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THE GROWTH AND NUTRIENT UPTAKES OF YELLOW PASSION FRUIT (*PASSIFLORA EDULIS* VAR. FLAVICARPA) SEEDLINGS IN RESPONSE TO ORGANIC FERTILISER APPLICATION UNDER TROPICAL CONDITIONS

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Abstract: Passion fruit is valued for its intense flavoured juice used in juice mixes. Though cultivation is prominent in many tropical regions, it is a new crop in southwest Nigeria regardless of the favourable ecology. New crop establishment depends on meeting the nutrient requirements, among other growth resources. Two experiments were conducted at Abeokuta to evaluate the optimum rate(s) of Sunshine Organic Fertilizer® (SOF) required for the growth of the seedlings. The SOF was applied at 0, 0.5, 1.0, 1.5, 2.0, and 2.5 t/ha in experiments arranged in Completely Randomised Design (CRD) replicated thrice. The application of SOF improved the growth of seedlings, but a rate above 2.0 t/ha resulted in depressed growth. In experiment 1, the application of 0.5 t/ha SOF gave the highest values of 152.7 cm, 19 mm and 19.0 for vine length, vine diameter and the number of leaves. In experiment 2, the number of leaves was the highest at 1.0 t/ha though similar to 1.5 and 2.0 t/ha. The application of SOF had a significant influence on the seedling leaf area (LA) in the experiments. The largest LA occurred in seedlings treated with SOF at 2.0 and 2.5 t/ha. Dry weight and foliar nutrient uptakes in both experiments were significantly influenced by SOF application. The application of SOF at 0.5 t/ha in experiment 1 resulted in higher N uptake, but the reverse was the trend in experiment 2, with higher nutrient uptakes at 1.5–2.5 t/ha SOF. Conclusively, an optimal rate of 2.0 t/ha had positive effects on seedling response.

Key words: fertiliser rate, growth, new crop, nutrient toxicity, nutrient uptakes.

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Introduction

Passion fruit (*Passiflora edulis* var. flavicarpa) is cultivated for fresh consumption and, more importantly, for the juice used as a flavouring for fruit juice mixes and wine. It is the most cultivated of the *Passifloraceae* family and native to Brazil though cultivation has spread to most tropical and subtropical regions of Africa, Asia, Australia and New Zealand (Morton, 1987; Knight and Sauls, 1994). Passion fruit has immense potentials as an industrial crop in southwest Nigeria, but there is little or no awareness of these potentials that can motivate commercial production (Joseph-Adekunle and Olubode, 2020). Passion fruit was introduced from Europe into Nigeria in the 1980s and is currently grown in Kaduna, Plateau and some western states of Nigeria in home gardens for juice making (Alegbejo, 2004; Aiyelaagbe et al., 2004; Joseph-Adekunle, 2006). These few localized production attempts did not follow standard production packages or fertiliser recommendations for optimum growth. Research results from previous works indicated that passion fruit responded to fertiliser application at the juvenile growth phase (Fagbayide and Joseph-Adekunle, 2002; Aiyelaagbe et al., 2005) though with conflicting rates. However, other researchers reported that the application of organic fertilisers, whether fortified or not, enhanced the development, production and fruit quality of sweet passion fruit (*Passiflora alata Dryland*) and yellow passion fruit as they developed adequate attributes for consumption (Damato et al., 2005; Britto et al., 2005; Joseph-Adekunle and Fagbayide, 2008) Meeting nutrient requirements is one of the essential factors for new crop establishment. Omotoso and Akinrinade (2013) reported positive responses on the growth and fruit quality of pineapple using applied fertilisers. The notion that organic fertiliser can be applied *ad libitum* needs to be examined in the face of growing environmental concern, especially from an organic point of view (Allen and Mangan, 2015). Tagliavini and Scandellari (2013) are of the opinion that nutrient uptake by crops is the backbone of proper fertiliser application in sustainable agriculture. The amounts of nutrients taken up under field conditions can be approximated to the amount of nutrients in the new biomass produced by the tree crop in one year. The experiments should determine the optimum rates of Sunshine Organic Fertilizer® (SOF) and industrially processed municipal wastes required for the growth and nutrient uptake of juvenile yellow passion fruit seedlings. These experiments were, therefore, conducted to assess the growth responses of yellow passion fruit (YPF) seedlings, dry matter accumulation and nutrient uptakes as influenced by rates of Sunshine Organic Fertilizer® (SOF).

Materials and Methods

Two experiments were conducted at the Federal University of Agriculture, Abeokuta, Nigeria (3° 25′ E 7° 15′ N, 100 m above sea level). The SOF rates were 0, 0.5, 1.0, 1.5, 2.0 and 2.5 t/ha based on the N requirement for passion fruit growth in the first experiment and repeated in experiment 2 as the validation of experiment 1. The soil and fertiliser were analysed for physical and chemical properties. Two seedlings were assigned to each treatment, and treatments were laid into Completely Randomised Design (CRD) with three replicates. Four-month-old seedlings of yellow passion fruit (YPF) were transplanted into 16-litre pots perforated at the bottom, previously filled with 20 kg of topsoil; the SOF was premixed with the soil two weeks before transplanting the seedlings. The seedlings were transplanted at the rate of one seedling per pot. Measurements were taken 15 weeks after transplanting on vine length in cm (VL) measured 3 cm above soil level to the tip of the longest vine, number of lateral vines (NLt), number of leaves (NL), vine diameter (VD in mm), and leaf area (LA cm^2). Leaf area was determined non-destructively at 16 weeks after transplanting (a week after measurement of growth parameter) by using the formula $Y = 11x – 49.2r^2$, where x = leaf length, r^2 = 0.94 (correction factor), Y = LA (Aiyelaagbe et al., 2005). Dry matter was determined 16 weeks after transplanting (WAT) by partitioning parts of sampled seedlings and oven drying at 65°C to constant weight. Nutrient contents of the dried leaf samples were analysed for nutrient concentration using standard procedures described by AOAC (1990), and nutrient uptakes calculated using the seedling dry foliar weight (g). Data were subjected to analysis of variance (ANOVA) using Genstat 12th edition and significant means separated using Duncan's Multiple Range Test (DMRT at $p \leq 0.05$).

Results and Discussion

The soil was sandy loam, slightly acidic, with low % N; moderate available P and Zn; with extremely low K in line with critical levels of soil nutrients (Chude et al., 2012). The Sunshine Organic Fertilizer® was low in N and P contents, but K content and total carbon concentrations were very high (Table 1).

Vegetative growth response of yellow passion fruit to Sunshine Organic Fertilizer® (SOF) application

The application of SOF had significant effects on the vegetative parameters of yellow passion fruit seedlings in both experiments. The longest vine was obtained in experiment 1, with the application of 0.5 t/ha, which was significantly different from other SOF rates except for 1.0 t/ha. The application of other rates of SOF and control on yellow passion fruit seedlings, however, resulted in lower vine length values. In experiment 2, a higher SOF rate of 1.5 t/ha had the longest vine but was not significantly different from other rates of SOF compared to 0.5 t/ha in experiment 1. The thickest vine diameter was obtained in seedlings treated with SOF at 0.5 t/ha in the experiment. This was followed by seedlings that received SOF of 1.5 t/ha, while SOF applied at 2.0 and 2.5 t/ha produced seedlings with significantly lower vine diameter values. In experiment 2, application rates above 0.5 t/ha resulted in vine diameter in the range of 14–17 mm, which was lower compared to experiment 1.

Table 1. Pre-transplanting soil and Sunshine Organic Fertilizer® physical and chemical properties.

Variables	Soil values	Sunshine Organic Fertilizer® values	
pH in water (1:1)	6.50	NA	NA
Macronutrients			
N (g/kg)	0.78	Total N (g/kg)	
Available P (mg/kg)	12.25	Total P (g/kg)	10.00
Total carbon (g/(g/kg)	2.16	Total carbon (g/kg)	9.87
Exchangeable bases (cmol/kg)		Exchangeable bases (g/kg)	22.62
Ca	3.87	Ca	63.75
Mg	0.96	Mg	4.31
K	0.07	K	6.86
Na	0.23	Na	3.97
Micronutrients (mg/kg)		Micronutrients (mg/kg)	
Mn	43.80	Mn	230.60
Zn	13.42	Zn	169.00
Cu	0.27	Cu	43.70
Fe	3.65	Fe	15.88
Particle size distribution (g/kg)		NA	NA
Sand	764		
Clay	60	NA	NA
Silt	176		
Textural class	Sandy loam		

The seedlings treated with SOF in experiment 1 produced the number of leaves in the range of 10 and 19 and were not significantly different. However, in experiment 2, the number of leaves almost doubled per SOF rate. The application of 1.0 t/ha recorded the highest number of leaves, which was similar to rates of 1.5 and 2.0 t/ha. The application of SOF had a significant influence on the seedling LA in the two experiments. The seedlings treated with SOF produced a smaller leaf area in the first experiment compared to the second. The application of SOF at higher rates resulted in the largest leaf area as seen in seedlings treated with SOF at 2.5 t/ha in experiment 1, and at 2.0 t/ha in experiment 2. The applied SOF had a significant effect on the number of laterals vines of the seedlings with control, 0.5 and 1.5 t/ha rates recording similar higher numbers and those seedlings treated with SOF at 1.0 and 2.0 t/ha produced the lowest mean number of lateral vines. Seedlings in experiment 2 treated with SOF at 2.5 t/ha had the significant highest value, followed by 0.5, 1.0 and 1.5t/ha, respectively. The observed apparent higher values in control for most of the vegetative parameters could be due to time lag taken for the mineralization of the SOF treated seedlings, hence, the need to augment nutrient status early to enhance a vigorous start. The depression of the growth parameters like vine length, number of leaves and number of lateral vines except for leaf area with the application of SOF at higher rates may be due to the excessive availability of some nutrients that could cause nutrient imbalance or antagonism or toxicity. Fageria (2001) has stated that, in crop plants, the nutrient interactions are generally measured in terms of growth response and nutrient concentrations. However, the observed trend of depressed growth at higher SOF rates is in line with the stance of Mimolana and Or (2000) that fertilisers should be applied in synchrony with crop demand in smaller quantities during the growing season. Improved growth responses have been affirmed by many researchers who reported that young plants developed large amounts of vegetative and root growth in response to adequate soil nutrient qualities occasioned by soil amendment (Aruleba and Fasina, 2004; Berberich et al., 2006). However, the depressed growth in seedlings treated with high rates of organic fertiliser beyond 1.5t/ha in the pots negated these earlier findings. The mind-set that excessive application of organic fertiliser or compost to the soil is not detrimental is misleading. It is against this backdrop that Mangan (2016) stated that excessive fertiliser application can create many soil and crop problems (Table 2).

Table 2. Effects of Sunshine Organic Fertilizer® application on the growth of yellow passion fruit seedlings 15 weeks after transplanting.

SOF (t/ha)	Vine length (cm)		Vine diameter (mm)		Number of Leaves		Number of lateral vines		Leaf area (cm^2)	
	Expt 1	Expt 2	Expt 1	Expt 2	Expt 1	Expt 2	Expt 1	Expt 2	Expt 1	Expt 2
0	194.3	202.2	17.0bc	13.0b	27.3	30.0b	2.9a	1.3ab	522.0	695.0
0.5	152.7	187.1	19.7a	7.0b	19.3	27.7bc	2.4ab	0.7b	497.0	730.0
1.0	127.3	188.2	19.0ab	16.0a	10.4	34.0b	1.0c	1.6ab	497.0	690.o
1.5	83.0	212.3	18.7ab	14.0a	13.3	33.0ab	1.8ab	1.4ab	440.0	698.0
2.0	83.0	200.1	14.0d	16.0a	12.0	33.4ab	0.7c	1.6ab	531.0	807.0
2.5	101.7	195.3	15.0cd	17.0a	11.0	29.0b	1.3bc	1.7a	543.9	624.0
SE	4.2	43.50	1.39	1.90	9.25	1.45	0.64	0.19	10.40	61.00

Means in the columns without letters are not significantly different at $p \leq 0.05$; SE = The standard error of the mean, SOF = Sunshine Organic Fertilizer®; Expt 1 = The first experiment; Expt 2 = The second experiment.

Effects of Sunshine Organic Fertilizer® application on the dry matter production of yellow passion fruit seedlings

The application of SOF at 0.5 and 2.5 t/ha resulted in the highest leaf dry weight, while SOF at 1.0 and 2.0 t/ha produced lower leaf dry weight. Yellow passion fruit seedlings treated with SOF at 1.5 and 2.5 t/ha produced the highest vine dry weight with tendrils attached and were similar though not statistically different from the control, SOF at 0.5 and 2.0 t/ha. The seedlings with SOF applied at 2.0 t/ha had the highest root dry weight and were significantly different from control and other SOF rates. The application of SOF at 2.5 t/ha resulted in the lowest seedling root dry weight, while other SOF rates had similar values. The highest total dry matter was obtained in YPF seedlings with SOF applied at 1.5 t/ha. The control with SOF applications at 2.0, 2.5 and 0.5 t/ha had lower values. In experiment 2, the application of the SOF at the different rates had significant effects on the biomass of seedlings with the highest leaf dry weight, vine and tendril dry weight and total dry weight occurring at 15 WAT. The application of SOF at 1.0 t/ha, however, resulted in the highest root dry weights. Conversely, the application of SOF at 0.5 t/ha and 2.5 t/ha resulted in consistently lowest leaf, vine and tendril dry weights. The observed trends supported the findings of Cavalcante et al. (2013) regarding the use of humic acid. They reported that humic substances sprayed positively affected the aerial part, root system and improved the quality of yellow passion fruit seedlings (Table 3).

Table 3. Effects of the Sunshine Organic Fertilizer® application on vegetative dry matter (g/plant) production in yellow passion fruit seedlings 16 weeks after transplanting.

SOF	Leaf dry Weight		Vine + Tendril dry weight		Root dry weight		Total dry weight	
	Expt 1	Expt 2	Expt 1	Expt 2	Expt 1	Expt 2	Expt 1	Expt 2
0	6.0ab	11.0bc	26.0ab	51.0b	4.0bc	9.0bc	36.0a	71.0b
0.5	7.0a	9.0c	23.0bc	40.0d	4.0bc	12.0ab	34.0ab	61.0c
1.0	5.0b	12.0b	20.0c	53.0a	6.0ab	8.0c	31.0b	73.0a
1.5	6.0ab	13.0a	27.0a	47.0c	4.0bc	11.0b	37.0a	71.0b
2.0	5.0b	13.0a	23.0bc	50.0b	8.0a	10.0b	36.0a	73.0a
2.5	7.0a	11.0bc	27.0a	40.0d	2.0c	13.0a	36.0a	64.0bc
SE	0.41	0.38	1.26	0.96	0.94	0.45	1.02	3.92

Means in a column with the same letters are not significantly different at $p \leq 0.05$, SOF = Sunshine Organic Fertilizer® in t/ha; SE = The standard error of the mean; Expt 1 = Experiment 1 and Expt 2 = Experiment 2.

Effects of the Sunshine Organic Fertilizer® application on yellow passion fruit seedling nutrient uptakes

The application of SOF in experiment 1 had a significant influence on foliar N, P, K, Mg, Fe, Mn and Cu uptakes in the yellow passion fruit seedlings in experiment 1. Plants that were treated with 0.5 t/ha SOF had maximum N uptake. This was followed by seedlings that did not receive SOF and those that received 2.5 t/ha SOF rate though insignificantly different. Higher rates of SOF resulted in significantly lower values of N uptake.

The P uptake was the highest in seedlings treated with SOF at 2.0 t/ha. Other rates had similar values except for SOF supplied at 1.5 t/ha without P uptake. The application of the SOF at 0.5 and 2.5 t/ha resulted in the significantly highest foliar K uptake while other rates had similar lower values. Foliar Ca and Zn uptakes of YPF seedlings were not significantly influenced by the SOF rates. This negated the findings of Tagliavini and Scandellari (2013), who found that Ca is often the nutrient absorbed at the highest amount, followed by N or K in the case of highly productive trees. Several factors affect nutrient uptake, including tree age, yields, tree vigour, but these effects also depend on the type of nutrient and specific crop characteristics. Some crops, such as grapes and apple, absorb relatively less N than peach, kiwifruit and orange. An increase in nutrient uptake is attributed to the increased availability of nutrients (Tagliavini and Scandellari, 2013). In experiment 2, yellow passion fruit seedlings without SOF and those treated with 0.5 t/ha had the significantly highest value compared to other SOF rates. The foliar Fe uptake was the highest in seedlings that received SOF at 2.5 t/ha. Yellow passion fruit seedlings without SOF, those with SOF applied at 2.0 and 2.5 t/ha had significantly higher foliar Mn uptakes. The highest foliar Cu uptake was observed in seedlings that received 0.5 t/ha of SOF, followed by seedlings that received SOF at 2.0 and 2.5 t/ha (Tables 4 and 5).

Table 4. The foliar nutrient uptake (g/plant) of yellow passion fruit seedling as influenced by the Sunshine Organic Fertilizer® application 16 weeks after transplanting (Experiment 1).

SOF (t/ha)	N	P	K	Ca	Mg	Zn	Fe	Mn	Cu
0	0.016ab	0.001a-c	0.031ab	0.011	0.009a	0.265	1.93bc	0.455a	8.25b
0.5	0.024a	0.001a-c	0.060a	0.002	0.009a	0.349	1.90bc	0.347ab	15.5a
1.0	0.011b	0.001a-c	0.050ab	0.00	0.00c	0.388	2.1ab	0.204bc	8.50b
1.5	0.11b	0.00c	0.031b	0.005	0.001c	0.244	3.82ab	0.228ab	8.75ab
2.0	0.012b	0.001a-c	0.023b	0.012	0.008ab	0.264	1.39c	0.379a	10.25ab
2.5	0.013b	0.002a	0.062a	0.001	0.004a-c	0.570	4.86a	0.429a	10.25ab
SE($p \leq 0.05$)	0.004	0.000	0.014	0.004	0.003	0.145	1.177	0.089	1.753

Means in a column with the same letters are not significantly different ($p \leq 0.05$) SE = The standard error of the mean, SOF = Sunshine Organic Fertilizer®.

Table 5. The foliar nutrient uptake (g/plant) of yellow passion fruit seedlings as influenced by the Sunshine Organic Fertilizer® application (Experiment 2).

SOF t/ha	N	P	K	Ca	Mg	Zn	Fe	Mn	Cu
0	0.025b	0.001b	0.024b	0.022bcd	0.011b	0.558bc	3.85b	0.968b	0.058b
0.5	0.016c	0.002a	0.021b	0.024bcd	0.014a	0.554bc	5.25b	1.417a	0.024b
1.0	0.020bc	0.002a	0.019b	0.026a-d	0.011bc	0.406bc	4.20b	0.875bc	0.200a
1.5	0.029a	0.002a	0.025a	0.026a-d	0.013ab	0.675ab	4.97b	1.365ab	0.288a
2.0	0.029a	0.002a	0.026a	0.019cde	0.013ab	0.667ab	8.11a	0.948b	0.000b
2.5	0.024b	0.001b	0.025a	0.017de	0.012ab	0.735a	3.53b	1.380ab	0.016b
SE	0.010	0.0004	0.004	0.005	0.002	0.150	3.000	0.303	0.1404

Means in a column with the same letters are not significantly different at $p \leq 0.05$ SE = The standard error of the mean, SOF = Sunshine Organic Fertilizer®.

Higher rates of SOF resulted in significantly lower values of N uptake. This is in line with the assertion of Mimolana and Or (2000) that nutrient uptake is reported to be influenced by soil properties, crop characteristics and growing conditions.

Regression models for the total dry weight (TDW) to total nutrient uptakes in yellow passion fruit seedlings as affected by the Sunshine Organic Fertilizer® application

Under experiment 1, yellow passion fruit seedlings treated with SOF showed positive significant data adjustments to linear regression models as functions of SOF rates with the total uptakes of N, Mn and Fe. These were characterised by a total dry weight (TDW) increase up to 65 g/plant for total N uptake with SOF added at 2.0 t/ha, 63 g/plant for total Mn uptake with an SOF rate of 2.5 t/ha and 68 g/plant for total Fe uptake at an SOF rate of 2.5 g/ha (Figures 1, 2 and 3).

The TDW showed a quadratic function in relation to Cu and K total uptakes. The maximum TDW of about 55 g/plant was obtained for total Cu uptake at above 2.0 t/ha SOF application rate, beyond which there was a decrease in TDW. For total K uptake, the TDW of about 56 g/plant was obtained at an SOF rate of 2.0 t/ha, beyond which there was a decrease in total K uptake (Figures 4 and 5).

Yellow passion fruit seedlings treated with SOF in the first experiment showed positive significant data adjustments to linear regression models as functions of SOF rates with the total uptakes of N, P and K. The regression models for the total dry weight (TDW) showed a quadratic function in relation to N, P and K total uptakes. The maximum TDW of about 55 g/plant was obtained for K uptake.

In experiment 2, TDW of about 56 g/plant was obtained at SOF rate of 2.0 t/ha, beyond which, there was a decrease in total K uptake (Figures 6–8).

A balanced supply of essential nutrients is one of the most important factors in increasing growth and crop yields. In crop plants, the nutrient interactions are generally measured in terms of growth response and change in the concentration or uptake of nutrients. Positive (synergistic) interaction is noted when the presence of two nutrients results in an increase in crop yield that is more than adding only one. Similarly, if adding the two nutrients together produces less yield as compared to individual ones, the interaction is negative (antagonistic). When there is no change, there is no interaction, and this is true for organic fertilizers.

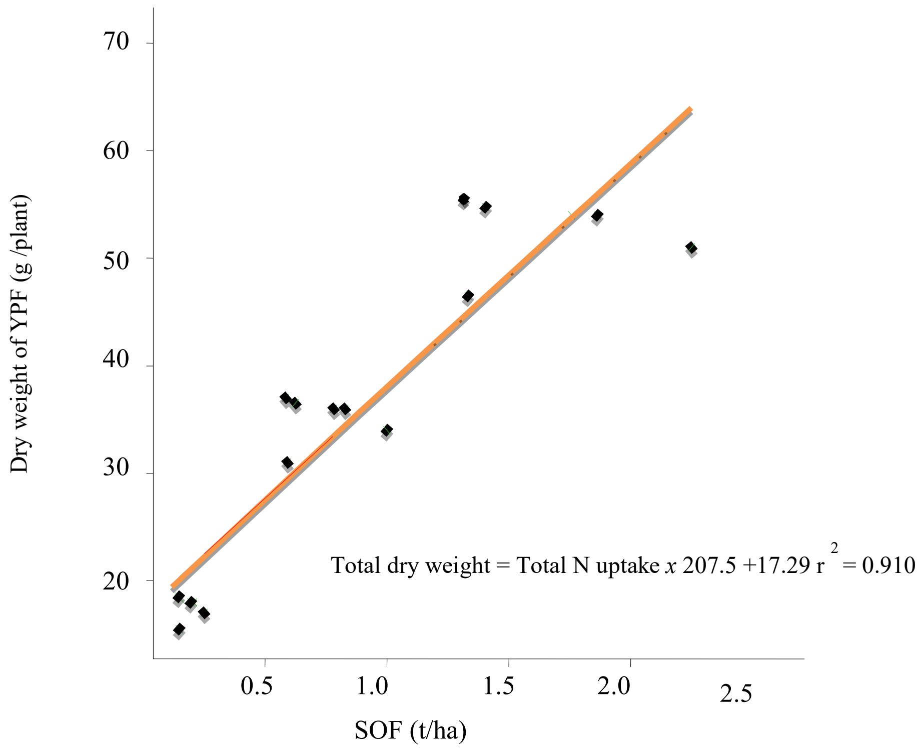

Figure 1. Total dry weight and total N uptake in YPF seedlings as influenced by the SOF rates in experiment 1.

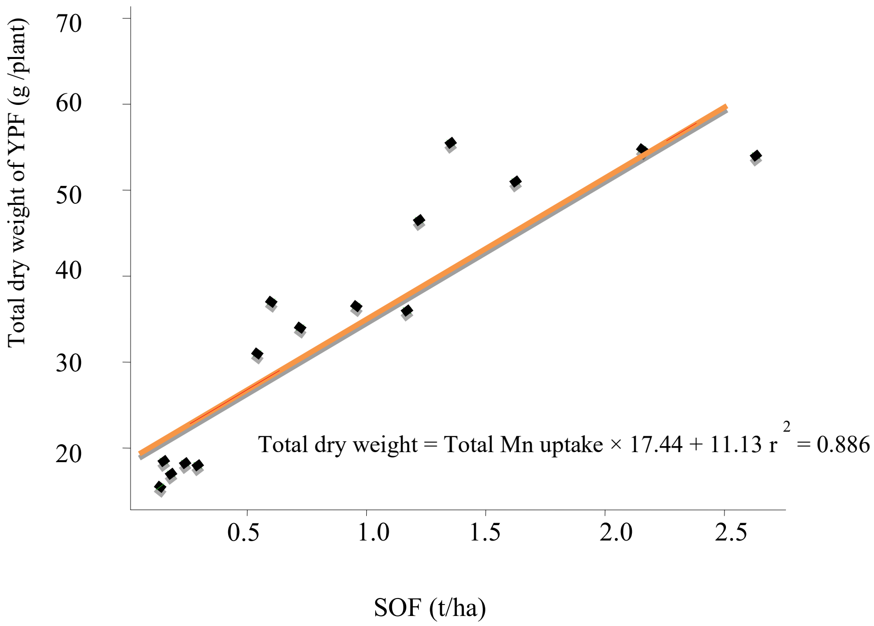

Figure 2. Total dry weight and total Mn uptake in yellow passion fruit seedlings as influenced by the SOF rates in experiment.

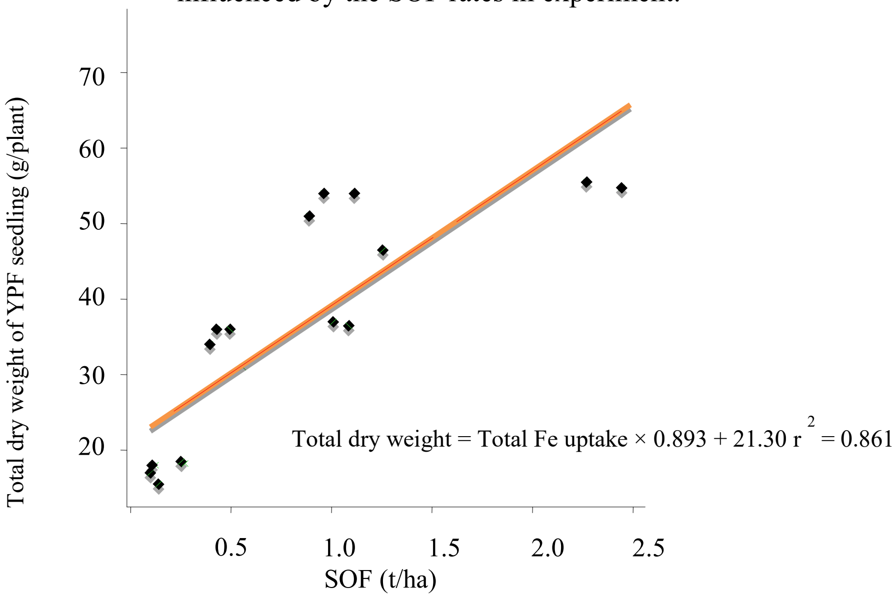

Figure 3. Total dry weight and total Fe uptake in yellow passion fruit seedlings as influenced by the SOF rates in experiment 1.

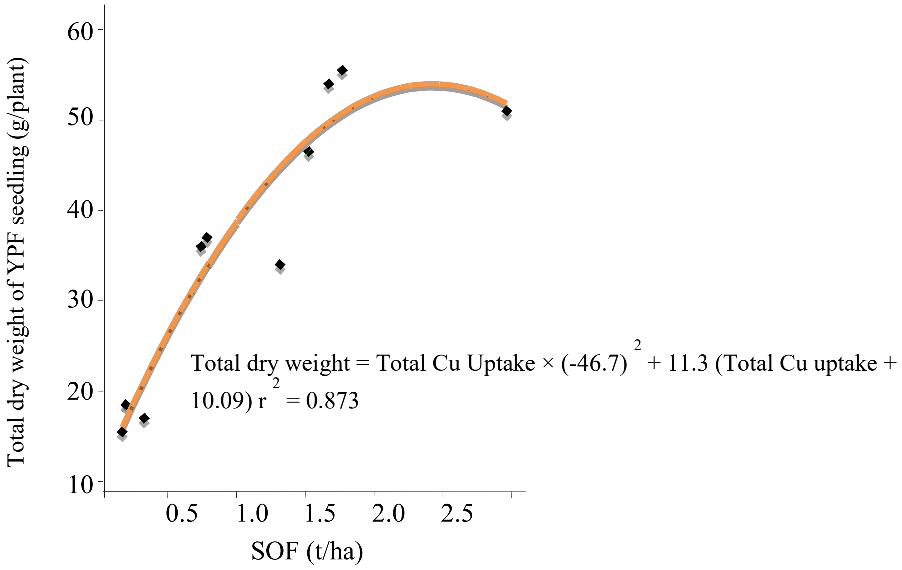

Figure 4. Total dry weight and total Cu uptake in yellow passion fruit seedlings as influenced by the SOF rates in experiment 1.

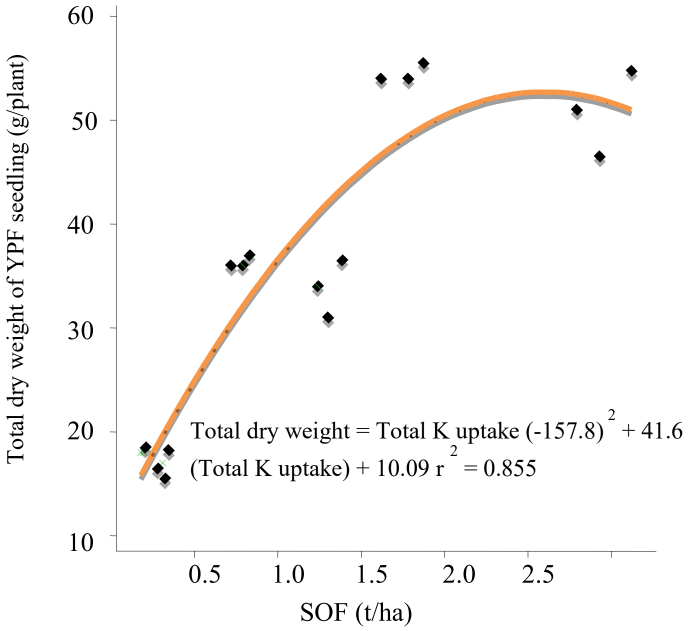

Figure 5. Total dry weight and total K uptake in yellow passion fruit seedlings as influenced by the SOF rates in experiment 1.

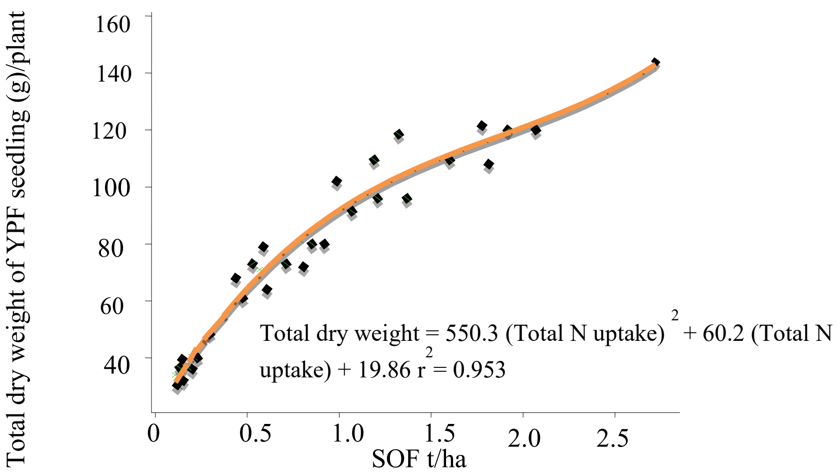

Figure 6. The relationship between total dry weight and total N uptake in yellow passion fruit seedlings as influenced by the SOF rates in experiment 2.

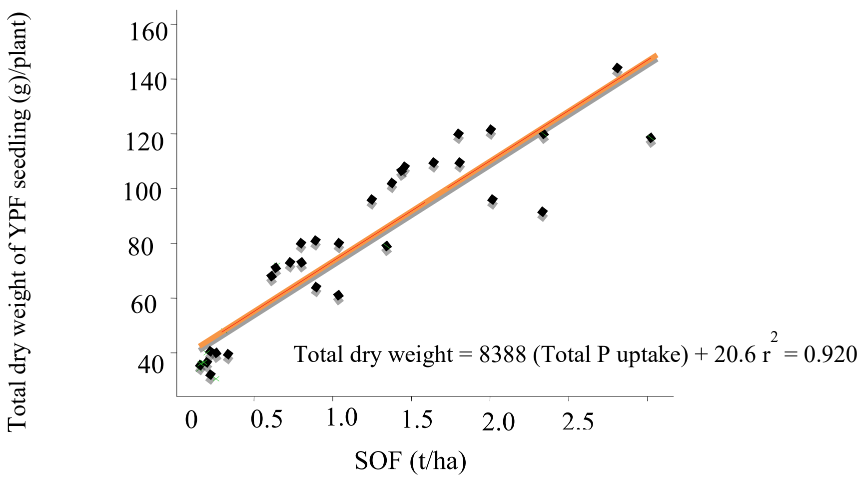

Figure 7. The relationship between total dry weight and total P uptake in yellow passion fruit seedlings as influenced by the SOF rates in experiment 2.

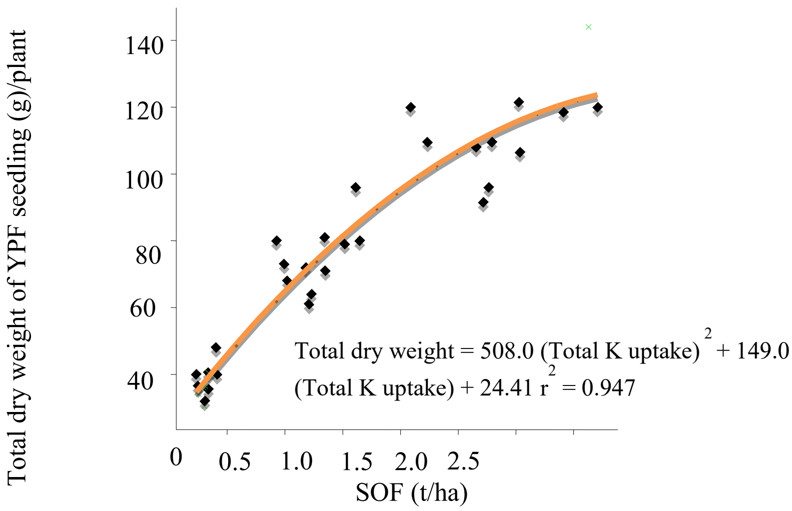

Figure 8. The relationship between total dry matter and total K uptake in yellow passion fruit seedlings as influenced by the SOF rates in experiment 2.

Conclusion

Applications of Sunshine Organic Fertilizer® at low rates enhanced the vegetative growth of yellow passion fruit at an early stage of growth, while a deleterious effect at higher rates was observed.

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RAST I USVAJANJE HRANLJIVIH MATERIJA SADNICA MARAKUJE (*PASSIFLORA EDULIS* VAR. FLAVICARPA) KAO ODGOVOR NA PRIMENU ORGANSKOG ĐUBRIVA U TROPSKIM USLOVIMA

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R e z i m e

Marakuja je cenjena zbog soka intenzivnog ukusa koji se koristi u mešavinama sokova. Iako je uzgajanje zastupljeno u mnogim tropskim regionima, to je nova kultura u jugozapadnoj Nigeriji bez obzira na povoljnu ekologiju. Zasnivanje novih useva zavisi od zadovoljavanja potreba za hranljivim materijama među ostalim resursima rasta. Dva eksperimenta su sprovedena u Abeokuti da bi se procenila/e optimalna količina organskog đubriva *Sunshine Organic Fertilizer*® (SOF) potrebnog za rast sadnica. SOF je primenjen u količini od 0, 0,5, 1,0, 1,5, 2,0 i 2,5 t/ha u eksperimentima raspoređenim u potpuno randomizovanom dizajnu u tri ponovljanja. Primena organskog đubriva SOF poboljšala je rast sadnica, ali je količina iznad 2,0 t/ha dovela do smanjenja rasta. U eksperimentu 1, primena od 0,5 t/ha organskog đubriva SOF dala je najveće vrednosti od 152,7 cm, 19 mm i 19,0 za dužinu loze, prečnik loze i broj listova. U eksperimentu 2, broj listova je bio najveći pri količini od 1,0 t/ha, ali slične vrednosti su dobijene kod količine od 1,5 i 2,0 t/ha. Primena organskog đubriva SOF u eksperimentima je imala značajan uticaj na lisnu površinu sadnica. Najveća lisna površina se javila kod sadnica tretiranih organskim đubrivom SOF u količini od 2,0 i 2,5 t/ha. Suva masa i usvajanje hranljivih materija preko lista u oba eksperimenta bili su značajno uslovljeni primenom organskog đubriva SOF. Primena doze od 0,5 t/ha organskog đubriva SOF u eksperimentu 1 dovela je do većeg usvajanja N, ali je obrnut trend bio prisutan u eksperimentu 2 sa većim usvajanjem hranljivih materija od 1,5 do 2,5 t/ha organskog đubriva SOF. Konačno, optimalna količina od 2,0 t/ha imala je pozitivan efekat na odgovor sadnica.

Ključne reči: količina đubriva, rast, novi usev, toksičnost hranljivih materija, usvajanje hranljivih materija.

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