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RESEARCH PAPER

Organomineral fertilizers potentiate Atlantic potato cultivation

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Abstract

R.C. Oliveira, J.M.Q. Luz, R.M.Q. Lana, G.O. Alves, R. Ferraz-Almeida, and R. Camargo. 2022. Organomineral fertilizers potentiate Atlantic potato cultivation. Int. J. Agric. Nat. Resour. 157-168. Analyses of potential sources and products that aim to balance nutrients in soil and plants; improve physical, mineral, and biological attributes of soil; and reduce environmental impacts require greater attention. Therefore, the aim of this study was to evaluate the agronomic efficiency of organomineral fertilizers (OMFs) in Atlantic potato cultivars. The experimental design was a randomized complete block design, with four treatments and six replicates. The treatments consisted of NPK mineral fertilizers (recommended according to soil analysis and nutritional crop requirements) as a control and NPK plus OMF according to composition and form of application (planting, ridging, and leaf), referred to as managements A and B, which indicate the amount of nutrients that the plants received. Therefore, treatments with OMF were designated as follows: P-OMF(A): organomineral fertilizer management applied through the planting furrow; PR-OMF (B): organomineral fertilizer management applied through the planting and ridging, and PR-OMF (B) + L-OMF (B): organomineral fertilizer management applied through the planting and ridging and by leaf application. The applications of P-OMF (A) and PR-OMF (B) + L-OMF (B) resulted in positive effects on special class production and total productivity of Atlantic potato tubers, which increased by 12% to 16% and 11% to 15.5%, respectively. The application of PR-OMF (B) + L-OMF (B) improved the soluble solid content by 2.7% compared to the control (absence of OMF application). Therefore, organomineral fertilizers have the potential to improve the quantitative and qualitative attributes of potatoes.

Keywords*:* fertilization, productivity, *Solanum tuberosum*, soluble solids.

Introduction

Potato (*Solanum tuberosum* L.) is an attractive crop in agricultural production because it has an extraordinarily high yield potential and is a good source of minerals, vitamins, antioxidants, protein, and fiber (Koch et al., 2020). It is the third main staple food in the world after rice (*Oryza sativa* L.) and wheat (*Triticum* spp.).

In Brazil, the average productivity of potato is 30.4 t ha^{-1} (IBGE, 2020). The high yield and commercial value of potato induce farmers to use

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high levels of farming inputs to increase tuber yield (Ierna et al., 2017). Among the factors that determine potato growth and yield, fertilization management stands out (Tiemens-Hulscher et al., 2014).

Fertilization management has a relevant impact on plant nutrition since well-nourished plants present horizontal resistance barriers to pests and disease attacks and improve morphophysiological features such as the wax layer and cell wall (Barbosa Junior et al., 2017). Despite the knowledge of high demand for inputs, there is still no specific fertilization recommendation for most potato cultivars, especially owing to the lack of information about their nutrient use efficiency in Brazil (Fernandes & Soratto, 2017).

Nutrients are provided in mineral forms and are readily available in the soil to facilitate absorption by the shallow root systems of potato varieties (Saravia et al., 2016). However, the long use of mineral fertilizers has caused irreparable damage to soil structures, mineral cycles, soil microbial flora, and plants (Solanki et al., 2015).

Concerns about the environment are a reflection of crop overfertilization, and the decline in the concentration of mineral nutrients in vegetables in recent years has increased the necessity of alternative cropping systems that are less dependent on mineral fertilization (Jahanzad & Park, 2017). Conversely, organominerals, biofertilizers, and biostimulants are potential environmentally friendly inputs that provide a low-cost approach for managing crop yield (Singh et al., 2016).

Organic composts and mineral fertilizers have many benefits in potato production, resulting in products from organic and mineral sources that feature improvements in the physical, mineral, and biological properties of soil (Cicatelli et al., 2014; Kammoun et al., 2017). The application of compost has resulted in significant improvements in potatoes.

The application of nutrients and compounds via leaves presents another interesting aspect of potato crop production since it allows supplementation of nutrients that can boost productivity (Braun et al., 2013), correcting possible nutrient deficiencies in soils and stimulating certain physiological stages of crops (Vajaria et al., 2018).

There have been few reports on the association of organic components with conventional mineral fertilizers in potatoes during their cycle and application form. Therefore, the aim of this study was to evaluate the agronomic efficiency of liquid organomineral fertilizers (OMFs) applied to leaves and soil on the productivity and quality of Atlantic potato tubers.

Material and Methods

The experiment was conducted using an Atlantic potato cultivar during the spring–summer of 2014 in Cristalina, state of Goiás, Brazil, which has a tropical and hot subhumid climate according to the Köppen classification system. Rainfall in this region occurs mostly during summer, and the area has an average annual temperature of 23 °C.

Soil mineral analysis was performed according to the method described by EMBRAPA (2011). The physical and chemical components of the 0-20 cm soil layer were as follows: pH (H_2O): 6.0; phosphorus: 14.0 mg dm^{-3}; potassium: 0.37 $cmol_c$ dm^{-3}; calcium: 5.8 $cmol_c$ dm^{-3}; magnesium: 0.8 $cmol_c$ dm^{-3}; aluminum: 0.0 $cmol_c$ dm^{-3}, cation and cation exchange capacity: 10.8 $cmol_c$ dm^{-3}; and base saturation: 64%.

The experimental design was a randomized complete block design, with four treatments and six replicates. The treatments consisted of (i) NPK mineral fertilizers (N: nitrogen; P: phosphorus; and K: potassium) recommended according to soil analysis and nutritional crop requirements as the control and (ii) NPK plus OMF according to composition and varying in form (planting, ridging, and leaf) and period of application. The periods of application refer to the time of application during the cycle of potato development. Managements A and B refer to the composition that the plants received.

Management A received total organic carbon, phosphorus, cobalt, and molybdenum, whereas management B received total organic matter, total organic carbon, nitrogen, potassium, calcium, sulfur, magnesium, boron, manganese, zinc, and copper. Therefore, treatments with OMF were designated as P-OMF (A): organomineral fertilizer management applied through the planting furrow; PR-OMF (B): organomineral fertilizer management applied through the planting and ridging; and PR-OMF (B) + L-OMF(B): organomineral fertilizer management applied through the planting and ridging and by leaf application. In the treatments, the management is described as follows: (i) P represents the planting application; (ii) PR represents the planting and ridging applications; and (iii) L represents the leaf/foliar application. The composition of the liquid fertilizers applied in the treatments is shown in Table 1.

In all treatments, the fertilization consisted of 2.3 t ha^{-1} 03-35-06 in planting and 350.0 kg ha^{-1} double sulfate of K and Mg in ridging. At 30, 45, and 60 days after planting, fertigation was applied via center pivot, with 50 kg ha^{-1} of urea, 6.0 kg ha^{-1} of magnesium sulfate, 3.0 kg ha^{-1} of manganese sulfate, and 1 kg ha^{-1} of zinc sulfate (Table 2).

The treatment P-OMF (A) received only the fertilizer with liquid organic matter applied at 1 L ha^{-1} through the planting furrow at 22 days after planting (DAP) (Table 2).

The PR-OMF (B) treatment received liquid organic matter (LOM fertilizer, soil; rate: 5.0 L ha^{-1}) and rooting-promoting fertilizer (rooted fertil-

Table 1. Composition of liquid fertilizers applied in treatments.

Fertilizer	Nutrients in Fertilizers (soluble in water, g L^{-1})				
LOM fertilizer (Soil)					
	Carbon	Nitrogen	Potassium		-
	126.5	115	11.5		-
LOM fertilizer (Foliar)					
	Carbon	Nitrogen	Potassium	Phosphorus	Cobalt
	75.6	25.2	-	37.8	3.78
Rooted fertilizer					
	Carbon	Nitrogen	Potassium		-
	184	126.5	11.5		-
Complexed foliar fertilizer					
	Carbon	Nitrogen	Potassium	Sulfur	Magnesium+Boron+Copper
	-	-	-	78.0	6.5
Mn/Zn foliar fertilizer					
	Carbon	Nitrogen	Potassium	Manganese	Zinc
	207	115	11.5	17.2	5.7
Ca/B foliar fertilizer					
	Carbon	Nitrogen	Potassium	Calcium	Boron
	-	-	-	104.0	24.0
N/K foliar fertilizer					
	Carbon	Nitrogen	Potassium		-
	-	45	450		-
Mg/S foliar fertilizer					
	Carbon	Nitrogen	Potassium	Magnesium	Sulfur
	-	-	-	49.6	62.0

LOM: liquid organic matter; phosphorus in $P2O_5$; potassium in K_2O.

Table 2. Soil management during the experiment.

Soil managements	Days after planting
P-OMF (A)*	
i- Urea, Magnesium sulfate, Manganese sulfate, and Zinc sulfate	30, 45, and 60
ii- LOM fertilizer, soil	22
PR-OMF (B)	
i- Urea, Magnesium sulfate, Manganese sulfate, and Zinc sulfate	30, 45, and 60
ii- LOM fertilizer, soil + Rooted fertilizer	0
iii- LOM fertilizer, soil	22
PR-OMF (B) + L-OMF (B)	
i- Urea, Magnesium sulfate, Manganese sulfate, and Zinc sulfate	30, 45, and 60
ii- LOM fertilizer, soil + Rooted fertilizer	0
iii- LOM fertilizer, soil	22
iv- Complexed foliar fertilizer Mn/Zn foliar fertilizer Ca/B foliar fertilizer	34 and 48
v- Mn/Zn foliar fertilizer Ca/B foliar fertilizer N/K foliar fertilizer Mg/S foliar fertilizer	60 and 90
vi- Mn/Zn foliar fertilizer N/K foliar fertilizer Mg/S foliar fertilizer	80
vii- Ca/B foliar fertilizer N/K foliar fertilizer	104

* P-OMF (A): organomineral fertilizer management applied through the planting furrow; PR-OMF (B): organomineral fertilizer management applied through the planting and ridging, and PR-OMF (B)+ L-OMF (B): organomineral fertilizer management applied through the planting, ridging and by leaf application.

izer; rate: 0.7 L ha^{-1}) through the planting furrow on the planting day. An additional rate of 3.0 L ha^{-1} of LOM fertilizer, soil was applied through the ridging at 22 days after planting (Table 2).

The PR-OMF (B) + L-OMF (B) treatment received the same amount as PR-OMF (B) with liquid organic matter (LOM fertilizer, soil; rate: 5.0 L ha^{-1}) and rooting-promoting fertilizer (rooted fertilizer; rate: 0.7 L ha^{-1}) through the planting furrow on the planting day. An additional rate of 3.0 L ha^{-1} of LOM fertilizer, was applied through the ridging at 22 days after planting. At 38 and 48 days after planting, rates of 2.0 L ha^{-1} of complexed fertilizer, 1.0 L ha^{-1} foliar Mn/Zn, and 1.0 L ha^{-1} of Ca/B foliar fertilizer were applied. At 60 and 90 DAP, the following fertilizers were applied using Mn/Zn foliar fertilizer (rate: 1.0 L ha^{-1}), Ca/B foliar fertilizer (rate: 1.0 L ha^{-1}), N/K foliar fertilizer (rate: 2.0 L ha^{-1}), and Mg/S foliar fertilizer (rate: 1.0 L ha^{-1}). The applications continued at 80 DAP with Mn/Zn foliar fertilizer (rate: 1.0 L ha^{-1}), N/K foliar fertilizer (rate: 1.0 L ha^{-1}), and Mg/S foliar fertilizer (rate: 1.0 L ha^{-1}). Finally, at 104 DAP, Ca/B foliar fertilizer (rate: 1.0 L ha^{-1}) and N/K foliar fertilizer (rate: 12.0 L ha^{-1}) were applied, as outlined in Tables 1 and 2.

The experimental plots consisted of five rows of 6.0 m each spaced 0.8 m apart, resulting in a total area of 24.0 m² per plot. Evaluations were carried out in two central rows. Soil preparation was performed according to the recommendation for potato cultivation, which is plowing, followed by trenching/levelling, and then opening of the furrows. The phytosanitary treatment used was the same as that used for commercial production of potatoes and was applied as needed, following integrated pest, disease, and weed management (Lopes et al., 2016; Nava & Diez-Rodríguez, 2016; Silva, 2016). The irrigation system used was aspersion in a central pivot. The plants received approximately 500 mm of water during the cycle, close to the volume of water indicated for cultivation, which varies from 450 to 550 mm.

At 68 DAP, leaf sampling was collected from the third fully developed trefoil, where 10 leaves were collected per plot, packed in paper bags, and sent to the laboratory for leaf analysis. Leaf tissue samples were composed of complete leaves (limbus + petiole), as recommended by CFSEMG (1999).

The samples were oven dried with forced air circulation (65 °C ± 5 °C). After drying, they were ground and submitted for determinations of macro- and micronutrients according to the methodology proposed by EMBRAPA (1999).

At the end of the experiment, at the time of potato harvest (131 DAP), the productivity of each treatment was determined. It is worth mentioning that the harvest would have been performed from 120 days, but the high precipitation conditions in the area did not allow harvesting.

The values of tubers produced in each plot were obtained by weighing and were expressed to one hectare. The size of the tubers of the Atlantic cultivar was classified according to the standards of industrialization: special (diameter greater than 42 mm); first (between 42 and 33 mm); second (less than 33 mm); discard (rotten, green, with nematodes, mechanical damage, etc.); and commercial total (special + first + second).

The soluble solid content was determined using the densimeter technique. In this technique, a tuber sample (3.63 kg) of each plot was immersed in a tank with a capacity of 100 L of water. The wet weight was obtained by calculating the specific weight of the sample, which is the content of soluble solids as a percentage.

The data obtained were subjected to analysis of variance using the F test at 5%. Multiple mean comparisons were performed with Tukey's test using Sisvar® statistical software.

Results

The contents of nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur ranged from 41.0 to 42.4; 2.1 to 2.4; 48.0 to 53.0; 16.0 to 18.0; 10.2 to 10.7; and 3.2 to 3.7 g kg^{-1}, respectively. The contents of boron, iron, copper, zinc, and manganese ranged from 32.0 to 39.0; 52.0 to 62.0; 241.0 to 318.0; 181.0 to 208.0; and 32.0 to 40.0 g kg^{-1}, respectively (Table 3).

Except for the macronutrient phosphorus, in all evaluated treatments, the contents of macronutrients and micronutrients were within the ideal ranges for potato cultivation according to Lorenzi et al. (1997) (Table 3).

The results indicated that the plants were cultivated under high nutrient availability, and there was no limitation to their adequate absorption. OMF supplementation was favorable, especially for micronutrients via foliar application, owing to the impact of high nutrient absorption on culture development (Table 3).

The components present in OMF, formed by nutrients, organic matter, and organic carbon, contributed to the effective productivity in the present experiment. These components possibly promoted a balance between the nutrients, each with its enzymatic and metabolic functions. Compared to the control, P-OMF(A) resulted in a 12% increase in the productivity of the special class, and PR-OMF (B)+ L-OMF (B) resulted in a 16% increase (Fig. 1).

For the first, second, and discard classes, the additive handling for physiological improvements did not differ among them, ranging from 2.05 to 1.78, 0.43 to 0.51, and 1.09 to 1.49 t ha^{-1}, respectively (Fig. 1).

For total commercial productivity, the same inferences for the special class can be considered. Compared to the control, the OMF applied was assimilated by the plants with yield returns of 11% and 15.5% when P-OMF (A) and PR-OMF (B)+ L-OMF (B) were applied, respectively (Fig. 2).

Table 3. Contents of macronutrients (nitrogen, N; phosphorus, P; potassium, K; calcium, Ca; magnesium, Mg; sulfur, S) and micronutrients (boron, B; iron, Fe; copper, Cu; zinc, Zn; manganese, Mn) in the leaves of Atlantic potatoes under management with organomineral fertilizer (OMF)

Treatments*	Macronutrient content (g kg^{-1})					
	N	P	K	Ca	Mg	S
Control (NPK)	42.4	2.2	51.5	17.0	10.4	3.2
P-OMF (A)	41.0	2.1	53.0	16.0	10.3	3.5
PR-OMF (B)	41.7	2.1	48.0	16.0	10.2	3.7
PR-OMF (B)+ L-OMF (B)	41.7	2.4	49.0	18.0	10.7	3.5
Average	41.7	2.2	50.4	16.8	10.4	3.5
	Micronutrient content (mg kg^{-1})					
	B	Fe	Cu	Zn	Mn	
Control (NPK)	32	52	241	184	35	
P-OMF (A)	35	54	287	181	37	
PR-OMF (B)	37	58	285	188	32	
PR-OMF (B)+ L-OMF (B)	39	62	318	208	40	
Average	35	56	282	190	36	

* P-OMF (A): organomineral fertilizer management applied through the planting furrow; PR-OMF (B): organomineral fertilizer management applied through the planting and ridging; and PR-OMF (B) + L-OMF (B): organomineral fertilizer management applied through the planting and ridging and by leaf application.

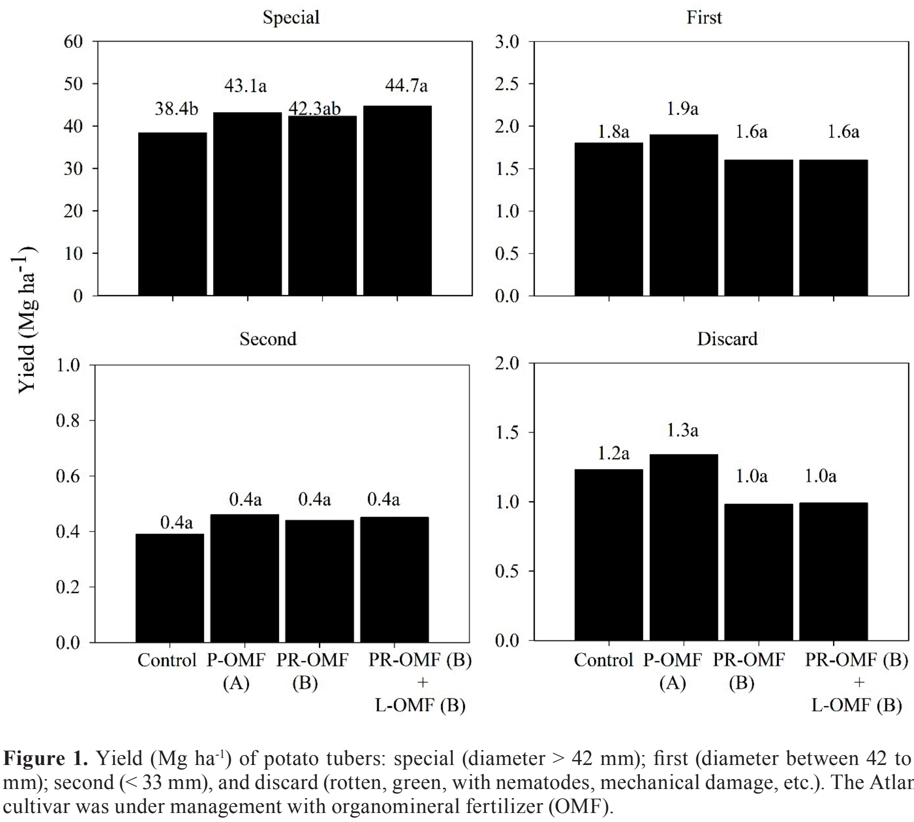

Figure 1. Yield (Mg ha^{-1}) of potato tubers: special (diameter > 42 mm); first (diameter between 42 to 33 mm); second (< 33 mm), and discard (rotten, green, with nematodes, mechanical damage, etc.). The Atlantic cultivar was under management with organomineral fertilizer (OMF).

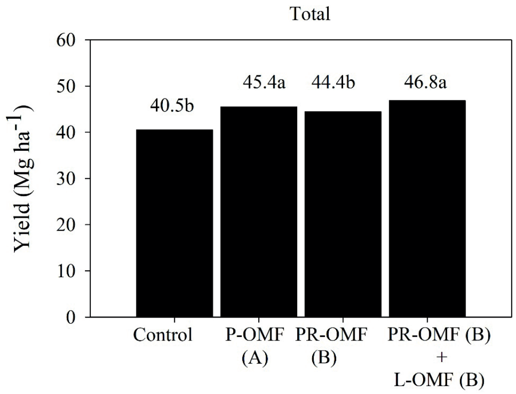

Figure 2. Total yield, commercial, (Mg ha^{-1}) of Atlantic potato tubers (special + first + second) under management with organomineral fertilizer (OMF).

*Treatments followed by the same letter do not differ from each other based on Tukey's test at 5%.

**P-OMF (A): organomineral fertilizer management applied through the planting furrow; PR-OMF (B): organomineral fertilizer management applied through the planting and ridging; and PR-OMF (B)+ L-OMF (B): organomineral fertilizer management applied through the planting and ridging and by leaf application.

The soluble solid content was also positively influenced by foliar products containing nutrients and other components, such as PR-OMF (B)+ L-OMF (B), with an average of 17.1% of total soluble solids (Fig. 3).

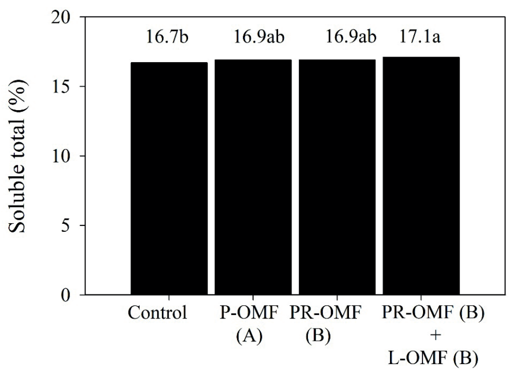

Figure 3. Soluble solid contents (%) of Atlantic potato tubers under management with organomineral fertilizer (OMF).

* Treatments followed by the same letter do not differ from each other based on Tukey's test at 5%.

* P-OMF (A): organomineral fertilizer management applied through the planting furrow; PR-OMF (B): organomineral fertilizer management applied through the planting and ridging; and PR-OMF (B)+ L-OMF (B): organomineral fertilizer management applied through the planting and ridging and by leaf application.

The most appropriate treatment will depend on openness to investment and the price of potatoes in the market. The cost of OMF that represented the best Atlantic cultivation performance was P-OMF (A), with a return of 4.5 Mg ha^{-1} of tubers, costing $ 25.8 ha^{-1}, and PR-OMF (B) + L-OMF (B), with a return of 6.3 Mg ha^{-1} of tubers and 0.5% soluble solid content, costing $ 115.30 ha^{-1} (Table 4).

Table 4. Cost of foliar supplementation with OMF fertilizers

Treatments*	Price (US$ ha^{-1})
P-OMF (A)	25.80*
PR-OMF (B)	28.30
PR-OMF (B) + L-OMF (B)	115.30

* P-OMF (A): organomineral fertilizer management applied through the planting furrow; PR-OMF (B): organomineral fertilizer management applied through the planting and ridging, and PR-OMF (B)+ L-OMF (B): organomineral fertilizer management applied through the planting and ridging and by leaf application.

In periods of favorable market quotations, investments in quantity and quality are compensatory. For qualitative factors, large investments with OMF inputs respond significantly. However, for quantitative factors, the results obtained from plantings involving the application of only P-OMF (A) are adequate (Table 4).

Discussion

Although P-OMF (A) contains the element P, a quantity considered high, which was applied in this study, did not reach the lower threshold considered suitable for potatoes (Lorenzi et al., 1997). This outcome may be due to the dynamics of P in the soil, in which 95% of the total P uptake by the root surface occurs via diffusion (Liu et al., 2015), and P absorption is highly dependent on the characteristics of root systems (Lopes et al., 2021; Zavaschi et al., 2020).

Although an increase in P concentration in soil solution increases its availability and consequently its absorption, as reported by Fernandes and Soratto (2012), it is worth mentioning that the balance between the contents of all nutrients has a greater impact on productivity than the adequacy to an ideal range. In the present study, the content below that recommended for P did not negatively affect productivity, which was even higher than the average found for the cultivar, indicating good management of the other aspects (crop protection) and a good balance observed among the other nutrients.

The stoichiometry between the nutrients involved has been studied and generated important information to explain the absorption and distribution of nutrients in plants (Wang et al., 2014). The understanding of nutrient metabolism in plant tissue and their interactions with organic fractions can guide the adoption of more rational and efficient management of nutrients and help highlight the relevance of considering nutrients and other factors together, as observed by the appropriate balance of nutrients in the present work.

The association between organic acids and nutrients was favorable to the productivity of the class with the highest commercial value and total productivity. The results of the application of OMF to the productivity of several species have been reported in the literature (Ferreira et al., 2022; Oliveira et al., 2022), including potato cultivation with pelleted OMF (Cardoso et al., 2015) and liquid OMF (Souza et al., 2017). Cardoso et al. (2017) applied pelleted OMF in planting and observed a 22% higher productivity than mineral fertilizer, which corroborates the results obtained in the present study.

Organic components are associated with a range of factors and interrelations in the soil, depending on the composition, degree of decomposition, and association with the nutrients in the products (source material) and those in the soil (crop residues from the last crops in the area). These associations result in a heterogeneous composition and consequently different mineralization dynamics (Illera-Vives et al., 2015).

The decomposition of humic acids contained in the organic fraction of the fertilizer can stimulate the activity of soil microorganisms around the root, facilitating the release of nutrients (Cardoso et al., 2017), which is considered a main advantage compared to mineral fertilizers (Ferraz-Almeida et al., 2019).

The application of OMF has many advantages: it improves soil life by improving soil fertility (Ayeni et al., 2012), increases water retention through high water-holding capacity, binding organic compounds (Hirich et al., 2014), and improves drought stress tolerance (El-Mageeda et al., 2015). According to Yao et al. (2015) and Vitale et al. (2017), the dynamics of OMF in soils reflect a reduction in N_2O emissions as a consequence of slow mineralization of organic components, contributing to better nutrient use efficiency by plants. All these functions help to improve the conditions of the soil environment, resulting in better plant and crop growth.

The mixing of several products with different sources and nutrients can promote deleterious effects in the production of potatoes, as reported by Souza et al. (2017). Soil contents, absorption capacity of crops, and the quantity contained in each product are extremely important since the imbalance between nutrients can generate competition in absorption sites, compromising the metabolic potential of plants.

The soluble solid content was also positively influenced by foliar products containing nutrients and other components. High total solid content provides high yields in the production of potato chips, as there is less oil retention during frying, improving the texture, color, and flavor of the final product (Fernandes et al., 2010). Products that allow the expression of good genetic attributes should be stimulated, as they have important effects on the final quality of the products.

Therefore, the application of organic components at appropriate rates should be considered a longterm investment and an integrative action of ecosystem components, which return to improve crop quality in subsequent crops.

Conclusion

The applications of P-OMF (A) and PR-OMF (B)+ L-OMF (B) had positive effects on special class tubers and the total productivity of tubers of the Atlantic cultivar, with increases between 12% and 16% and 11% and 15.5%, respectively. The application of PR-OMF (B) + L-OMF (B) improved soluble solid contents by 2.7% compared to the control (absence of OMF application). Therefore, organomineral fertilizers have the potential to improve the quantitative and qualitative attributes of potatoes.

Disclosure statement

The authors declare that they have no personal, commercial, academic, political, or financial conflicts of interest.

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Resumen

R.C. Oliveira, J.M.Q. Luz, R.M.Q. Lana, G.O. Alves, R.F. Almeida, y R. Camargo. 2022. Los fertilizantes organominerales potencian el cultivo de papa Atlantic. Int. J. Agric. Nat. Resour. 157-168. El análisis de las posibles fuentes y productos que apuntan a equilibrar los nutrientes en el suelo y las plantas, mejorar los atributos físicos, minerales y biológicos del suelo y reducir los impactos ambientales necesitan más atención. En este sentido, el objetivo de este estudio fue evaluar la eficiencia agronómica de los fertilizantes organominerales (OMF) en papa, cultivar Atlantic. El diseño experimental fue un bloque completo aleatorizado, con cuatro tratamientos y seis repeticiones. Los tratamientos consistieron en el control -fertilizantes minerales NPK (recomendado de acuerdo con el análisis del suelo y los requerimientos nutricionales del cultivo); y NPK más OMF de acuerdo con: composición y forma de aplicación (plantación, crestas y hojas), que fue llamado a lo manejo A y B. Lo manejo A y B se relaciona con las tasas de nutrientes que recibieron las plantas. Por lo tanto, los tratamientos con OMF se designaron como: P-OMF (A): manejo de fertilizantes organominerales (A) aplicado en el surco de siembra; PR-OMF (B): manejo de fertilizantes organominerales (B) aplicada en la siembra y la formación de surcos y PR-OMF + L-OMF (C): manejo de fertilizantes organominerales (B) aplicada en la siembra, la formación de surcos y la aplicación de hojas. Las aplicaciones de P-OMF (A) y PR- PR-OMF (B)+ L-OMF (B) dan como resultado una acción positiva para la producción de Clase Especial y la productividad total de los tubérculos del cultivar Atlantic, con incrementos entre 12 y 16% y 11 a 15.5%, respectivamente. La aplicación de PR-OMF (B)+ L-OMF (B) mejora en un 2.7% el contenido de sólidos solubles, en comparación con la ausencia de aplicación de OMF. Por lo tanto, los fertilizantes organominerales presentan potencial para mejorar los atributos cuantitativos y cualitativos de las papas.

Palabras clave: fertilización, productividad, *Solanum tuberosum*, sólidos solubles.

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