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THE EFFECT OF VERMICOMPOST AND K+AMINO ON THE WINTER RAPE GROWTH

Margit Olle
Aru Agricultural Ltd.
Vandu tee 17, Hulja, Lääne-Virumaa, Estonia, 45203
NPO Veggies Cultivation
Kesa 60, Tartu, Estonia, 50115
margit.olle@gmail.com

Summary

Vermicompost contains a high concentration of macro- and micronutrients, vitamins, growth hormones, enzymes such as proteases, amylases, lipases, cellulases, and chitinases, as well as immobilized microflora. Vermicompost improves plant germination, growth, biomass, and yield. K+amino is a biologically active liquid soil amendment that is suitable for organic gardens of all types. It is a 100 % veganic growth- and health-promoting liquid microbial inoculant for all plant types, particularly fast-growing crops like vegetables, fruits, and blooms. The purpose of investigation was to look the effect of vermicompost and k+amino on the winter rape germination and growth. Methods: There were six treatments: 1. A rape (means a rape crop in Aru Agricultural Ltd. soil), 2. A rape+YaraBela AXAN 0.3g per pot, 3. A rape+vermicompost 7.9 g per pot in the soil+the vermiextract is sprayed on the plants 1 week after sowing, 2 weeks after sowing, both treatments 1:30, 33 ml extract per 1 L water, 4. A rape+vermicompost 7.9 g per pot in the soil, 5. A rape+vermiextract is sprayed on the plants 1 week after sowing, 2 weeks after sowing, both treatments 1:30, 33 ml extract per 1 L water, 6. A rape+K+Amino biostimulator is sprayed on the plants 1 week after sowing, 2 weeks after sowing, both treatments 5 ml K+Amino per 1 L water. Results: Rape plants were elongated in treatment with YaraBela AXAN. Stem diameter was largest in K+Amino treatment. Root length was lowest in treatment with vermicompst extract (soil was too moisty and compacted). Conclusions: Vermicompost tended to improve plant growth, while stem diameter was largely increased by using k+amino fertilizer. It turns out both actually are good sources of mineral nutrients and also different enzymes and microbes, which help plants grow.

Keywords: growth, K+amino, nutrient content, organic cultivation, plant height, rape, root length, shoot height, stem diameter, vermicompost.

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1. Introduction

Oilseed rape (*Brassica napus*) is the second most important oilseed crop and a member of the mustard family (*Brassicaceae*), which includes 338 genera and over 3,709 species grown worldwide, primarily in temperate and mountainous areas. B. napus is a young crop species (AACC genome, 2*n*=38) that resulted from a natural hybridization between B. rapa (AA genome, 2*n*=20) and B. oleracea (CC genome, 2*n*=18) [1]. With 25.5, 20.3, 13.3, 8.4, and 3.9 million metric tons of rapeseed production in 2018, Europe, Canada, China, India, and Australia are the leading production zones [2].

Rapeseed is the second largest global source of protein meal for animal rations. Rapeseed is the third most produced vegetable oil after soybean [*Glycine max* (L.) *Merr.*] and oil palm, in addition to protein (*Elaeis guineensis Jacq.*). Rapeseed is native to Asia and the Mediterranean, and its natural oil quality is frequently used in industry due to its high erucic acid content. On the other hand, Canadian plant breeders discovered a rapeseed with low erucic acid (2 %), glucosinolate (30 mol/g), and glucosinolate content in its defatted meal and named it canola (to mean Canada oil or Canada oil with low acid) [3].

In recent years, the disposal of organic wastes from home, agricultural, and industrial sources has produced significant environmental and economic concerns, and many various systems to handle this problem have been developed [4].

The widespread use of agrochemicals for agricultural production and protection has had a severe impact on soil health, crop yield, and the environment. Organic amendments have been recommended as a viable option for improving soil and plant health. Vermicompost additives provide a long-term solution to plant nutrition by enhancing soil health and fertility [5].

Vermicomposting is defined as the bioxidation and stabilization of organic material by earthworms and mesophilic microorganisms working together [6]. Reduced irrigation water use, reduced pest attack, reduced termite attack, reduced weed growth; faster rate of seed germination and rapid seedling growth and development; greater numbers of fruits per plant (in vegetable crops) and greater numbers of seeds per ear (in cereal crops) are just a few of the beneficial effects of vermicompost usage in agricultural production [7].

The advantages of vermicompost are [8]:

1. Vermicompost contains a high concentration of macro- and micronutrients, vitamins, growth hormones, enzymes such as proteases, amylases, lipases, cellulases, and chitinases, as well as immobilized microflora.

2. Vermicompost can be produced at a low-cost "on-farm" using simple techniques. While chemical fertilizers are high-tech and expensive products manufactured in factories.

3. Vermicompost improves plant germination, growth, biomass, and yield.

4. Vermicompost boosts plant mineral nutrients, antioxidant activity, and total phenolics.

5. Vermicompost has been widely used to control plant diseases and pests.

Because of the availability of vital plant nutrients, vermicompost promotes plant emergence [5].

Adding vermicompost to soil improves plant growth. Vermicompost enhances soil physical qualities by lowering bulk density and improving soil water retention capacity. Furthermore, soil application of vermicompost as a supplemental dosage has the potential to increase soil nitrogen, phosphorus, and potassium availability. Vermicompost feature abundant microbial populations and variety, as well as huge particle surface surfaces that offer many microsites for microbial activity [9].

The advantages of vermicompost on soil [10]:

1. Improve soil structure and minimize soil erosion by increasing soil organic matter.

2. Boost the number of beneficial soil bacteria, microbial activity, and nutrients.

3. Increase the capacity for cation exchange.

4. Reduces soil bulk density, preventing compaction and erosion.

5. Control of soil-borne plant diseases.

6. Increase the soil's water-holding capacity.

7. Get rid of soil salinity.

8. Maintain the soil's pH at its ideal level.

In addition to adding pure vermicompost to soil the vermicompost extract was sprayed to the plants.

Vermicompost tea is a liquid vermicompost solution created by combining vermicompost with water and fermenting it for a specific amount of time. Compost tea is classified into two types: aerated compost tea and nonaerated compost tea. While compost is steeped in water, nutrients, and microorganisms are extracted. Microorganisms convert insoluble nutrients into soluble forms, promoting a diverse range of organisms in vermicompost tea during the brewing process [11].

K+amino is a new product, so searching the literature gives no mark about it. K+amino has followed advantages (https://betterorganix.com/shop/kamino):

1. K+amino is a biologically active liquid soil amendment that is suitable for organic gardens of all types.

2. It is a 100 % veganic growth- and health-promoting liquid microbial inoculant for all plant types, particularly fast-growing crops like vegetables, fruits, and blooms.

3. K+amino contains potent growth hormones, enzymes, and microbes.

4. Improves plant resistance to stress and pathogens.

5. Mineralizing bacteria and beneficial root fungi are present.

6. Immediately beneficial upon application.

7. Improves nutrient absorption.

8. Eco-friendly and veganic.

Yara Bela AXAN (27 % N+9 % SO_3) is a 7.5:1 N:S ratio uniform compound granular nitrate-based nitrogen and sulfur fertilizer that can be applied to all crops. Nitrogen is present in Yara Bela AXAN as nitrate and ammonium. Sulphur is present in Yara Bela AXAN as calcium sulphate, which is highly soluble and quickly reaches plant roots. Unlike ammonium sulphate, calcium sul-

phate does not reduce the proportion of available nitrate in the formulation. Yara Bela AXAN is a homogeneous, uniform-sized granular fertilizer with a high bulk density (https://www.frontierag.co.uk/crop-production/crop-nutrition/products/product/Yara Bela AXAN-axan). The results will be seen also in accordance with this fertilizer, which is in use now in the farm.

Why this investigation was needed? Organic waste disposal has caused increasing environmental and economic problems. Also, the high cost of synthetic fertilizers is a problem for farmers. Hereby the aims are: The purpose of this investigation was to assess the influence of the low cost vermicompost technology (which uses the organic wastes) on the crop growth. Another aim of the investigations was to look at the effect of vermicompost and k+amino on rape growth.

2. Materials and Methods

The pot experiments in the greenhouse were carried through in the summertime at the Räpina School of Horticulture, Põlva County, Estonia (58.09650, 27.44679).

Experiments were carried through with winter rape variety Cult. Variety Cult Description: High-yield variety. Good winter resistance. Resistant to lodging. Short to medium height. High in crude fat.

There were six treatments:

1. A rape (means a rape crop in Aru Agricultural Ltd. soil).
2. A rape+YaraBela AXAN 0.3g per pot.
3. A rape+vermicompost 7.9 g per pot in the soil+the vermiextract is sprayed on the plants 1 week after sowing, 2 weeks after sowing, both treatments 1:30, 33 ml extract per 1 L water.
4. A rape+vermicompost 7,9 g per pot in the soil.
5. A rape+vermiextract is sprayed on the plants 1 week after sowing, 2 weeks after sowing, both treatments 1:30, 33 ml extract per 1 L water.
6. A rape+K+Amino biostimulator is sprayed on the plants 1 week after sowing, 2 weeks after sowing, both treatments 5 ml K+Amino per 1 L water.

The preparation of vermicompost extract: 1 kg of vermicompost is placed in a net bag and hung from the top of an open container, followed by 60 liters of water. The compost air diffuser is then placed in the water, beneath the compost, to enrich the water with air while also circulating it to break up the vermicompost aggregates and dissolve the water-soluble particles. After an hour of using a diffuser, the extract is further filtered with a fine paper filter and a pump system to prevent splashing and clogging of watering systems.

The amount used in spraying vermicompost extract: 1:30, 33 ml extract per 1 L water.

Chemical properties of the soil used in treatments on the sowing date are in **Table 1**. At sowing time only two different contents in treatments were available. The pH was determined from a 1M KCl suspension with a soil:solution ratio of 1:2.5. The suspension was allowed to stand for 1 hour before determination. Mettler Toledo Seven Easy pH meter was used for determination. P, K, Ca and Mg contents were measured by AL or Egner-Riehm Domingo method. Soil organic matter was analyzed by LOI method, heated at 500 °C for at least 4 h. N was analyzed by Kjeldahl method.

Table 1

Chemical properties of the soil used in treatments on the sowing date

At sowing date	pH(KCl)	P (AL)	K (AL)	Ca (AL)	Mg (AL)	Organic matter	Kjeldahl
Treatment	–	mg/100g	mg/100g	mg/100g	mg/100g	%	N %
Soil	7.12	17.10	41.00	3889.00	40.80	7.05	0.24
VC in soil	7.11	18.10	47.20	3797.00	42.70	7.63	0.31

Rape seeds were sown (sowing depth 1 cm) on 28 June 2022 in plastic pots. The pot size was 0.5 L and the pot diameter on the top of the pot was 12 cm. Pots were filled with soil or soil and vermicompost mixture.

Experimental design: complete randomized block design. Each plot consisted of 3 pots and each pot of 10 plants. The experiment had 4 replications. The experiment was repeated at the same time. The first experiment had in total of 72 pots and the second experiment had also in

total of 72 pots. The total amount of plots in experiments was 144. The distance between the pots was 10 cm. The distance between plots was 20 cm.

The greenhouse lighting was turned off. All plants were grown with a minimum day and night temperature of 24 °C and 21 °C, respectively. All pots were watered according to the need and all pots got equally watered.

On 19.07.22 the height of shoots, length of roots, and stem diameter were recorded. The stem diameter was measured by an Electronic Metric Vernier Caliper.

Analyses of variance were carried out on the data obtained using programme Excel 2019, comparison of means was calculated by Fisher LSD test. Used signs: *** – p<0.001; ** – p=0.001–0.01; * – p=0.01–0.05; NS not significant, p>0.05.

3. Results

Rape plants were elongated in treatment with YaraBela AXAN (**Table 2**). YaraBela AXAN treatment increased shoot height by 20 % compared to the control treatment. Stem diameter was largest in K+Amino treatment (**Table 2**). K+amino treatment increased the stem diameter by 30 % compared to the control treatment. Root length was lowest in treatment with vermicompost extract (soil was too moist and compacted) (**Table 2**). Root length decreased in vermicompost extract treatment by 34 % compared to control treatment. A picture of rape plants in the experiment is in **Fig. 1**.

Table 2

The height (cm), stem diameter (mm), and root length (cm) of winter rape plants according to treatments

Treatment	Shoot height (cm)	Stem diameter (mm)	Root length (cm)
Control	12.56	1.40	17.20
YaraBela	15.77	1.55	16.88
VC soil, VC extract	12.55	1.58	14.70
VC soil	11.77	1.27	15.18
VC extract	12.12	1.55	11.37
K+amino	12.53	2.00	16.73
p	***	***	*
LSD	1.56	0.23	4.22

Fig. 1. Picture of rape plants in the experiment according to treatments (left treatment 1, right treatment 6)

4. Discussion

Vermicompost is suitable for plant growth due to the presence of microbiota, specifically fungi, bacteria, and actinomycetes [12]. Plant-available nutrients in vermicompost include nitrates, phosphates, exchangeable calcium, and soluble potassium, all of which promote plant growth and nutrient content. While K+amino (https://betterorganix.com/shop/kamino) can help plants grow by containing powerful growth hormones, enzymes, and microbes.

There was a tendency that in treatments (vermicompost in soil+vermicompost extract and vermicompost extract) was greater stem diameter, which is a growth factor. It means vermicompost improved plant growth. It is in accordance with many findings [13–16]. Similarly, scientists found

that due to vermicompost plant growth-promoting properties, it boosts crop growth, yield, and quality [5]. Vermicompost treatments were shown to be advantageous for plant growth and may be suggested for watermelon cultivation based on the findings. The most effective vermicompost dosages were 150 kg/d [17].

In one experiment farm manure and vermicompost treatments were shown to be effective in plant growth parameters studied in watermelon than the control application. When compared to animal manure, vermicompost treatment had a greater and more beneficial influence on fruit weight, fruit breadth, fruit height, fruit thickness, and yield. Vermicomposting might provide better outcomes than agricultural manure. This might be due to the fact that the physical and chemical qualities of vermicompost were superior to those of animal manure. At the same volume ratio, vermicompost performed better than cow dung compost, and adding 25 % worm casing produced the greatest results [17].

Why vermicompost increases plant growth?

Vermicast (earthworm excreta) is a nutritive organic fertilizer high in humus, NPK, micronutrients, beneficial soil microbes, nitrogen-fixing, phosphate-solubilizing bacteria, actinomycets, and growth hormones auxins, gibberellins, and cytokinins. Vermicompost and its body liquid (vermiwash) have been shown to be both growth promoters and crop plant protectors [18].

Plant nutrients found in vermicompost include N, P, K, Ca, Mg, S, Fe, Mn, Zn, Cu, and B. The high humic acid content of vermicompost promotes the synthesis of phenolic compounds such as anthocyanins and flavonoids, which may improve plant quality and act as a deterrent to pests and diseases [19].

Vermicompost is primarily composed of C, H, and O, but it also contains nutrients like N, P, Ca, K, Mg, and S, and micronutrients that have similar effects on plant growth and yield as inorganic fertilizers applied to soil. Likewise, vermicompost contains a high proportion of humic substances, which provide numerous sites for chemical reactions and microbial components known to enhance plant growth and disease suppression via the activities of bacteria (Bacillus), yeasts (Sporobolomyces) and Cryptococcus), and fungi (Trichoderma), as well as chemical antagonists such as phenols and amino acids [19].

The application of vermicompost improved the physical conditions of the soil, allowing for better aeration of plant roots, drainage of water, facilitation of actions of N+, P+, and K+ exchange, sustained availability of nutrients, and thus uptake by the plants, resulting in better growth [20].

In addition to mineral nutrients, vermicompost's microbial characteristics stimulate plant development significantly. The biostimulatory efficiency of vermicompost is most likely due to plant growth-stimulating chemicals such as humus, phytohormones, and other perhaps undiscovered new compounds. Auxins are a kind of phytohormone that plays a key role in controlling plant development processes [21].

Vermicompost not only improves nutrient cycling and the input of important microbial varieties, but it also influences the systems that make plant growth regulators. During vermicomposting, earthworms and microbial diversity contribute plant growth hormone-like compounds (such as fulvic acid or humic acid) to organic materials. The presence of plant growth regulators (PGR) in vermicompost has been proposed as one element that may lead to higher plant growth and production [22].

On the other hand, it is clear that the use of vermicompost may be highly effective and sustainable, both economically and environmentally, since it can represent a viable approach for mitigating the presence of toxic residues in food plants, in addition to stimulating plant development [23].

K+amino increased the stem diameter, i.e. growth of plants. Why? The reason might be followed. K+amino contains powerful growth-promoting hormones, enzymes, and microbes. In addition, it contains mineralizing bacteria and beneficial root fungi, which all promote plant growth (https://betterorganix.com/shop/kamino).

To summarize, vermicompost had a tendency to improve plant growth, while stem diameter was largely increased by using k+amino fertilizer. It turns out both of them actually are good sources of mineral nutrients and also different enzymes and microbes, which help plants grow.

Limitations of the study. Due to financial limitations the content of nutrients in rape plants was not studied.

Prospects for further research. Prospects for future research could be to study the effect of k+amino and vermicompost on the nutrient content of rape and to make experiments in field conditions.

5. Conclusions

Vermicompost tended to improve plant growth, while stem diameter was largely increased by using k+amino fertilizer. It turns out both of them are good sources of mineral nutrients and also different enzymes and microbes, which help plants grow.

Conflict of interest

The authors declare that they have no conflict of interest about this research, whether financial, personal, authorship or otherwise, that could affect the research and its results presented in this paper.

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Data availability

Data will be made available on reasonable request.

Use of artificial intelligence

The authors confirm that they did not use artificial intelligence technologies when creating the currrent work.

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