USE OF ORGANOMINERAL FERTILIZERS IN AGRICULTURE: POTENTIALITY, PRODUCTION AND BENEFITS

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ABSTRACT – Organomineral fertilizers are the combination and / or mixture of organic fertilizers with mineral fertilizers. This combination provides the necessary nutrients for the development of the crops, being the organic matter, an enhancer of these minerals, besides an aggregator in the improvement of the physical, chemical and biological properties of the soil. The objective of this work was to highlight the potential, production and benefits of using organominerals in crops, such as: lettuce, arugula, tomatoes, soybeans, coffee, corn, cowpea, potatoes, sugar cane, eucalyptus, wheat and sesame. It is noteworthy that numerous studies prove the effectiveness of these fertilizers in crops, aiming at numerous agronomic parameters. In addition to the environmental liability, it can generate a lot of revenue with this product with growth potential in the world agricultural market.

Keywords: fertilizing, soils, phosphor, agribusiness

USO DE FERTILIZANTES ORGANOMINERAIS NA AGRICULTURA: POTENCIALIDADE, PRODUÇÃO E BENEFÍCIOS

RESUMO – Fertilizantes organominerais são a combinação e/ou mistura de fertilizantes orgânicos com fertilizantes minerais. Essa combinação fornece os nutrientes necessários para o desenvolvimento das culturas, sendo a matéria orgânica, um potenciador desses minerais, além de um agregador na melhoria das propriedades físicas, químicas e biológicas do solo. Objetivou-se com esse trabalho, evidenciar as potencialidades, a produção e os benefícios do uso de organominerais nas culturas, como: alface, rúcula, tomate, soja, feijão, café, milho, feijão-caupi, batata, cana-de-açúcar, eucalipto, trigo e gergelim. Vale ressaltar que inúmeros estudos comprovam a eficácia desses fertilizantes em cultivos, visando inúmeros parâmetros agronômicos. Além do passivo ambiental, podendo gerar bastante receita com esse produto com potencial de crescimento no mercado agrícola mundial.

Palavras-chave: fertilização, solos, fósforo, agronegócio

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INTRODUCTION

Organic fertilizers are sediments of animal and plant origin and may be liquid or solid, which is destined to fertilize the soil (KIEHL, 2013). It demonstrates numerous advantages in improving the quality of the soil, besides having a low cost of production, having an environmental liability due to the reuse. These fertilizers need to be mineralized by the action of microorganisms present in the soil, forming the hummus, being the source of nutrients for the absorption of plants (JENKINSON & LADD, 1981; FERREIRA et al. 2017).

Inorganic or mineral fertilizers are residues derived from ores, composed by nitrogen, phosphorus and potassium (KIEHL, 2013), with the use of nitrogen fertilizers, the presence of ammonia, in phosphate fertilizers, superphosphates, thermophosphates and phosphates in general, and potassic fertilizers, potassium chloride and potassium sulphate, the forms being assimilated by plants.

A promising option is the use of organic waste in the production of organomineral fertilizers (MARTINS et al., 2017). Organomineral fertilizers are the combination and/or blend of organic fertilizers fortified with mineral fertilizers. Loss of nutrients such as nitrogen, phosphorus, and potassium are reduced by the presence of the organic matter present in the organic fertilizer, which is a protection for these nutrients.

In addition, this combination provides the necessary nutrients for the development of the crops, being the organic matter, a potentiator of these minerals, as well as an aggregator in the improvement of the physical (SILVA et al., 2012), chemical and biological properties of the soil (EMBRAPA, 2019).

To regulate the production, labeling, and distribution of organomineral fertilizers, it is necessary to adopt the guidelines contained in Normative Instruction No. 25 of July 28, 2009, of the Ministry of Agriculture, Livestock and Food Supply (MAPA, 2009).

The organomineral fertilizers shall have the specifications, guarantees, and characteristics: guaranteed or declared primary, secondary and micronutrient macronutrients of the product, these shall have at least: for products with primary macronutrients produced and marketed separately (N, P, K) or in mixtures (NP, NK, PK or NPK): 10%, 30% maximum moisture, minimum cation exchange capacity (CEC) of 80 mmolc kg\(^{-1}\) and total organic carbon of at least 8%, these products are added secondary macronutrients or micronutrients (TRANI et al., 2013).

However, the objective of this literature review was to observe the production and potential of the use of organomineral fertilizers in various cultures, proving their effectiveness and benefits, as a promising option.

According to Kiehl (2013), the production of organomineral fertilizers in the factories can be carried out in the scheme described in Figure 1.

\[\text{Defined formula and weighing of raw materials} \rightarrow \text{Forwarded to mixer} \rightarrow \text{The mixture is conveyed to a gravity-discharged silo or tank}
\]

\[\downarrow \]

\[\text{Organomineral sent to bagger (powder) and granules will have the mixture destined to the granulator} \rightarrow \text{The granulating apparatus will receive the mixture, where an atomized water jet will be applied under high pressure}
\]

\[\downarrow \]

\[\text{The fertilizer in the form of powder passes to a granulated organomineral} \rightarrow \text{As a result of the water jet application of the previous stage, the water applied is removed by means of a rotating cylindrical dryer}
\]

\[\downarrow \]

\[\text{The granulated organomineral fertilizer should have about 10 and 20\% moisture in order to be bagged without causing jamming in the bagger}
\]

\[\downarrow \]

\[\text{From the dryer, the still hot fertilizer goes to the cooler, where it will lose heat it still had} \rightarrow \text{From the cooler, the fertilizer goes to the bin of the bagger.}
\]

\[\downarrow \]

\[\text{The bagger receives the fertilizer from the bag hopper silo, which is usually used with 50 kg bags without seams} \rightarrow \text{From the bagger, the sacarias are sent to the product depot}
\]

\[\downarrow \]

\[\text{The product is now ready to be marketed}
\]

**Figure 1.** Commercial production of organomineral fertilizers. Source: Kiehl (2013)

It is worth mentioning that it is necessary to observe the legislation during the production of the fertilizer. This means that each sack of the fertilizer must have on the label or in a label the factory data and weighing of raw materials.
parameters referring to the type of organomineral guaranteed by the producer.

An alternative to produce organic waste produced in the means of organomineral fertilizers by production of the properties (Figure 2).

Figure 2. Production of organomineral fertilizers produced by the producer, aiming to use the residues from the property. Source: Ventura (2019).
In Figure 3, we have an organomineral fertilizer produced with organic residues from a property. It is noted that an ideal material was obtained to be placed in the planter.

![Organomineral fertilizer produced from was ready to be used in a planter.](image)

**Figure 3.** Organomineral fertilizer produced from waste from a property, ready to be used in a planter.

The benefits of organomineral fertilizer are evident in soil properties, as well as their potential in agricultural crops. With this, we address the potentialities and influences of this fertilizer in several crops, which are economically important in the Brazilian agribusiness.

**Organomineral in lettuce (Lactuca sativa L.)**

Lettuce is native to Europe and Western Asia, which belongs to the Asteraceae family, is now considered the most important leafy vegetable in Brazil, as a result of being the most consumed. A small stem plant in which the leaves are flat or curly, and may or may not form the head, showing several greenish tones (COSTA et al., 2018). In the work of Kawamoto et al. (2018), when evaluating the association of organomineral fertilizers class A foliar, Biocontrol-O® and Alpha X 35 - O® in the production of lettuce seedlings, with two double factorial trials with four doses and two products, observed the use of organomineral fertilizers applied via leaf in lettuce seedlings promotes an increase in height, fresh shoot, and root mass. Luz et al. (2010), demonstrated that in general, the organomineral fertilizers promoted a greater development of the seedlings in relation to the treatment without any application of fertilizer.
Organomineral in arugula (*Eruca sativa* L.)

Arugula is a brassica of the Brassicaceae family, originating in the Mediterranean and Western Asia, whose leaves are much appreciated in the form of salad. In Brazil, its production and consumption are prominent in the South, Southeast and Northeast, generating employment and income for family agriculture (SILVA et al., 2012).

In the work of Oliveira et al. (2018), when evaluating the effect of organic carbon from a liquid organomineral fertilizer on the initial development of rocket seedlings, with one trial being four doses of liquid fertilizer and two sources (organomineral and zinc sulfate) and a control treatment without application, observed that application of the liquid organomineral fertilizer provides increase in root length, number of leaves, dry shoot mass, root dry mass, chlorophyll A content and total chlorophyll content of rocket seedlings, compared to zinc sulfate, such a positive result of the fertilizers is linked to the benefits of the composition of these fertilizers.

Organomineral in soybean (*Glycine max* L.)

The cultivation of soy is an economically important crop worldwide, due to the demand for products originating from grains. This demand is observed due to the geographical need, and from that, we aim to reduce input costs and increase productivity.

In the work of Borges et al. (2015), when evaluating the yield of soybean and maize grains as a function of the management of fertilization with organic residues and mineral fertilization, testing control (without fertilization), mineral fertilization and organomineral: fertilization with refrigerated residue (1 t ha\(^{-1}\)); fertilization with refrigerator residue (2 t ha\(^{-1}\)); fertilization with refrigerated residue (3 t ha\(^{-1}\)); fertilization with refrigerated residue (4 t ha\(^{-1}\)); fertilization with poultry litter (1 t ha\(^{-1}\)); fertilization with poultry litter
(2 t ha<sup>-1</sup>); fertilization with poultry litter (3 t ha<sup>-1</sup>); fertilization with poultry litter (4 t ha<sup>-1</sup>), concluded that soybean yield increased with the application of increasing doses of organic residues, that the average yield of soybean grains with fertilization of chicken litter was higher the average yield of grains with refrigerator residue and the lowest yields of soybean were observed in the soil that did not receive any fertilization.

The use of the poultry litter can demonstrate a benefit of environmental liabilities, as well as to realize the fertilization of the soil and increase in the production, besides improvement of the properties of the soil due to the organic matter. The use of it may be economically viable in the production of soybeans, depending on availability, dose and price in the region, as a result of transportation in Brazil to increase the value of the product, Ribeiro et al. (2009) and Ghosh et al. (2009) they emphasize that the physical, chemical and biological advantages in the soil are not limited to the year of application of the residue.

In the work of Toledo et al. (2017), when evaluating the response of common bean to the application of organic, organomineral and mineral fertilizers in Red Latosol Eutroferric, testing mineral, organomineral and organic fertilizers in different doses, with the addition of a control treatment, observed that organomineral and organic fertilizers with sheep manure) determined the highest productivity of common bean and that can substitute the mineral fertilization in the production of the common bean. Fernández-Luqueño et al. (2010) and Galbiatti et al. (2011), observed a positive effect of organic fertilization compared to mineral fertilizers and Martins et al. (2015), observed productivity equivalent to organic fertilization with the mineral.

In the work of Nakayama et al. (2013), in evaluating and comparing the efficiency of organomineral fertilizer with mineral fertilizer in the vegetative development and productivity of the bean (<i>Phaseolus vulgaris</i> L.) under no-tillage system, by testing mineral fertilizer, 08-28-16 - 200 kg ha<sup>-1</sup>, the other with organomineral fertilizers in decreasing plots, 04-14-08+MO – 250 kg ha<sup>-1</sup>; 04-14-08+MO – 200 kg ha<sup>-1</sup>; 04-14-08+MO – 150 kg ha<sup>-1</sup>, and 04-14-08+MO – 100 kg ha<sup>-1</sup>, concluded that in the organomineral fertilizer presented the highest productivity before the mineral (chemical), due to the nutritional availability and benefits associated with the improvement of the chemical, physical and

Organomineral in common bean (<i>Phaseolus vulgaris</i> L.)

The common bean belongs to the genus <i>Phaseolus</i> spp., originating in the Americas, being an agricultural product very used in human food, having socioeconomic importance, due to the generation of jobs in its production.

biological properties of the soil. Similar results were observed by Ferreira et al. (2009), who concluded that the use of organomineral fertilizers provided significant increases in the production components (grain mass per plant and 1,000 grains, number of pods per plant and final yield) of the bean.

In addition to the superiority of organomineral fertilizers, in some trials, such as Anjos et al. (2017), observed that organominerals used in conjunction with NPK fertilization increased leaf area index and dry matter index of common bean stems.

**Organomineral in coffee (Coffea arabica L.)**

Coffee production is one of the main agricultural activities around the world (SUÁREZ et al., 2016). Its production is highlighted in countries of the tropical region such as Brazil, Colombia, and Mexico, and as a result, are the largest producers in the world scale, being one of its sources of export (CHAPAGAIN & HOEKSTRA, 2007). Brazil is currently the largest exporter of green coffee, with 30% of the total marketed (NISHIJIMA et al., 2012).

In the work of Fernandes et al. (2017), Fertium Phosphorus recovery efficiency in relation to the use of conventional fertilizers, testing four doses of Fertium Phós (100% of the need, 75% of the need of the plants, 50% of the need of the plants, 25% of the plants), associated or not with organic matter source and three additional treatments (controls), being 100% of the need via Super Simple Phosphate (SSP), 100% of the need via SSP plus an organic source, besides a treatment that did not receive phosphorus, observed that the use of the total dose of Fertium Phós increased the phosphorus content, and the dose of 100% of the plant needs to increase the fresh and dry matter of the coffee plants and Fertium Phós showed a tendency to be more efficient in providing phosphorus to plants that simple superphosphate associated or not with corral manure.

In the work of Santinato et al. (2016), (12% N and 13% S) and Vitfértil 8 (8% N, 4% P, 8% K and 8% S), concluded that there was a tendency increased productivity using organomineral fertilizers compared to exclusively mineral fertilizers.

In the work of Nascentes et al. (2016), in evaluating the effect of the use of VALORIZA® organomineral fertilizer, on first crop coffee after planting, on the vegetative development, plant productivity and nutritional parameters of the crop, testing organomineral and mineral fertilization at doses of 50%, 75% and 100% in recommended that the organomineral VALORIZA®, maintained a good fertilization, raising macro and micronutrient contents in the soil and leaf, maintaining a good nutritional maintenance of the plants and superior yield when compared to half the dose of mineral fertilization, and similar with the other doses of the mineral, being necessary,
more studies or cultures in several years to prove the efficiency of the organomineral and its influence in the production.

**Organomineral in corn (Zea mays L.)**

Corn is cultivated worldwide, belonging to the Poaceae family, being this cereal one of the main sources of human food, currently in several regions as subsistence, besides animal feed, due to the nutritional qualities (BORÉM & GIÚDICE, 2004).

In the work of Malaquias & Santos (2016), when evaluating parameters of productivity in relation to the behavior of the use of strictly chemical and conventional fertilization, opposing organomineral fertilization, aiming at sustainable development, supply, solubilization and residual effect of nutrients in the soil, reuse of by-products and production costs, aiming at dilution of costs for the producer, the benefits of the use of organominerals were concluded, due to the combination of organic residues with mineral sources, aiming their use in perennial or annual commercial crops with high added value, besides the use of organominerals present physical characteristics, chemical and biological resources, providing organic matter to the soil, improving fertility, structure, aeration and water retention, and the organomineral becomes economically viable to transform organic wastes and waste from agent of the condition of polluters into products conditioning of the physical aspects of the soil and providing nutrients to the plants, aiming at reducing the use of mineral fertilizers, contributing to environmental conservation.

In the work of Machado et al. (2016), when comparing the effect of organomineral fertilizer with mono-ammonium phosphate (MAP), on the growth of corn plants, it was concluded that organomineral fertilizer presented higher efficiency than MAP in sandy soil. The benefits and influence of organic residues on the crop.

**Organomineral in the cowpea (Vigna unguiculata (L.) Walp.)**

Cowpea has attracted interest from medium and large farmers, increasing the spread of this crop to other regions. Such culture has a prominence in the poorest regions of Brazil, due to the low cost of production, high protein value and adaptability to different climates (REIS et al., 2018).

In the work of Melo et al. (2009), when evaluating the impact of the use of organic fertilizer on the chemical characteristics of the soil and the productivity of the cowpea, the manure dose was significantly increased yield by 101%, in addition to contributing to improve the chemical characteristics of the soil and increase the availability of nutrients for absorption by plants.

In the work of Pereira et al. (2013), when evaluating the production of common

bean cowpea submitted to different sources and doses of organic fertilizers, testing cattle manure, goat manure and earthworm humus, in different doses, observed the bean obtained higher production when soil worm humus was incorporated in the soil, however, cattle manure is also efficient in production, using smaller doses. Such results reinforce the benefits and potential of using isolated residues but added with mineral fertilizers, which can bring much better results within cowpea.

Organomineral in potato (*Solanum tuberosum* L.)

Potato is the third most important food crop in the world, following wheat (*Triticum spp.*) and rice (*Oryza sativa*) (AGRIANUAL, 2014). It is an herbaceous plant whose commercial product is the tubers that are modified stems that store reserves and need imposed for the perpetuation of the species (Cardoso et al., 2015), being its origin in the Cordillera of the Andes (Filgueira, 2008; Fernandes et al., 2010), being that according to Miranda Filho et al. (2003), Brazilian climatic conditions allow planting all year round.

In the work of Souza et al. (2017), when evaluating the agronomic efficiency of organomineral fertilizers in potato, testing the organominerals Acorda + Aminosan + Fitofert; Fitofert; Agrees and a witness who received only conventional fertilization of NPK, concluded that Acorda product applied in the furrow of planting favors the increase of productivity.

Organomineral in sugarcane (*Saccharum officinarum* L.)

Sugarcane is a semi-perennial species of the Poaceae family. It presents itself as an important crop, providing not only food but also renewable energy, in addition, it is possible to envisage an even more promising future in the economic, social and environmental field for the planet (MORAES et al., 2017). Currently, Brazil is the largest producer of sugarcane (CONAB, 2017) with an estimate for the 2017/18 harvest season of 8.4 million hectares with an estimated production of 647.63 million tons (MAPA, 2018).

The work of Garcia et al. (2018), the effect of phosphorus fertilization on the production of phosphorus in the first stage of the sugarcane production was evaluated using two sources (mineral and organomineral) and five doses of phosphorus (20, 40, 80, 160 and 320 mg kg\(^{-1}\) of soil), it was concluded that there was no difference between the sources used on the development and the nutritional status of sugarcane plants, reinforcing the efficiency and similarity of the sources, and in other parameters, such as soil properties or environmental liabilities tend to highlight the organomineral.
Organomineral in eucalyptus (*Eucalyptus globulus* Labill.)

Brazil has unique characteristics in the production of forest areas, both in native or planted forests, becoming the second holder of forest area in the world, and the areas planted are 2.5% (FAO, 2015) with approximately 7.5 million hectares (IBÁ, 2015).

In the work of Magalhães et al. (2017), when evaluating the efficiency of organic phosphorus fertilizers in eucalyptus seedlings, testing organomineral fertilizers with organic sources (cattle manure, poultry litter and wood sawdust biochar) and minerals (triple superphosphate - 46% of total P2O5 and natural reactive phosphate of Bayovar - 34% of total P2O5), in addition to a reference treatment (magnesium thermophosphate and BASACOT MINI 6M®, the organic granular fertilizer with natural reactive phosphate of Bayovar was concluded and the cattle manure allowed development of eucalyptus seedlings similar to the reference treatment, being an alternative of using.

Rezende et al. (2016) evaluated the addition of two types of biochar in the substrate to produce teak seedlings (*Tectona grandis* L.f.) and defined that 25% of this substrate was enough to increase seedling growth.

Organomineral in wheat (*Triticum aestivum* L.)

In Brazil, the wheat crop stands out in the agricultural market with production between 5 and 6 million tons annually in the central west, southeast and south regions, and the southern region is the largest producer of this cereal (BARBOSA et al., 2016).

In the work of Gasparin et al. (2017), when analyzing the performance of the wheat crop, when submitted to different fertilization formulations, composed of mineral fertilizers, animal wastes or organomineral fertilizers, combined or applied alone, testing organomineral and mineral with bovine manure and chicken litter, in addition to treatments of organomineral, mineral, chicken litter and bovine manure, in isolation, the viability of the use of animal wastes in the fertilization of soils in complementation to commercial chemical fertilization was completed. The supplementation of the bed of chicken with mineral fertilizer increased the number of tillers per plant up to 70% and double the number of leaves per plant after 60 days after sowing, and the complementation of bovine manure with mineral fertilizer also increased the number of tillers per plant (38%).

Morais & Gatiboni (2015) found that both types of fertilizers, either the mineral or organomineral takes about 30 days to provide the plants with the phosphorus present in their chemical composition. Other studies evaluated the association between organic and
mineral fertilization in cover to increase soil fertility (CASSOL et al., 2012).

**Organomineral in sesame (Sesamum indicum L.)**

Sesame is a plant considered rustic, easy to grow, tolerant to drought, production of foods with high nutritional index (SILVA et al., 2016), being a source crop of low-income families, besides potential in the production of cosmetics and medicines (CRUZ et al., 2013).

In the work of Silva et al. (2016), when evaluating sesame growth and yield at different levels of organomineral solution, testing organominerals with 25% of the recommended dose for sesame (50-80-20), 50%, 75%, 100% and 125%, in addition to the absolute control in six applications in the form of organomineral solution via fertigation at 15, 22, 29, 36, 43 and 50 days after emergence. The authors concluded that the doses of biofertilizer influence the height, stem diameter and number of fruits of the sesame plants, proving their effectiveness in the agricultural crops.

**CONCLUSIONS**

The agricultural crops stimulated the use of mineral or chemical fertilizers, as a result of the return of increment in final productivity, is that over the years, this return only tends to decline.

For this, not only visualizing the productivity, we must observe other parameters, even environmental, when performing fertilization. And there is an economically viable alternative, which is the use of organic waste as fertilizers, which are already used by small farmers.

Another important parameter to be observed is the mineral sources used as fertilizers, which are said to be irreplaceable inputs, which at some point will be exhausted. Unlike the organic sources, which are renewed and have increased production due to the expanding products in their segments.

We must stop being radical and fertilize only with fertilizer, but observe the benefits of the alternatives, is not to use only one type of fertilization, whether mineral or organic.

In this way, organomineral fertilizers appear as a promising option, both in the economics of mineral sources and in the use of organic sources that have benefits in the physical, chemical and biological properties of the soil due to the presence of organic matter. Several studies prove the efficacy of these fertilizers in several crops, aiming at numerous agronomic parameters. In addition to environmental liabilities, we can generate a lot of income from this product that has the potential to grow in the global agricultural market.

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