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RESEARCH PAPER

Effect of bokashi and vermicompost leachate on yield and quality of pepper (*Capsicum annuum*) and onion (*Allium cepa*) under monoculture and intercropping cultures

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Abstract

J.D. Álvarez-Solís, J.A. Mendoza-Núñez, N.S. León-Martínez, J. Castellanos-Albores, and F.A. Gutiérrez-Miceli. 2016. Effect of bokashi and vermicompost leachate on yield and quality of pepper (*Capsicum annuum*) and onion (*Allium cepa*) under monoculture and intercropping cultures. Cien. Inv. Agr. 43(2):243-252. Organic fertilization and crop association are two agroecological management practices that have the potential to optimize land use in horticultural production. The objective of this study was to evaluate the effect of Bokashi and Bokashi amended with Vermicompost Leachate (VL) on the growth, yield and quality of jalapeño pepper (*Capsicum annuum* L.) and onion (*Allium cepa* L.) in monoculture and intercropping cultures. This work was conducted under rainfed conditions in the community of Santa Rosa el Oriente, a municipality of Trinity, Chiapas. A randomized complete block design in a split plot arrangement with six treatments and four replicates by treatment was used. Bokashi significantly increased the number of leaves and plant height in onion (37 and 62%) and jalapeño pepper (133 and 94%) compared with the control plants. In jalapeño pepper and onion, the content of capsaicin and soluble solids was 41 and 42% higher with the application of Bokashi plus VL, respectively. In onion, Bokashi increased the polar and equatorial diameters and bulb weight by 28, 69 and 269%, respectively, and its yield increased from 6.4 to 21.0 t ha⁻¹. The land equivalent ratio (LER) was 1.34 to 1.55, which indicated that intercropping was advantageous on monoculture, regardless of the fertilization type. Therefore, the application of Bokashi and crop association favored the yield and quality of jalapeño pepper and onion with an efficient use of the land.

Key words: Bokashi, capsaicin, land equivalent ratio, soluble solids, vermicompost leachate.

Introduction

On an international level, small farmers accomplish their agricultural, livestock and forestry activi-

ties with very scarce land and capital resources, which results in small landholdings and extreme poverty. It has been estimated that approximately 1.4 billion people depend on conducting agricultural work under rainfed conditions, with several environmental and economic limitations and

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without access to modern agricultural technology (Altieri, 2002). The use of industrial fertilizers in agricultural production is expensive for small farmers; most cannot buy such fertilizers. Furthermore, there has been serious concern about the long-term adverse effects of the intensive use of chemical fertilizers on both soil health and the environment (van Diepeningen *et al.*, 2006). A new approach to natural resource management must be developed so agricultural systems can be built and adapted in a site-specific way according to the conditions of small farmers (Altieri, 2002). In this work, we considered two relevant agroecological management practices: the use of local organic fertilizers to maintain soil fertility and plant nutrition, and crop association to optimize land use. Jalapeño pepper (*Capsicum annuum* L.) and onion (*Allium cepa* L.) are two important crops for family food security and for sale in local market. Capsaicin in jalapeño peppers and piruvic acid in onions are related to the pungency of the vegetables and provide important antioxidants for the human diet (Teare-Ketter and Randle, 1998; Vázquez-Flota *et al.*, 2007).

There are different methods for producing organic fertilizers by processing the organic residues that result from agricultural activity. The composting process, such as Bokashi, is a biological aerobic transformation of organic residues with energy sources (such as molasses) that accelerate the oxidation of organic matter through a thermophilic phase (45 to 65 °C) in which microorganisms liberate heat, carbon dioxide and water, thus permitting the obtainment of a product in a short period of time. The vermicomposting does not include a thermophilic phase, but involves the use of earthworms for breaking down and stabilizing the organic wastes (Atiyeh *et al.*, 2000). In the vermicomposting process, beds filled with composted waste, earthworms and bedding material are fitted with a drainage and collection system. Leachate obtained as effluent from vermiculture beds, which is often called Vermicompost Leachate (VL), can be used as a liquid fertilizer (García-Gómez *et al.*, 2008;

Oliva-Llaven *et al.*, 2010). It has been shown that organic fertilizers, such as Manure, Compost, Bokashi and VL, improve the soil organic matter and nutrient availability (Sinaj *et al.*, 2002) and increase the microbial biomass, soil enzyme activity (Acosta and Paolini, 2005), and number and diversity of soil bacteria (van Diepeningen *et al.*, 2006). Its positive effects on soil quality are reflected in better nutrition and crop yields and could modify the organoleptic characteristics of fruits due to an increase in organic substances (Gutiérrez-Miceli *et al.*, 2007; Oliva-Llaven *et al.*, 2008). However, the amount of organic fertilizer that must be applied varies between crops and depends on the availability of resources which has the small farmer for processing. Therefore, it is necessary to test different complementation alternatives to determine which meet the nutritional requirements of plants. One option is to combine soil with foliar organic fertilization.

Intercropping is the mixed growth of two or more crops in the same field. This practice reduces the risk of total loss, improves the use of resources, provides protection against pests and diseases, and provides stability and the proper administration of work throughout the year (Vandermeer, 1990; Malézieux *et al.*, 2009). One way to determine the benefit or limitation of intercropping is by measuring the unit or land equivalent ratio (LER), defined as the area of land under monoculture that is needed to obtain the same production in intercropping (Willey and Rao, 1980; Dariush *et al.*, 2006). The benefits of intercropping are a reason to evaluate spatial and temporal designs in horticultural crops that act in synergy between the components of biodiversity above and underground, which are key factors that influence ecological processes such as nutrient cycling and productivity (Altieri and Nicholls, 2007). The integration of organic fertilization and crops association with agroecological management could to improve production with fewer external inputs and without negative environmental impacts (Altieri, 2002). The aim of this study was to evaluate the effect of Bokashi and VL as organic fertilizers and to

determine the crop association on the growth, yield and quality of jalapeño peppers (*C. annuum*) and onion (*A. cepa* L.) under rainfed conditions in Santa Rosa el Oriente, Chiapas.

Material and methods

This study was conducted in the community of Santa Rosa el Oriente, a municipality of Trinity, Chiapas, México, located at 91°40'27'' N and 16°08'10'' O, at 1407 m above sea level. This community is inhabited by 55 families of the Maya Chuj ethnic group. The land surface for each family is 3,750 m², of which 3,125 m² is occupied by maize and bean production and the rest by the home garden. The predominant climate is temperate humid, with rain year-round and an average annual temperature of 16-18 °C, without the risk of frost in the colder months. The average annual rainfall is 1,840 mm, peaking in August-November (1,200 to 1,400 mm) (Ramírez-Marcial *et al.*, 2010). The soil is a Rendzic Leptosol and is shallow stony, shallow and steep, with high levels of organic matter (6.6%) and total N (0.45%); it is low in P-Olsen (2.2 mg kg⁻¹), its pH is slightly acidic (6.6) and it has high CEC (28.8 Cmol kg⁻¹).

The experiment was established with the participation of a group of small farmers interested in the organic production of onion and jalapeño pepper in a plot that had been used for maize cultivation. Six treatments were evaluated: 1) Monoculture without fertilizer; 2) Monoculture fertilized with Bokashi; 3) Monoculture fertilized with Bokashi plus Vermicompost Leachate (VL); 4) Intercropping without fertilizer; 5) Intercropping fertilized with Bokashi; and 6) Intercropping fertilized with Bokashi plus VL. The experimental design consisted of split plots and randomized blocks with four replications. The main plot corresponded to the type of fertilizer (Bokashi, Bokashi plus VL, and control without fertilizer), and a small plot was assigned to the crop association of jalapeño pepper and

onion (monoculture and intercropping). The experimental units had an area of 2.25 m². A substitution model was used in intercropping (García, 2003), where 40% of the plants in the onion monocrop were substituted by jalapeño pepper plants. The seeds of the plants were obtained in the local market, sown in a seedbed and held for 62 days. In transplantation, the plant spacing was 15×30 cm for onion and 30×45 cm for jalapeño pepper. Bokashi was applied upon transplanting at 10 cm deep with a dose of 10 kg m⁻². VL was applied as a foliar fertilizer at up to 10% every 10 d since 22 d after transplanting (DAT) at four different times.

Bokashi was prepared through an aerobic fermentation process for 30 days with the following materials: sheep, chicken and cow manures, corn stalks, straw, green grass, green leaves and forest soil, which was added with yeast and molasses. VL was obtained from a vermiculture bed with cow manure and earthworm (*Eisenia fetida*) (García-Gómez *et al.*, 2008). Before transplanting and fertilizer application, a soil sample from a 20-cm depth was collected. Organic fertilizers and soil were processed and analyzed using the techniques described in the Mexican Official Norm (2002); Nitrogen (N) was determined by the micro-Kjeldahl technique and Phosphorous (P) by the Olsen method (using NaHCO₃ 0.5 M, pH 8.5). Macronutrients (K, Ca, Mg, Na) and micronutrients (Cu, Fe, Mn and Zn) were extracted with acetate of ammonium 1N, pH 7 in soil, and with a solution of nitric acid-perchloric acid (HNO₃-HClO₄) in Bokashi. Ca, Mg and extractable micronutrients were determined by atomic absorption spectrophotometry, and K and Na were detected by flame emission spectroscopy. The chemical characteristics that were determined are shown in Table 1. For disease control, an application of Bordeaux mixture (1% at 14 DAT) was performed because the jalapeño pepper developed symptoms of basal stem rot (*Phytophthora* spp.) and wide stem (*Fusarium* spp.). A second application was made at 30 DAT (Restrepo, 2007).

Table 1. Nutrient content (mg kg⁻¹) in the experimental soil, Bokashi and vermicompost leachate (VL).

	N	P	K	Ca	Mg	Na	Cu	Fe	Mn	Zn
Soil	4500.0	2.2	97.8	2186.0	611.2	96.6	1.6	34.6	20.6	1.2
Bokashi	9500.0	105.8	4844.5	18538.0	8431.4	1971.1	224.9	234.8	3038.2	137.7
VL	236.0	3.2	39.4	52.9	164.0	405.2	13.8	12.6	10.9	51.6

To assess the effect of treatments on plant growth, plant height was measured, and the number of leaves was counted at 33 DAT. Additionally, the fresh and dry weights of foliage (oven dried for 48 h at 65° C) were measured at 63 DAT. At harvest time, the length and diameter of jalapeño pepper were measured, as were the polar and equatorial diameters of the onion. The yield of jalapeño pepper was measured considering 4 cuts; fruit weight was assessed according to the Mexican Official Norms for onion (2003) and jalapeño pepper (2007). The soluble solids content in onion bulbs and jalapeño fruit was determined using a refractometer (Abbe 2WAJ) in degrees Brix, according to the method of AOAC (1990). To estimate the effect that the treatments had on pungency in onion and jalapeño pepper, pyruvic acid and capsaicin concentration were determined according to the methods proposed by Teare-Ketter and Randle (1998) and García *et al.* (2006), respectively. The onion bulbs and jalapeño pepper fruits from each treatment were cut into small slices and pooled. For the determination of pyruvic acid, 20 g of a fresh sample was mixed and homogenized with 20 mL of deionized water for 10 min; 0.5 mL of a homogenized sample was mixed with 1.5 mL of trichloroacetic acid (5%) and allowed to sit for 1 hr, and 18 mL of deionized water was added. Then, 1 mL of this solution was mixed with 1 mL of 2,4-dinitrophenylhydrazine (0.0125 %) and 1 mL of deionized water, the mixture was incubated at 37 °C for 10 min, and 5 mL of NaOH (0.6N) was added. The reading was accomplished using a spectrophotometer (Varian Spectr AA220) to 420 nm, with sodium pyruvate serving as the

standard to obtain the standard curve (Teare-Ketter and Randle, 1998). For the determination of capsaicin, 5 g of a fresh sample was mixed and homogenized with 5 mL of ethanol, agitated for 15 min, and then filtered with ethanol until it reached a volume of 10 mL. An aliquot of 2 mL was put on a separation funnel, and 3 mL of a solution buffer pH = 3, 10 mL of distilled water and 10 mL of Adogen-Tolueno were added. The mixture was agitated and allowed to rest until two phases appeared. The organic phase was recovered, and the concentration of capsaicin was estimated with a spectrophotometer (Varian Spectr AA220) at 286 nm, using capsaicin to obtain the standard curve (0-0.5 mg mL⁻¹) (García *et al.*, 2006).

The LER was calculated using the formula $LER = \sum (Y_{pi}/Y_{mi})$, where Y_p is the yield of each crop in the intercrop and Y_m is the yield of each crop in the monoculture (Dariush *et al.*, 2006). For each crop, (i) a ratio was calculated to determine the partial LER, and partial LERs were summed to give the total LER for the intercrop. When $LER > 1$, intercropping is advantageous over monoculture; when $LER = 1$, the planting mode does not matter; and when $LER < 1$, monoculture is advantageous over intercropping (Willey and Rao, 1980).

Statistical analysis

The data were analyzed using analysis of variance (ANOVA) for a split plot design and a Tukey test to compare the means ($P \leq 0.05$). All analyses were performed using the SPSS v15 program.

Results and discussion

Growth and plant biomass

The height and number of leaves in onion and jalapeño varied significantly ($P \leq 0.05$) between treatments, with higher values found for the application of Bokashi and Bokashi plus VL compared to plants without fertilizer. Intercropping had no significant effect on these variables of growth, and no significant interaction between factors was found (Table 2). Onion plants that were fertilized with Bokashi and Bokashi plus VL showed average increases of 37 and 27% in the number of leaves and increases of 62 and 46% in height relative to the control without fertilizer, whereas the jalapeño pepper exhibited increases of 111 and 129% in the number of leaves and of 94 and 84% in plant height. These results show that there was a greater response to organic fertilization in jalapeño pepper than in onion and that Bokashi plus VL application did not exceed the growth obtained with Bokashi.

The fresh and dry weight of foliage in the jalapeño and onion varied significantly ($P \leq 0.05$) between fertilization treatments. Neither crop association nor interaction with fertilization had no significant influence (Table 2). Applying Bokashi promoted greater fresh and dry weight of foliage, with average increases of 421 and 214% in jalapeño and 262 and 157% in onion compared to the control. In both cases, there was no significant difference

between Bokashi application and Bokashi plus VL. The positive effect of organic fertilizers on plant growth has been attributed to its ability to supply minerals (Castro *et al.*, 2009; Álvarez-Solís *et al.*, 2010) and the variety of organic compounds that it contains (Gutiérrez-Miceli *et al.*, 2007; Olivallaven *et al.*, 2008). Nitrogen in organic fertilizer is mainly in organic form, and its availability varies depending on its concentration and C/N ratio, which in turn depend on the materials used in the fertilizer's manufacture and maturity. In this work, Bokashi had a high content of total N (0.95%) and a low C/N ratio (9.6), which favors nutrient availability. In addition, it is important to consider the content of macro- and micro-nutrients that were provided by Bokashi (Table 1), which may explain why there was no response to the foliar application of VL.

Physical and organoleptic characteristics of plants

Neither applying Bokashi alone or in combination with VL nor the crops association had a significant effect on the size or fresh weight of jalapeño pepper fruit (Table 3). According to the Mexican Official Norm (2007), the length (3.0–4.9 cm), width (2.5–2.9 cm) and weight (< 15.0 g) of the harvested peppers could be classified as a short size, but with regard to quality, they were found to possess an extra degree of quality: they were free of physiological, me-

Table 2. Growth and biomass in jalapeño pepper and onion plants cultivated in monoculture and intercropping using Bokashi and vermicompost leachate (VL) as organic fertilizers.

Factors	Foliage weight (g plant ⁻¹)							
	Height (cm)		Number of Leaves		Fresh		Dry	
	Pepper	Onion	Pepper	Onion	Pepper	Onion	Pepper	Onion
Culture type								
Monoculture	17.0±5.8 a ¹	40.8±10.8 a	54.4±28.6 a	6.1±1.0 a	8.7±7.2 a	18.6±14.7 a	1.9±1.4 a	1.3±0.9 a
Intercropping	16.2±5.2 a	42.0±10.6 a	42.4±16.2 a	6.3±1.3 a	5.3±3.9 a	24.0±14.4 a	1.4±1.7 a	1.6±0.9 a
Fertilization								
Bokashi	20.2±3.1 a	49.4±5.1 a	56.7±26.2 a	7.0±0.8 a	9.9±5.8 a	28.6±14.7 a	2.2±1.1 a	1.8±0.9 a
Bokashi +VL	19.1±4.0 a	44.4±8.5 a	61.5±14.6 a	6.5±0.7 a	8.9±6.2 a	27.5±10.5 a	2.1±1.0 a	1.9±0.7 a
Control	10.4±2.1 b	30.5±6.8 b	26.9±11.0 b	5.1±1.0 b	1.9±1.1 b	7.9±7.3 b	0.7±0.2 b	0.7±0.5 b

¹Means (\pm SD) with different letters in a column for each factor are significantly different (Tukey, $P \leq 0.05$).

Table 3. Physical and organoleptic characteristics in jalapeño pepper fruits cultivated with monoculture and intercropping using Bokashi and vermicompost leachate (VL) as organic fertilizers.

Factors	Length	Width	Fresh weight (g)	Soluble solids (° Brix)	Capsaicin (mg g ⁻¹)
	(mm)				
Culture type					
Monoculture	48.5±4.8 a ¹	18.8±1.5 a	9.0±1.8 a	1.6±0.67 a	0.31±0.09 a
Intercropping	46.2±5.2 a	18.2±1.8 a	8.2±2.0 a	1.4±0.52 a	0.31±0.13 a
Fertilization					
Bokashi	47.9±3.9 a	18.8±1.6 a	9.0±1.4 a	1.5±0.71 a	0.32±0.10 ab
Bokashi + VL	45.4±4.7 a	18.8±2.1 a	8.5±2.4 a	1.8±0.44 a	0.36±0.10 a
Control	48.6±6.3 a	18.0±1.2 a	8.2±1.8 a	1.2±0.41 a	0.25±0.12 b

¹Means (± SD) with different letters in the columns for each factor are significantly different (Tukey, $P \leq 0.05$).

chanical and biological defects. The amount of soluble solids in jalapeño pepper did not vary between treatments. The concentration of capsaicin was significantly higher ($P \leq 0.05$) in Bokashi plus VL (41%) than in the control (Table 3). The observed capsaicin values coincide with those reported by (García *et al.*, 2006). Capsaicin is a compound of nitrogen sources, and its increase may be related to the nutritional status of the plant (Vázquez-Flota *et al.*, 2007). Johnson and Decoteau (1996) found that the capsaicin content had a quadratic response to nitrogen fertilization. According to the results of analyses of soil and Bokashi, the contents of total N occur at very high levels. In addition, the activity of the -O-methyltransferase caffeic acid enzymes and synthetase capsaicinoids may be the main limiting factor for the production of capsaicinoids in *in vitro* cultures (Ochoa and Gómez, 1993). Additionally, the application of organic fertilizer has a positive effect on the enzyme activity (Acosta and Paolini, 2005).

The onion bulb size showed a significant difference ($P \leq 0.05$) when Bokashi was applied, with increases of 28, 69 and 269% in the polar and equatorial diameters and weight, respectively, compared to the control (Table 4). According to the Mexican Official Norm (2003), a middle size (5.1-7.0 cm) of onion was found. The onion presented development, coloration and brightness that were typical of the variety; therefore,

it was considered a premium product. The application of organic fertilizer promoted the increase of soluble solids in onion bulb (Table 4); however, the values obtained were lower than those reported by Abrameto *et al.* (2010). The soluble solids content is important because it relates to the sweetness of the fruit, but when the concentration of organosulfur compounds is high, the sweet taste produced by sugars of the onion is not perceived (Mallor, 2008). It has been found that vermicompost increased the content of soluble solids in tomato and jalapeño pepper (Gutiérrez-Miceli *et al.*, 2007; Oliva-Llaven *et al.*, 2008). Pyruvic acid in onion bulbs showed no significant difference between the fertilization treatments and intercropping. However, onion bulbs had 66 and 41% more pyruvic acid with Bokashi and Bokashi plus VL than did the control plants (Table 4). The concentration of pyruvic acid was within the range reported by Abrameto *et al.* (2010) and higher than that reported by Hamilton *et al.* (1998). The values of pyruvic acid in onions found in this study are higher, and the onions are thus considered spicy, possibly due to the scarcity of water during the growing period that was reflected in the water content of the bulbs, thereby increasing the concentration of sulfur compounds (Sun *et al.*, 2006). The concentration of pyruvic acid in onion bulbs is associated with agronomic practices, such as the amount of water in the fruit and the ability of the plant to accumulate sulfur compound into cells (Raigón, 2006).

Table 4. Physical and organoleptic characteristics in onion bulbs cultivated as monoculture and intercropping using Bokashi and vermicompost leachate (VL) as organic fertilizers.

Factors	Polar diameter	Equatorial diameter	Fresh weight (g plant ⁻¹)	Soluble solids (° Brix)	Pyruvic acid (µM g ⁻¹)
	(mm)				
Culture type					
Monoculture	68.5±11.2 a ¹	53.2±13.7 a	100.1±62.2 a	2.1±0.79 a	11.0±4.03 a
Intercropping	66.7±8.5 a	54.1±13.9 a	97.0±53.0 a	2.3±0.42 a	10.8±3.75 a
Fertilization					
Bokashi	74.1±6.9 a	64.9±7.8 a	142.6±44.8 a	2.7±0.41 a	12.0±4.33 a
Bokashi + VL	70.9±6.8 a	57.9±7.5 a	114.4±40.3 a	2.3±0.42 a	11.2±4.23 a
Control	57.7±6.9 b	38.2±6.7 b	38.6±16.2 b	1.6±0.51 b	9.6±2.74 a

¹Means (± SD) with different letters in the columns for each factor are significantly different (Tukey, P≤0.05).

Yield and land equivalent ratio (LER)

The yield of onion showed highly significant differences between fertilization treatments (P≤0.01). The onion yield in monoculture was 257 and 243% higher with Bokashi and Bokashi plus VL than in the control plants without fertilizer, whereas in intercropping, the increased yield was 194% and 185%, respectively (Table 5). The yield of onion with Bokashi in monoculture treatment (24.5 t ha⁻¹) is near the national average (28.2 t ha⁻¹) (SAGARPA, 2010), indicating that the use of this compost is favorable to support the production of onion. In contrast, the yield of jalapeño pepper did not vary significantly between fertilization treatments, and the yield that was attained with Bokashi plus VL in monoculture (1.9 t ha⁻¹) was lower than the national average (12 t ha⁻¹) (Lujan *et al.*, 2010). It is possible that the low yield obtained with jalapeño pepper was due to the presence of some diseases during early vegetative growth, such as cercospora leaf spot (*Cercospora capsici*), basal stem rot (*Phytophthora* spp.) and evil of the stem (*Fusarium* spp.). Although these diseases were controlled with the application of Bordeaux mixture, they may have influenced the early plant development.

In all fertilization treatments, jalapeño pepper and onion intercropping showed a greater

the LER compared with monocultures (Table 5), indicating a more efficient use of land in intercropping. A maximum LER of 1.55 for combined yield of onion and jalapeño pepper in intercropping with the application of Bokashi was attained. This LER indicates that the area planted in monocultures would need to be 55% greater than the area planted to the intercrop for the two to produce the same combined yield (Dariush *et al.*, 2006). Moreover, a LER higher than 1.0 indicates that the presence of positive inter-specific interference that exists in the mixture is not as intensive as the inter-specific interference that exists in the monoculture (Ahmed, 2012).

In conclusion, the fertilization with Bokashi increased the growth and weight of onion and jalapeño pepper plants. Additionally, Bokashi promoted higher diameter and weight of onion bulb, as reflected in the increase in yield. Bokashi plus Vermicompost Leachate (VL) increased capsaicin concentration in the fruit of jalapeño pepper and soluble solids in onion bulb. The Land Equivalent Ratio was higher than 1.0, indicating a more efficient land use with intercropping in comparison with the monoculture. Therefore, organic fertilization and intercropping are two agroecological management practices that favor the yield and quality of jalapeño pepper and onion with an efficient use of the land.

Table 5. Yield and Land Equivalent Ratio (LER) in pepper and onion plants cultivated as monoculture (M) or intercropping (I) using Bokashi and vermicompost leachate (VL) as organic fertilizers.

Organic fertilizers	Culture type	Yield (t ha ⁻¹)		Partial LER		LER
		Onion	Pepper	Onion	Pepper	
Bokashi	M	24.5±9.5 a ¹	1.6±0.8 a	0.72	0.83	1.55
	I	17.5±5.2 ab	1.3±0.4 a			
Bokashi + VL	M	23.5±8.4 a	1.9±1.1 a	0.72	0.62	1.34
	I	17.0±3.7 ab	1.3±1.0 a			
Control	M	6.9±1.4 b	1.4±0.7 a	0.87	0.67	1.54
	I	6.0±0.9 b	0.9±0.5 a			

¹Means (± SD) with different letters in the columns within each factor are significantly different (Tukey, P≤0.05).

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Resumen

J.D. Álvarez-Solís, J.A. Mendoza-Núñez, N.S. León-Martínez, J. Castellanos-Albores y F.A. Gutiérrez-Miceli. 2016. Efecto de bokashi y lixiviado de vermicomposta sobre el rendimiento y la calidad de chile (*Capsicum annuum*) y cebolla (*Allium cepa*) en monocultivo y cultivos asociados. Cien. Inv. Agr. 43(2):243-252. La fertilización orgánica y la asociación de cultivos son dos prácticas de manejo agroecológico con el potencial de optimizar el uso de la tierra en la producción hortícola. El objetivo de este estudio fue evaluar el efecto de Bokashi y Bokashi adicionado con Lixiviado de Vermicomposta (LV) sobre el crecimiento, rendimiento y calidad de chile jalapeño (*Capsicum annuum* L.) y cebolla (*Allium cepa* L.) cultivados en monocultivo y en policultivo. El experimento se realizó bajo condiciones de temporal en la comunidad Santa Rosa el Oriente, La Trinitaria, Chiapas. Se utilizó un diseño de bloques completos al azar con un arreglo de parcelas divididas con seis tratamientos y cuatro repeticiones por tratamiento. Bokashi incrementó significativamente el número de hojas y la altura de la planta en cebolla (37 y 62%) y chile jalapeño (33 y 94%) en comparación con las plantas control. En chile jalapeño y cebolla el contenido de capsaicina y sólidos solubles fueron 41 y 42% más altos con la aplicación de Bokashi adicionado con VL, respectivamente. En cebolla Bokashi incrementó 28, 69 y 269% los diámetros polar y ecuatorial y el peso del bulbo. Con la aplicación de Bokashi el rendimiento de cebolla incrementó de 6.4 a 21 t ha⁻¹. Se obtuvo una relación equivalente de tierra (RET) de 1.34 a 1.55, indicando que el policultivo fue ventajoso sobre el monocultivo, indistintamente del tipo de fertilización. Por lo tanto, la aplicación de Bokashi y la asociación de cultivos favorecieron el rendimiento y la calidad de chile jalapeño y cebolla con un eficiente uso de la tierra.

Palabras clave: Bokashi, Capsaicina, lixiviado de Vermicomposta, Relación Equivalente de Tierra, sólidos solubles.

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