significant effect on the number of branches in tomatoes. The application of 8 t/ha of CC and 30 kg N/ha of NPK 15-15-15 fertiliser gave the highest number of branches, but this did not differ significantly from the values observed by applying 8 t/ha of CC and 15 kg N/ha of NPK 15-15-15 fertiliser, and 10 t/ha of CC and 30 kg N/ha of NPK 15-15-15 fertiliser. The lowest number of branches was observed at 6 t/ha of CC and 0 kg N/ha of NPK 15-15-15 fertiliser (Table 7). *Chromolaena odorata* compost and NPK fertiliser interactions significantly improved tomato leaf area at varying levels. The application of 8 t/ha of CC and 30 kg N/ha of NPK 15-15-15 fertiliser gave the highest leaf area but did not differ significantly from the leaf area observed at 10 t/ha of CC and 30 kg N/ha of NPK 15-15-15 fertiliser, and 8 t/ha of CC and 15 kg N/ha of NPK 15-15-15 fertiliser. The lowest leaf area was observed in the control (Table 7). The number of days to 50% flowering was not significantly improved by CC and NPK fertiliser interactions. The interaction of CC and NPK 15-15-15 fertiliser increased tomato fruit set significantly at different levels of interactions. The interaction of 8 t/ha of CC and 15 kg N/ha of NPK 15-15-15 fertiliser gave the highest tomato fruit set compared to the other treatments (Table 7).

In the field, the interaction of CC and NPK 15-15-15 fertiliser significantly increased tomato height at 8 t/ha of CC and 15 kg N/ha of NPK 15-15-15 fertiliser, 10 t/ha of CC and 15 kg N/ha of NPK 15-15-15 fertiliser, and 10 t/ha of CC and 30 kg N/ha of NPK 15-15-15 fertiliser compared to the control (Table 8). The interaction of 10 t/ha of CC and 30 kg N/ha of NPK 15-15-15 fertiliser significantly improved the number of leaves in tomatoes compared to the other treatments, except for treatments involving 15 t/ha of CC and 15 kg N/ha of NPK 15-15-15 fertiliser and 10 t/ha of CC and 15 kg N/ha of NPK 15-15-15 fertiliser (Table 8). Furthermore, there were significant interactions between CC and NPK fertiliser on tomato branching. Applying 8 t/ha of CC and 30 kg N/ha of NPK 15-15-15 fertiliser gave the highest number of branches, while the least was observed in the control (Table 8). Interactions of CC and NPK 15-15-15 fertiliser on leaf area indicated a significant higher leaf area when 8 t/ha of CC and 15 kg N/ha of NPK 15-15-15 fertiliser, and 10 t/ha of CC and 15 kg N/ha of NPK 15-15-15 fertiliser were applied compared to the other treatment combinations, except 10 t/ha of CC and 30 kg N/ha of NPK 15-15-15 fertiliser (Table 8). Similarly, the interaction of CC and NPK 15-15-15 showed no significant reduction in the number of days to 50% flowering. However, the least was observed in the treatment involving 10 t/ha of CC and 15 kg N/ha of NPK 15-15-15 fertiliser, and the highest in the control (Table 8). The number of fruits/plant was significantly enhanced by the application of CC (Table 8). The interaction of CC and NPK 15-15-15 fertiliser resulted in a significant increase in the number of fruits in tomatoes. The interaction of 10 t/ha of CC and 30 kg N/ha of NPK 15-15-15 fertiliser within the treatment gave the highest number of fruits, while the lowest was observed in plants treated with 0 t/ha of CC and 15 kg N/ha of NPK 15-15-15 fertiliser (Table 5). The interaction of CC and NPK 15-15-15 fertiliser significantly improved fruit size in tomatoes at varying levels. The highest fruit size was observed in plants treated with 8 t/ha of CC and 30 kg N/ha of NPK 15-15-15 fertiliser (Table 8). The interactions of CC and NPK 15-15-15 fertiliser varied significantly among treatments with respect to fruit yield. The highest fruit yield was observed in plants treated with 8 t/ha of CC and 30 kg N/ha of NPK 15-15-15 fertiliser. However, the fruit yield was not significantly different from the values observed in the interaction involving 10 t/ha of CC and 6 t/ha of CC with 30 kg N/ha of NPK 15-15-15 fertiliser. The least fruit yield was observed in the control (Table 8).

Table 8. The growth performance of tomatoes as influenced by the interactions of the *Chromolaena odorata* compost and NPK 15-15-15 fertiliser at 49 days after transplanting under field conditions.

	Plant height (cm)	No. of leaves/plant	No. of branches	Leaf area (cm^2)	50% flowering	No. of fruits/plant	Size/ fruit	Fruit yield (t/ha)
Siam weed compost x NPK 15-15-15 fertiliser								
0 t/ha + 0 kg	51.59	27.74	4.29	1222.71	37.28	10.92	31.45	9.47
0 t/ha + 15 kg N/ha	70.46	30.56	6.11	1201.84	33.00	10.22	45.71	14.67
0 t/ha + 30 kg N/ha	69.86	35.45	6.11	1953.93	36.67	10.56	48.77	18.40
6 t/ha + 0 kg	76.91	41.37	6.52	2725.18	32.59	14.38	42.22	20.47
6 t/ha + 15 kg N/ha	82.20	41.56	5.67	2255.08	34.00	12.44	46.52	20.27
6 t/ha + 30 kg N/ha	81.00	39.89	6.78	2604.47	31.00	18.67	41.99	24.05
8 t/ha + 0 kg	87.23	41.62	7.29	2417.64	32.62	13.95	31.81	15.64
8 t/ha + 15 kg N/ha	83.10	56.67	7.56	4533.73	34.00	12.55	45.12	17.50
8 t/ha + 30 kg N/ha	92.93	47.34	9.44	3139.96	32.00	14.78	64.61	31.73
10 t/ha + 0 kg	85.11	42.11	6.22	2943.91	32.00	17.78	41.98	25.77
10 t/ha + 15 kg N/ha	91.20	62.34	8.11	5050.79	29.33	18.11	48.43	26.86
10 t/ha + 30 kg N/ha	103.66	75.45	9.11	4169.84	31.00	20.89	58.26	28.58
LSD	32.61	17.64	2.56	1033.30	ns	6.00	16.08	7.10

ns = Not significant at the 0.05 probability level.

The basic principle reported to underlie the integrated nutrient management concept is the maintenance or improvement of soil fertility for sustainable crop production. This was evident in the better performances of tomatoes treated with the combined application of Siam weed compost and NPK 15-15-15 fertiliser compared to their sole applications. The improvement in the performance of tomatoes under integrated nutrient management practices has also been well documented (Kisetu and Heri, 2014; Ogundare et al., 2015; Islam et al., 2017). The combined application of inorganic and organic fertilisers has been reported to have a beneficial effect on mitigating the deficiency of micronutrients (Bitew and Alemayehu, 2017). Similarly, increased soil organic matter and available water holding capacity, and a decrease in soil bulk density have been reported to create a good soil condition for enhanced growth of crops (Agboola and Omueti, 1982;

Rosen and Allan, 2007). The results revealed that responses obtained from the combined application of CC and inorganic fertiliser were no exception to the benefits derived from integrated nutrient management. Subsequently, the better growth and yield of tomato crops when 8 t/ha of CC and 30 kg N/ha of NPK 15-15-15 were combined indicated that this level was better for the Ibadan local tomato cultivar. At a higher level of fertiliser application (i.e. 10 t/ha of CC and 30 kg N/ha of NPK 15-15-15), the yield of tomatoes decreased. In addition, the chemical properties of the soil used in this study indicated that the soil was low in nutrients required for an optimum yield of tomatoes as recommended by Sainju et al. (2003). This may be explained by the fact that high tomato fruit yield and improved fruit quality are produced from optimum N fertiliser application (Oyinlola and Jinadu, 2012), while the abundant development of vegetative parts of the plant resulted from the excessive application at the expense of reproductive growth (Sainju et al., 2003; Tisdale et al., 2003).

Correlations between tomato growth and yield parameters

The Pearson correlation coefficient showed that plant height was significantly correlated to the number of leaves and days to 50% flowering (Table 9). Also, a high significant correlation ($p < 0.01$) was observed between the number of leaves and the number of branches, leaf area and fruit set at 49 DAT. Similarly, the number of branches and fruit set at 49 DAT were highly correlated. The observed leaf area was significantly correlated to fruit set at 49 DAT. The Pearson correlation coefficient indicated that the number of leaves and the number of branches were negatively correlated with days to 50% flowering, with a significant correlation observed with leaf area and fruit set at 49 DAT.

Table 9. The Pearson correlation coefficient of the growth and yield parameters considered in the pot experiment.

	Number of leaves	Number of branches	Leaf area	Days to 50% flowering	Fruit set
Plant height	0.36*	0.24	0.24	0.44**	0.25
Number of leaves		0.89**	0.79**	-0.13	0.46**
Number of branches			0.82**	-0.27	0.55**
Leaf area				-0.47**	0.44**
Days to 50% flowering					-0.38*

*; ** = The correlation is significant at the 0.05 and 0.01 levels, respectively.

Plant height was significantly correlated to the number of leaves and the number of fruits/plant, and had high significant ($p < 0.01$) correlations with the number of branches/plant, fruit size and fruit yield (Table 10). Similarly, a high significant correlation was observed between the number of leaves, the number of branches and yield components. Leaf area was observed to correlate significantly with yield components and the yield of tomatoes. The number of fruits and fruit size correlated significantly with tomato fruit yield. All parameters correlated negatively with days to 50% flowering, and the significance was observed for plant height and leaf area.

Table 10. The Pearson correlation coefficient of the growth and yield parameters considered in the field experiment.

	Number of leaves	Number of branches	Leaf area	Days to 50% flowering	Number of fruits	Fruit sizes	Fruit yield
Plant height	0.40*	0.60**	0.51**	-0.64**	0.36*	0.51**	0.65**
Number of leaves		0.50**	0.82**	0.08	0.58**	0.34*	0.48**
Number of branches			0.61**	-0.16	0.34*	0.78**	0.58**
Leaf area				-0.38*	0.45**	0.38*	0.44**
Days to 50% flowering					0.03	-0.19	-0.28
Number of fruits						0.14	0.66**
Fruit sizes							0.59**

*; ** = The correlation is significant at the 0.05 and 0.01 levels, respectively.

The correlations between plant height, the number of leaves and leaf area are substantiated by Jo and Shin (2020). In addition, Sanam et al. (2022) report that the correlation in growth parameters varies in tomatoes. The negative relationship between days to 50% flowering and other growth parameters in the pot and field studies implied that an increase in vegetative growth was at the expense of flowering, especially in the leaf area. This was further affirmed by the negative correlation coefficient observed between days to 50% flowering and yield. According to Sainju et al. (2003), the insufficient nutrient status increased days to 50% flowering, while excess also delayed flowering. Similar findings have been reported on pigeon pea (Padi, 2003) and maize (Anjorin and Ogunniyan, 2014). The high correlation coefficient between leaf area and yield and the yield components of tomato indicated that the plant was able to translocate photosynthate to the fruit, thereby increasing the harvest. This finding supported the report of Hidaka et al. (2019) on strawberries. The leaf acts as a source from which photosynthates are translocated to the harvestable target organs. The same was also evident from the investigation of Liu et al. (2020), stating that the final grain yields in maize had a relationship with total leaf areas.

Conclusion

The result of this investigation further confirms a higher influence of the application of organic and mineral fertilisers over the single application of each fertiliser type on tomato growth and yield through soil fertility improvement. The application of Siam weed compost at 8 t/ha and 30 kg N/ha of NPK 15-15-15 increased tomato growth and yield over the other treatments. It was closely followed by 10 t/ha of CC and 30 kg N/ha of NPK 15-15-15 application. However, the influence of 8 t/ha of Siam weed compost and 30 kg N/ha of NPK 15-15-15 was concluded to be more effective and efficient for maximum tomato production.

References

Adeboye, M., Osunde, A., Ezenwa, M., Odofin, A., & Bala, A. (2009). Evaluation of the fertility status and suitability of some soils for arable cropping in the Southern Guinea Savanna of Nigeria. *Nigerian Journal of Soil Science*, *19* (2), 115-120.

Agboola, A.A., & Omueti, J.A. (1982). Soil fertility problem and its management in tropical Africa. In R. Lal, P.A. Sanchez, R.W. Cummings, Jr. (Eds.), *Proceedings of the International Conference on land clearing and development in the Tropics*, International Institute of Tropical Agriculture, (pp. 234-240). Ibadan, Nigeria.

Anjorin, F.B., & Ogunniyan, D.J. (2014). Comparison of growth and yield components of five quality protein maize varieties. Inter*national Journal of Agriculture and Forestry*, *4* (1), 1-5.

Akinrinola, T.B. (2018). Influence of Siam weed [Chromolaena odorata (L) King and Robinson] compost on the growth and yield of tomato (Solanum lycopersicon L.). *Nigerian Journal of Horticultural Science*, *23*, 46-53.

AL-Kahtani, S.H., Ahmed, M.A., Al-Selwey, W.A., & Abdel-Razzak, H.S. (2018). Evaluation of composted agricultural crop wastes application on growth, mineral content, yield, and fruit quality of tomato. *Journal of Experimental Biology and Agricultural Sciences*, *6* (1), 159-167.

Asadu, C.L.A., Ezeaku, P.I., & Nnaji, G.U. (2004). Land Use and Soil Management Situations in Nigeria: An Analytical Review of Changes. *Outlook on Agriculture*, *33* (1), 27-37.

Ayeni, L.S. (2011). Integrated plant nutrition management: A panacea for sustainable crop production in Nigeria. *International Journal of Soil Science*, *6*, 19-24.

Ayoola, O.T., & Adebayo, A.K. (2017). Response of local tomato varieties to application of poultry manure, cow dung and inorganic fertiliser. *Journal of Biology, Agriculture and Healthcare*, *7* (10), 31-38.

Ayoola, O.T., & Adeniyan, O.N. (2006). Influence of poultry manure and NPK fertiliser on yield and yield components of crops under different cropping systems in southwest Nigeria. *African Journal of Biotechnology*, *5,* 1386-1392.

Bitew, Y., & Alemayehu, M. (2017). Impact of crop production inputs on soil health- A review. *Asian Journal of Plant Science*, *16*, 109-131.

Bouyoucos, G.H. (1951). A recalibration of the hydrometer for making mechanical analysis of soils. *Journal of Agronomy, 43*, 434-438.

Carmassi, G., Incrocci, L., Incrocci, G., & Pardossi, A. (2007). Non-destructive estimation of leaf area in (Solanum lycopersicum L.) and gerbera (Gerbera jamesonii H. Bolus). *Agricoltura Mediterranea, 137*, 172-176.

Fasakin, K., Afe, A.I., & Saka, N.A. (2019). Growth and yield response of okra (Abelmoschus esculentus (L.) Moench) to fertilizer types and times of application in the southern guinea savanna agro-ecozone of Nigeria. *Journal of Agricultural Sciences, 64* (4), 353-366.

Fawole, O.B., Alor,iE. T., & Ojo, O.A. (2016). Evaluation of two composts for the improvement of crop yield using tomato (Lycopersicon esculentum) as test crop. *Journal of Agricultural Sciences, 61* (1), 37-44.

Hidaka, K., Miyoshi, Y., Ishii, S., Suzui, N., Yin, Y-G., Kurita, K., Nagao, K., Araki, T., Yasutake, D., Kitano, M., & Kawachi, N. (2019). Dynamic Analysis of Photosynthate Translocation Into Strawberry Fruits Using Non-invasive ^{11}C-Labeling Supported With Conventional Destructive Measurements Using ^{13}C-Labeling. *Frontier Plant Science 9,*1946.

Ilori, O.J., Ilori, O.O., Sanni, R.O., & Adenegan-Alakinde, T.A. (2011). Effect of Chromolaena odorata on the growth and biomass accumulation of Celosia argentea. *Research Journal of Environmental Sciences*, *5* (2), 200-204.

Islam, M.A., Islam, 1.S., Akter, A., Rahman, M.H., & Nandwani, D. (2017). Effect of organic and inorganic fertilisers on soil properties and the growth, yield and quality of tomato in Mymensingh, Bangladesh. *Agriculture*, *7*, 18-25.

Jo, W.J., & Shin, J.H. (2020). Effect of leaf-area management on tomato plant growth in greenhouses. *Horticulture, Environment, and Biotechnology, 61,* 981-988.

Juo, A.S.R. (1979). *Selected methods for soil and plant analysis*: Manual series No. 1. International Institute of Tropical Agriculture, Ibadan, Nigeria.

Kisetu, E., & Heri, P. (2014). Effects of poultry manure and NPK (23:10:5) fertilizer on tomato variety tanya grown on selected soil of Morogoro Region, Tanzania. *Asian Journal of Crop Science*, *6* (2)*,* 165-175.

Koopmans, C.J., & Bloem, J. (2018). Soil quality effects of compost and manure in arable cropping. Results from using soil improvers for 17 years in the MAC trial. Louis Bolk Institute. Publication number 2018-001 LbP. 40pp. Retrieved May 05, 2019, from www.louisbolk.nl/publicaties

Liu, W., Ming, B., Xie, R., Liu, G., Wang, K., Yang, Y., Guo, X., Hou, P., & Li, S. (2020). Change in Maize Final Leaf Numbers and Its Effects on Biomass and Grain Yield across China. *Agriculture*, *10* (9), 411.

Nnabude, P.C., Nweke, I.A., & Nsoanya, L.N. (2014). Response of three varieties of tomatoes (Lycopersicon esculentum) to liquid organic fertiliser (alfa life) and inorganic fertiliser (NPK 20:10:10) and for soil improvements. *European Journal of Pure and Applied Chemistry*, *1,* 32-41.

Nweke, I.A., & Nsoanya, L.N. (2013). Soil pH: An indices for effective management of soils for crop production. *International Journal of Scientific and Technology Research*, *2,* 132-134.

Ogundare, S.K., Babalola, T.S., Hinmikaiye, A.S., & Oloniruha, J.A. (2015). Growth and fruit yield of tomato as influenced by combined use of organic and inorganic fertilizer in Kabba, Nigeria. *European Journal of Agriculture and Forestry Research*, *3,* 48-56.

Oyinlola, E.Y., & Jinadu, S.A. (2012). Growth, yield and nutrient concentrations of tomato as affected by soil textures and nitrogen. *Asian Journal of Agricultural Research*, *6,* 39-45.

Padi, F. K. (2003). Correlation and Path Coefficient Analyses of Yield and Yield Components in Pigeonpea. *Pakistan Journal of Biological Sciences, 6*, 1689-1694.

Priyadarshani, W.M.N., & Thayamini, H.S. (2020). The effects of goat manure and sugarcane molasses on the growth and yield of beetroot (Beta vulgaris L). *Journal of Agricultural Sciences (Belgrade), 65* (4), 321-335.

Rosen, C.J., & Allan, D.L. (2007). Exploring the benefits of organic nutrient sources for crop production and soil quality. *Hortechnology*, *17,* 422-430.

Sainju, U.M., Dris, R., & Singh, B. (2003). Mineral nutrition of tomato. *Journal of Food, Agriculture and Environment*, *1,* 176-183.

Sanam, T., Triveni, S., Sridhar, G.N., Ningoji, S.N., & Desai, S. (2022). Correlation and regression models of tomato yield in response to plant growth by different bacterial inoculants and inoculation methods. *Agronomy Journal, 114* (1), 452-460.

Tisdale, S.L., Nelson, W.L., Beaton, J.D., & Havlin, J.L. (2003). *Soil fertility and fertilisers*. 5th Edn., Prentice-Hall of India, Pvt Ltd., New Delhi, India.

Upendra, M.S., Ramdane, D., & Bharat, S. (2000). Mineral nutrition in tomato. *Food, Agriculture and Environment, 1*, 176-183.

Uyi, O.O., Ekhator, F., Ikuenobe, C.E., Borokini, T.I., Aigbokhan, E.I., Egbon, I.N., Adebayo, A.R., Igbinosa, I.B., Okeke, C.O., Igbinosa, E.O., & Omokhua, G.A. (2014). Chromolaena odorata invasion in Nigeria: A case for coordinated biological control. *Management of Biological Invasions*, *5,* 377-393.

Walkley, A., & Black, I.A. (1934). An examination of Degtjareff method for determining soil organic matter and a proposed modification of the chromic acid titration method. *Soil Science*, *37,* 29-37.

Received: July 23, 2019
Accepted: July 4, 2022

UTICAJ PRIMENA KOMPOSTA OD SIJAMSKOG KOROVA I MINERALNIH ĐUBRIVA NA PRODUKTIVNOST PARADAJZA

Tajudeen B. Akinrinola* **i Hassan Tijani-Eniola**

Odsek za ratarstvo i hortikulturu,
Univerzitet u Ibadanu, Ibadan, Nigerija

R e z i m e

Paradajz je važna povrtarska kultura sa visokim zahtevima za hranljivim materijama u zemljištu. Stoga se poboljšanje plodnosti zemljišta može postići korišćenjem lako dostupnih izvora hranljivih materija. *Chromolaena odorata* (sijamski korov) je široko rasprostranjen korov u Nigeriji, a kompost koji se pravi od ove biljke ima potencijal da poveća prinos paradajza. Međutim, postoji nedostatak informacija o odgovoru paradajza na interakcije komposta koji se pravi od biljke *Chromolaena odorata* i NPK đubriva. U faktorijalnom rasporedu 4 x 3, pri dozi 0, 6, 8 i 10 t/ha komposta od sijamskog korova i pri dozi 0, 15 i 30 kg N/ha NPK 15-15-15 đubriva procenjeni su u potpuno slučajnom blok dizajnu za ispitivanje u sudovima i u polju, korišćenjem 10 kg/sudu odnosno 33333 biljaka/ha, sa 3 ponavljanja. Podaci o parametrima rasta i prinosa su obrađeni analizom varijansi korišćenjem programa SAS verzije 9.0. U sudovima je interakcija varijante sa 8 t/ha komposta od sijamskog korova i 30 kg N/ha NPK 15-15-15 đubriva dala značajno veći broj listova, broj grana, lisnu površinu i najviše plodova 49 dana nakon presađivanja u odnosu na druge tretmane. U polju je broj plodova/biljci (20,89) bio značajno veći uz interakciju varijante od 10 t/ha komposta od sijamskog korova i 30 kg N/ha NPK 15-15-15 đubriva, dok je tretman sa 8 t/ha komposta od sijamskog korova i 30 kg N/ha NPK 15-15-15 đubriva dao značajno veću masu ploda (64,61 g) i prinos (31,73 t/ha) u odnosu na kontrolu (11,33, 32,09 g odnosno 9,66 t/ha). Stoga je preporučena primena 8 t/ha komposta od sijamskog korova sa 30 kg N/ha NPK 15-15-15 đubriva.

Ključne reči: kompost od biljke *Chromolaena odorata*, NPK 15-15-15, interakcije đubriva, rast, prinos ploda.

Primljeno: 23. juli 2019.
Odobreno: 4. juli 2022.

*Autor za kontakt: e-mail: tb.akinrinola@gmail.com