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RESEARCH ARTICLE

TRANSFORMING WASTE: A REVIEW ON BOKASHI'S IMPACT ON SOIL HEALTH, CROP GROWTH, AND PEST AND DISEASE MANAGEMENT

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ABSTRACT

Bokashi is an anaerobic fermentation based composting method, which plays a role as an effective soil amendment for improving soil health, enhancing crop yields and promoting sustainable agriculture. Bokashi is enriched with effective microorganisms (EM) which accelerates organic matter decomposition, increasing nutrient availability while minimizing nutrient loss as well as greenhouse gas emissions. This review has demonstrated Bokashi's significant impact on growth, including improved germination, higher yields and better nutrient uptake across various crops such as maize, soybean, tomato, and watermelon. Additionally, it's role on pest and disease management by supporting beneficial microbes and suppressing plant pathogens.

KEYWORDS

Bokashi, Compost, Effective Microorganisms, Fermentation, Organic, Waste

1. INTRODUCTION

Bokashi is an odorless composting method based on the principle of anaerobic fermentation in a closed system, carried out by adding special effective microorganisms (EM) to accelerate the breakdown of organic matter. This novel method is known as EM-Bokashi, was developed in the 1980s by Professor Teruo Higa at the University of the Ryukyus, Japan (Higa and Parr, 1994). Organic wastes are collected and filled with carriers in the closed bokashi bin and the waste is compressed to prevent aeration. After filling of the container/bin it is left to be fermented for at least 2 weeks (Hillberg, 2021). When we introduce dry carrier (e.g., wheat bran) or a liquid form via a microbial spray (e.g., activated EM) then, these microorganisms work on food waste to consume sugar and the fermentation process begins (Footer, 2013). Effective Microorganisms (EM) are a mix of beneficial, naturally occurring microbes that help improve soil and plant health. When applied as inoculants, they boost microbial diversity, enhance soil fertility, and support better plant growth and crop yields. EM consists of around 80 different types of beneficial microbes, including lactic acid bacteria (like Lactobacillus species), yeasts (such as Saccharomyces cerevisiae), photosynthetic bacteria, actinomycetes, and mold fungi (Ndona et al., 2011; Olle and Williams, 2013; Iriti et al., 2019). And the second step is fermented product is buried in soil for further degradation (Hillberg, 2021). As it is anaerobic process so it has numerous benefits: (a)Can use all types of food wastes, including meat, cheese, dairy and bread (b)No need of specific ratio about mixing greens and browns (c)There is no insect or rodent issues (d)Faster than traditional composting (e)Full of beneficial microorganisms (f) No loss of nutrients to the ground or to the atmosphere (g)Minimal greenhouse gasses are produced (h) No putrid odors (Footer, 2013). Bokashi boosts plant health by improving soil structure, making nutrients easier to absorb, and encouraging strong root growth. It also enhances plant functions and supports beneficial microbes, leading to better growth and higher yields (Ginting, 2019).

2. IMPACT OF BOKASHI ON PLANT GROWTH AND YIELD

A study shown that application of Bokashi provides the highest products in the number of leaves, the number of fruits, fresh weight of fruits, dry weight of fruits, and germination date of okra seeds (Mukhtar et al., 2022). The study conducted to evaluate the growth and yield performance of EM-bokashi on radish in lahar soil found that EM-bokashi (300g) performed highly significant on the number of days to germination, final length of the longest leaf, average of tuber length, and average of tuber weight of radish (De Guzman and Dagupan, 2022). Similarly, 500g of aerobic bokashi per hill performs a significant effect on length and yield of Sweet 16-F1 Watermelon (Citrullus lunatus) (Bataga et al., 2022). Application of mulch + Bokashi increased maize and peanut production, seed dry weight and 100- seed weight was found in marginal soils in southeast Sulawesi, Indonesia (Karimuna et al., 2016). Addition of 5% Bokashi to growing medium results in improvement in cultivation of *Kalanchoe blossfeldiana*, improves plant nutrient and water uptake, has chlorophyll content and is more efficient in use of water (Prisa, 2020). Combination of Bokashi-type biofertilizer with substrates is beneficial for the cultivation of vegetables because it increases the nutrient use efficiency by activating enzymes that stimulate the absorption and chelation of certain elements (Hata et al., 2020).

Similarly, application of Bokashi to the soil found that increase in crop yields of sweet corn, *Pogostemon cablin* and *Origanum vulgare* (Xu, 2001; Zaman et al., 2010). Addition of rock Phosphate while preparing Bokashi results in increasing P and Ca content of biofertilizer; as well as use of Bokashi increase Chlorophyll index in parsley leaves (Murillo-Amador et al., 2015; Maass et al., 2020). Stem diameter, branch number, root length and plant fresh weight of tomato (*Lycopersicum esculentum Mill.*) were highly influenced by addition of bokashi to soil (Pohan et al., 2019). Bokashi made from banana stems can be used as soil conditioner as well as a source of nutrients for increased growth and yield of soyabean crops in coastal sand areas (Faozi et al., 2018). Bokashi kirinyu at a dose of 30 ton/ha equivalent to 600 g/polybag gave the best growth and yield to paprika plants on alluvial soil (Lestari et al., 2019). Bokashi, 10% BM (likely a type of beneficial microorganism treatment), and Penergetic (a soil or plant stimulant) led to an increase in fruit or vegetable production in the first three trusses (clusters of flowers or fruits) of a tomato plant during two consecutive growing cycles (Hata et al., 2021). Highest increase in vegetative growth of Lettue was obtained with bokashi at the approx. dose of 14g and there was an increase in fresh weight of the aerial part when it carried out two applications (Ferreira et al., 2017). 16% Bokashi

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gives better results in germination and initial growth on Passion fruit (*Passiflora edulis L.*) (Bocoli et al., 2020).

3. Bokashi's Role in Pest and Disease Management

Study conducted at Indonesia on Pakcoy (*Brassica rapa L.*) found that 2 spraying of Plant Growth Promoting Rhizobacteria (PGPR) with bokashi 1:1 kg/polybag reduced pest intensity by 9.12% and disease incidence by 7.20% (Nik et al., 2024). Efficient use of *T.harzianum* and bio-fertilizers Bokashi and salicylic acid single or integrated gives significant increase in the percentage of germination and reduce the fungal disease incidence and severity of the fungal disease and achieve a significant increase in plant height and wet and dry weight and leaf area of Eggplant (Almammory and Matloob, 2019).

Similarly, Treatment of interaction among the bioagents *P.cyclopiu* and *T.harzianum* , and bokashi bio-fertilizer cause a significant reduction in the root rot incidence of Fig plant (Kadhim and Matloob, 2022). Bokashi (EM) as a Bio-control Agent can Suppress the Growth of *Phytophthora Cinnamomi Rands* (Aryantha and Guest, 1999). Nitrogen metabolism in EM Bokashi-fertilized tomato plants accounted for the high *phytophthora* resistance (Xu et al., 2001). An application dose of Bokashi between 13 and 14 g/pot promoted decrease in *M. javanica* reproduction in lettuce (Ferreira et al., 2017). Combination of Bio fresh biological agents with bokashi containing cow's feses, straw, and soy litter can reduce Maydis leaf blight disease by 47.36% and increase production by 53.54% in Maize plants (Khaeruni et al., 2020).

4. Impact of Bokashi on Soil Health

Bokashi is a natural soil enrichment technique that helps improve soil health and boost plant growth. By enhancing soil properties, it creates a more favorable environment for crops while also reducing the need for chemical fertilizers. Farmers and gardeners have reported numerous benefits from using Bokashi, including better soil fertility, healthier plants, and more sustainable farming practices. This method not only supports plant production but also contributes to an eco-friendlier approach to agriculture (Ginting, 2019).

Several research were conduct on Bokashi, research found that EM Bokashi treatments in soil improve soil fertility by boosting the soil's cation exchange capacity (CEC) and nutrient availability, also enhance soil structure by reducing bulk density, improves soil porosity and permeability as well as soil's microbial biomass. Combining EM Bokashi with subdrainage treatments proved more effective than using farmyard manure (FYM) or chemical fertilizers in improving grain yield and quality and also helps to maintain balance water and salt level in the soil, promoting healthier and increasing crops production (Xiaohou et al., 2008).

The application of Bokashi fertilizers in marginal soil could improve soil chemical properties. It is found that application of Bokashi increases the production of soyabean (*Glycine max L.*) (Wijayanto et al., 2016). The addition of Bokashi made from water hyacinth (*Eichhornia crassipes*) has been reported to improve soil conditions, enhancing the growth and yield of soybean, corn, and rice in dryland soils (Ginting, 2019). The combination of legume cover crops (*Centrosema pubescens*, *Calopogonium mucunoides*, and *Pueraria javanica*) with Bokashi significantly improved soil C-organic, phosphorus (P), and potassium (K) levels while also enhancing the uptake of iron (Fe) and manganese (Mn) by the cover crops.

5. Conclusion

Bokashi is an effective organic soil amendment that enhances soil fertility, improves plant growth, and contributes to sustainable farming practices. It is based on the principle of anaerobic fermentation process, which is rich in beneficial microorganisms, accelerates organic matter decomposition, making essential nutrients more available to plants. This review highlights Bokashi's positive impact on crop yield, soil structure, and nutrient retention, reducing dependency on chemical fertilizers. Additionally, its role in pest and disease management has shown promising results in controlling pathogens and improving plant resilience. The integration of Bokashi with other organic practices, such as legume cover crops and microbial inoculants, further amplifies its benefits, supporting a more regenerative and eco-friendly agricultural system.

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