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Improving Yield of *Corchorus olitorus L.* with legacy fertility of Jackbean Fallow and Compost amendments in an Organic Production System

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Abstract

Ability of applied soil fertilizer to sustain crop production beyond a cropping season is an advantage to farmers, especially resource-constrained organic farmers who cannot afford repeated application of synthetic fertilizers. Thus, this report presents evaluation of legacy soil fertility (residual) influence of previous Jack bean-fallow and a commercial compost application on the yield of corchorus in an organic production system in two cropping seasons of 2014. The experiment was conducted at the Organic Vegetable Garden of Teaching and Research Farm, University of Ibadan, Ibadan, Nigeria. Corchorus seeds were sown in plots of Brewery Waste Compost grades A and B, Brewery Waste Compost grade A + Jack bean residual fertility, Brewery Waste Compost grade B + Jack bean residual fertility, Jack bean residual and Control (no soil additive). The experiment was laid out in a Randomized Complete Block Design (RBCD) replicated four times. Data collected were subjected to statistical analysis of variance using GENSTAT edition 5 and means were separated using least significant difference (LSD) at (p≤ 0.05). In the first season, Brewery Compost Grade B resulted into the highest dry weight of corchorus (1.93 t/ha) which was not significantly higher than that of combination of Brewery Compost Grade A+ Jack bean (1.84 t/ha), while Brewery Compost Grade A+Jack bean (2.21 t/ha) resulted into highest dry matter yield in the second cropping. Thus, it could be concluded that combination of Brewery Compost Grade A + Jack bean could be used for producing corchorus by resource constraint farmers who may not be able to apply additional fertilizer in second cropping.

Introduction

Poor soil fertility as a result of unsustainable agricultural practices is one of the major threats to agricultural productivity and food security in the smallholder farming systems in the tropics (Sanchez and Leakey, 1997). Each year, tropical soils' finite capacity to grow food and fibre has progressively decreased, largely because of the decline in soil fertility (Adeoye *et al*., 2009). Therefore, the management of the soil in order to prevent further degradation and soil productivity is imperative. Legumes can play an important role in management of soil fertility for vegetable production, especially in tropics where low native fertility is a major constraint to crop production. In the same vein, composts are widely used as soil amendments to improve soil structure, provide plant nutrients and facilitate the re-vegetation of disturbed soils (Bradys and Weil, 2002). However, the use of either leguminous crops or compost for soil fertility purpose in organic farms has financial implications which most resource constraint farmers may not be able to adopt at all times. Thus, there is a need to investigate the influence of legacy (residual) soil fertility as influenced by the previously applied fertilizers for crop production.

While most farmers are familiar with improving crop yields with application of fertilizers, there is a dearth of information on the influence of residual (legacy) fertility of previously applied fertilizers on

subsequent crops. Legacy soil fertility (Güerena *et al.,* 2016) is very important for resource constraint farmers who may not have the capability of applying fertilizers to soils frequently.

Jack bean (*Canavaliaensiformis*) is a legume cover crop that is an efficient, low-cost source of nitrogen with considerable potential to improve soil fertility in intensified cropping systems (Carsky *et al.,* 1998). *Corchorus olitorus* also is a leafy vegetable consumed many parts of West Africa, Asia and in the Middle East (Akoroda and Akinlabi, 1987). Thus, investigating the influence of legacy fertility of compost-Jackbean on yield of corchorus is imperative.

Materials and methods

The experiments were conducted at the Organic Vegetable Garden Teaching and Research Farm, University of Ibadan, Nigeria. It is located in the derived savannah South-west Nigeria which lies between latitude 7°24'N and longitude 3°54'E with elevation of 62m above sea level. The mean monthly temperature ranges between 24°C and 30°C and the mean annual rainfall ranges between 1800 mm to 2100 mm.

This investigation was based on legacy fertility (residual) effects of the treatments previously applied which were Brewery Waste Compost grades A and B, Brewery Waste Compost grade A +Jack bean residual fertility, Brewery Waste Compost grade B + Jack bean residual fertility, Jack bean residual and Control (no soil additive). In previous experiment, composts were applied at the rate of 100 kg N/ha in an inter-crop of Jackbean and corchorus with resultant yields of corchorus under compost grade B (31.24t/ha^{-1})> grade A (26.80t/ha^{-1}) > grade B + Jack-bean > and compost grade A + Jack-bean. Thus, no fertilizer was applied during the reported investigation. Pre-cropping soil analysis was carried out using chemical standard procedures. The experiment was laid out in a Randomized Complete Block Design (RBCD) replicated four times having a total land area of 166.4m^2 with 24 beds of 1.5m x 1m each. The soil texture ranged from sandy to loamy sand which is slightly acidic. The residual effect of the soil amendment is being evaluated on yield of *Corchorus olitorious*.

Corchorus seeds were sown in March and July 2014, respectively for first and second planting on different plots, using drill method with spacing of 0.3m inter-row and 0.5m inter-bed spacing. The plants were thinned to an average of 270 plants/ bed which equate to an average population of 1.8 million plants/ hectare. The dry weight was obtained after five weeks sowing by destructive sampling offive representative plants on each bed in an oven of temperature 65°C until constant weights. Plant yield data were subjected to statistical analysis of variance using GENSTAT edition 5 and means were separated using least significant difference (LSD) at ($p \leq 0.05$).

Results

Tables 1 and 2 show the pre-planting chemical properties for both planting cycles. The result show that soil pH range of the first planting was moderately acidic (5.9 - 6.1) while that of the second plots was slightly acidic to moderately acidic (5.6 - 5.7). The Organic carbon across the two planting cycles ranged 3.2 - 4.9 g/kg, which was below the critical range (20 g/kg) according to FFD, (2002). The pre-planting total nitrogen content of all the plots was low (0.1-0.2 g/kg) according to FFD, (2002). Available phosphorus was very high in the dry season (43-50 mg/kg), but low during the second planting (14 -26 mg/kg) this may be due to leaching and fixation (Mengel and Kirkby, 2001). Potassium was very high (6.2 cmol/kg) in the control plot in the dry season compared to the amended soils. It was however, high in the rainy season (5.1-7.6 cmol/kg).

In the first season, Brewery Compost Grade B application resulted in the highest dry weight of corchorus (1.93 t/ha) which was not significantly higher than that of combination of Brewery Compost

Grade A+ Jack bean (1.84 t/ha) and Brewery Compost Grade B + Jack bean (1.67 t/ha). Brewery Compost Grade A had the lowest dry weight of 1.24 t/ha and it performed lower than Jack bean (1.42 t/ha) and control (1.51 t/ha) at the end of the first planting. At the end of the second planting, the highest dry weight was produced by soils treated with Brewery Compost Grade A+Jack bean(2.21 t/ha), followed bycontrol (1.99 t/ha), with the least from Jackbean fallow.

Table 1. **Influence of soil fertility methods on legacy chemical properties of the experimental soil at first planting**

Treatments	pH(H_2O)	Organic C g/kg	Total N g/kg	Avail. P mg/kg	Ca cmol/kg	Mg	K
Control	6.1	4.9	0.1	50	5.1	0.1	0.1
BCGA+Jb	6.1	3.9	0.1	43	3.8	0.1	0.1
BCGB+Jb	6.0	3.7	0.2	49	4.3	0.1	0.1
BCGA	5.9	3.2	0.1	47	2.1	0.1	0.1
BCGB	6.0	3.2	0.1	45	2.9	0.1	0.1
JB	6.0	4.9	0.2	46	3.0	0.1	0.1
MEAN	6.0	3.9	0.1	46	3.5	0.1	0.1
SD	0.1	0.6	0.1	2.7	1.1	0.1	0.1

Table 2. **Influence of soil fertility methods on legacy chemical properties of the experimental soil at second planting**

Treatments	pH(H_2O)	Organic C g/kg	Total N g/kg	Avail. P mg/kg	Ca cmol/kg	Mg	K
Control	5.7	3.5	0.2	26	3.0	1.3	0.2
BCGA+Jb	5.6	3.4	0.2	23	1.7	1.3	0.1
BCGB+Jb	5.6	3.3	0.2	23	1.6	3.5	0.1
BCGA	5.6	3.4	0.2	14	2.4	1.5	0.1
BCGB	5.7	3.2	0.2	21	1.8	1.9	0.1
JB	5.6	4.0	0.2	26	2.1	1.2	0.1
MEAN	5.6	3.5	0.2	22	2.1	383	6.8
SD	0.1	0.3	0.2	4.4	0.6	24.9	1.0

Legend
BCGA - BREWERY COMPOST GRADE A
BCGB - BREWERY COMPOST GRADE B
JB- Jack bean
SD- standard deviation

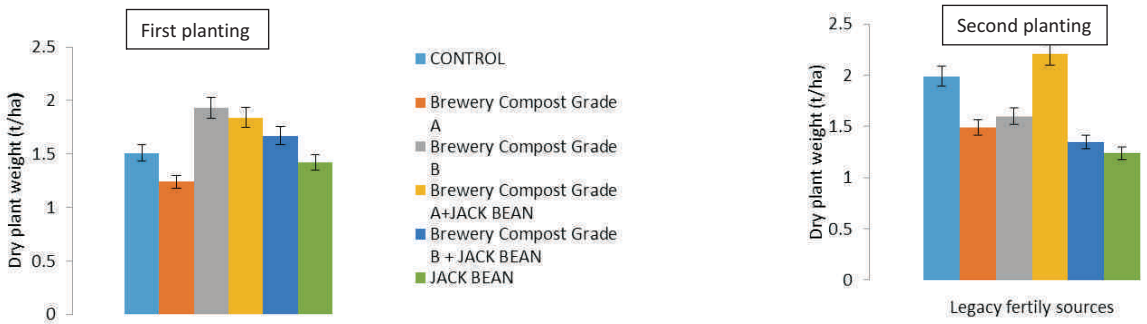

Figure 1. **Dry yield of corchorus at 5 weeks after sowing as influenced by different legacy fertility sources**

Discussion

Despite the fact that the experimental soils have been previously used to raise corchorus, low soil nitrogen and no other form of fertilizers were supplied, the dry plant yields obtained from all the treatments were higher than the range of 0.66 – 1.34 t/ha reported by Adediran *et al.* (2015). The better legacy soil fertility effect of the combination of Brewery Compost grade B and Jack bean implied that the combination of this compost and Jackbean (a legume) increased yield of *Corchorus olitorus* L. when compared with control of no previous soil additive. This is in consonance with the report of AdeOluwa and Bello, 2017 and Abedi*et al.,* 2010 where residual effects of organic nitrogen fortifiers and composts produced high yield of *Amranthus caudatus* and wheat, respectively. Olanikan (2006) reported that organic fertilizers increased organic matter status of the soil and enhanced crop production; it could have resulted into the significant difference observed in the dry yield of corchorus. Tanimu *et al,* (2007) also reported that forage leguminous fallow increased the yield of maize when compared to control. All these align with the fact that organic fertilizers and leguminous crop could improve soil nutrients, thereby increasing the yield of crop.

Conclusion

The result of this investigation revealed that the legacy soil fertility from combination of Brewery Compost grade B and Jackbean could increase the yield of corchorus, hence recommended as an alternative soil fertility measure for organic corchorus production.

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