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# EFFECT OF AN ORIGIN EXTRACTS TO YIELD OF OATS UNDER CONVENTIONAL AND ORGANIC GROWING CONDITIONS

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There are found only some reference sources about influence of organic origin extracts (OOE) on plant growing. The aim of the study was to evaluate the effect of treatment with organic origin extracts on yield of oats (*Avena sativa* L.). Oats were cultivated in the fields at the State Stende Cereal Breeding Institute (Latvia) under conventional growing conditions (N80-85, P50-80, K70-80 kg $ha^{-1}$) (CGC) and under organic growing conditions (OGC). The field experiments were carried out for two years (2011 to 2012) on sandy loam and sod-podzolic soil with near neutral acidity, medium and high plant available phosphorus and potassium content. Humic substances (HS) were extracted from peat and vermicompost in 45°C with cavitation method and part of obtained extracts were heated up to 95°C. The plants were treated with 6 different organic origin extracts. The oats yield is evaluated. Significant difference was observed in oats yield variation between the experimental years in both growing conditions. The average yields of oats were in 2011 year 4 and 6.4 t $ha^{-1}$ and in 2012 year 2.6 and 4.6 t $ha^{-1}$ accordingly for OGC and CGC. Organic origin extracts showed significant effects on the yield of oats in OGC. Significant difference was not observed in oats yield in CGC. The work was carried out within the framework of the project "Organiskas izcelsmes produktu izvilkumu un to ietekmes izpēte augkopībā" (Study of Organic Origin Extracts and their Effect on Crop Farming) (No 2DP/2.1.1.1.0/10/APIA/VIAA/082) financed by the European Regional Development Foundation (Activity 2.1.1.1.).

Key words: organic origin extracts, humic substances, oats, growing conditions.

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## INTRODUCTION

Only some reference sources about influence of organic origin extracts (OOE) on plant growing have been found, however even these references are only based on studies of their impact on various stages of growth leaving aside the question of harvest (Canellas et al. 2002, Eyheraguibel et al. 2007, Xu et al. 2012). Conclusions drawn from two articles (Zaller 2006, Seyedbagheri 2010) shed light that OOE has no effect on tomato and potato harvests. OOE use on Chinese cabbage resulted in positive effects but only with regard to the outcome valid for the market rather than total harvest (Wang et al. 2010). However, even these few conclusions are practically not usable, for effects of these extracts depend on too many conditions: crops being cultivated, agro-climatic

Table 1. Nutrient content in organic origin extracts

| | | 2011 | | | | 2012 | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | K45 | K95 | B45 | B95 | K45 | K95 | B45 | B95 |
| Organic mater | % | 0.210 | 0.200 | 0.190 | 0.170 | 0.205 | 0.200 | 0.173 | 0.175 |
| HS | mg $l^{-1}$ | 1316.8 | 1196.2 | … | 869.1 | 960.3 | 1020.7 | 792.3 | 781.4 |
| HA/FA ratio | | 2.41 | 1.80 | 7.14 | 5.58 | 3.63 | 3.44 | 3.32 | 2.38 |
| COOH | mmol $g^{-1}$ | 3.00 | 4.20 | 5.00 | 5.30 | 3.10 | 2.70 | 3.60 | 3.50 |
| $K_{PEG/W}$ | | 18.76 | 9.40 | 8.85 | 8.40 | 15.65 | 6.75 | 11.00 | 9.17 |
| N | mg $l^{-1}$ | 25.04 | 24.83 | 33.02 | 34.29 | 26.29 | 24.47 | 46.38 | 48.21 |
| P | mg $l^{-1}$ | 0.30 | 0.65 | 7.92 | 6.99 | 2.07 | 1.17 | 4.27 | 3.77 |
| S | mg $l^{-1}$ | 37.63 | 41.22 | 31.91 | 47.12 | 39.51 | 35.52 | 46.14 | 42.28 |
| Cl | mg $l^{-1}$ | 6.08 | 6.47 | 9.23 | 10.53 | 7.86 | 7.65 | 11.98 | 10.61 |
| K | mg $l^{-1}$ | 303 | 326 | 320 | 296 | 595.0 | 568.0 | 471.0 | 459.0 |
| Ca | mg $l^{-1}$ | 59 | 76 | 98 | 73 | 11.00 | 11.00 | 23.00 | 24.00 |
| Mg | mg $l^{-1}$ | 14 | 15 | 31 | 18 | 0.30 | 0.30 | 3.40 | 3.50 |
| B | mg $l^{-1}$ | … | … | … | … | 2.90 | 2.40 | 4.10 | 5.30 |
| Fe | mg $l^{-1}$ | 5.7 | 6.3 | 4.8 | 5.8 | 3.90 | 3.70 | 5.10 | 5.60 |
| Cu | mg $l^{-1}$ | 0.05 | 0.04 | 0.04 | 0.53 | 0.017 | 0.012 | 0.04 | 0.054 |
| Mn | mg $l^{-1}$ | 0.04 | 0.02 | 0.29 | 0.25 | 0.020 | 0.010 | 0.110 | 0.130 |
| Zn | mg $l^{-1}$ | 0.14 | 0.81 | 0.13 | 0.36 | 0.360 | 0.400 | 0.180 | 0.230 |
| Ti | mg $l^{-1}$ | 0.167 | 0.114 | 0.324 | 0.074 | 0.117 | 0.135 | 0.176 | 0.239 |

Table 2. Chemical characteristics of soils

| Parameter | Plant available soil nutrient concentration (mg.$L^{-1}$) in 1M HCl extraction | | | |
|---|---|---|---|---|
| | Conventional field | | Organic field | |
| | 2011 | 2012 | 2011 | 2012 |
| N | 43 | 30 | 32 | 60 |
| P | 414 | 621 | 425 | 512 |
| K | 170 | 220 | 185 | 260 |
| Ca | 1280 | 3360 | 2720 | 5100 |
| Mg | 200 | 605 | 620 | 1660 |
| S | 6 | 8 | 8 | 15 |
| Fe | 1595 | 1275 | 1655 | 1225 |
| Mn | 215 | 185 | 300 | 250 |

| Parameter | Plant available soil nutrient concentration ($mg.L^{-1}$) in 1M HCl extraction | | | |
|---|---|---|---|---|
| | Conventional field | | Organic field | |
| | 2011 | 2012 | 2011 | 2012 |
| Zn | 3.70 | 12.5 | 5050 | 6.50 |
| Cu | 5.20 | 5.1 | 3.45 | 3.00 |
| Mo | 0.09 | 0.03 | 0.03 | 0.03 |
| B | 0.2 | 0.10 | 0.30 | 0.10 |
| pH/KCl | 5.74 | 6.38 | 6.59 | 6.88 |
| Organic mater (%) | 1.84 | 2.60 | 2.23 | 2.38 |

Table 3. Mean Air Temperature, Cº (data from Stende weather station)

| Month | 2011 | 2012 | Long-term observations |
|---|---|---|---|
| | ± to long-term data | | |
| IV | 2.6 | 1.3 | 4.3 |
| V | 0.4 | 0.8 | 10.2 |
| VI | 2.6 | -1.0 | 14.2 |
| VII | 2.9 | 1.2 | 16.3 |
| VIII | 0.8 | 0.0 | 15.5 |

Table 4. Precipitation, mm (data from Stende weather station)

| Month | 2011 | 2012 | Long-term observations |
|---|---|---|---|
| | ± to long-term data | | |
| IV | -10.2 | 5.7 | 37 |
| V | 9.7 | 13.9 | 45 |
| VI | 2.6 | 21.7 | 57 |
| VII | 78.3 | 4.7 | 87 |
| VIII | 68 | 28.1 | 87 |

Table 5. Yield of oats T/ha at 14% humidity

| | 2011 | | 2012 | |
|---|---|---|---|---|
| | Convent. growing | Organic growing | Convent. growing | Organic growing |
| Control | 6.64 | 3.59 | 4.71 | 2.42 |
| K-45 | 6.45 | 3.78 | 4.44 | 2.38 |
| K-95 | 6.50 | 3.74 | 4.62 | 2.55 |
| B-45 | 6.50 | 4.02 | 4.58 | 2.50 |
| B-95 | 6.32 | 4.52 | 4.62 | 2.49 |
| B-45+K-95 | 6.36 | 4.65 | 4.75 | 2.59 |
| B-45+B-96 | 6.21 | 4.35 | 4.64 | 2.53 |

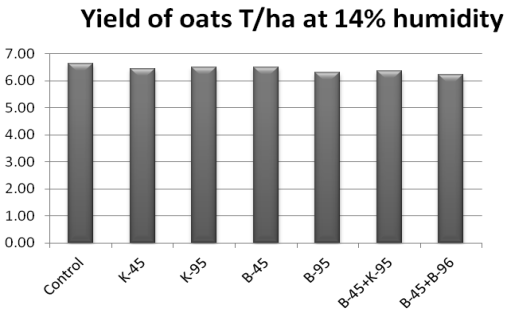


Fig.1. Yield of oats in year 2011 under conventional growing conditions.

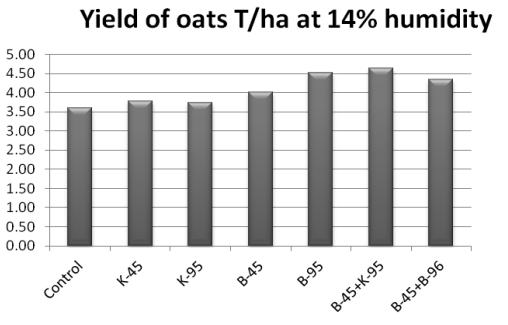


Fig.2. Yield of oats in year 2011 under organic growing conditions.

conditions, soil composition, the intended fertilizer regime, the applied dose of extract and plant development stages in which OOE is being used. We can draw conclusions from everything mentioned above that it is necessary to study the effects of OOE in each individual case. The aim of the study was to evaluate the effect of treatment with organic origin extracts on yield of oats (*Avena sativa* L.) in western part of Latvia. The field experiments were carried out for two years (2011 to 2012) under conventional growing conditions (CGC) and under organic growing conditions (OGC).

## MATERIAL AND METHODS

Experimental conditions. Six OOE from peat, vermicompost, peat-vermicompost mix used in this trial were produced by the Scientific Research and Production Firm "Intellectual resources" LTD (Latvia) by extraction at 45°C regime with cavitation method and part of obtained extracts were heated up to 95 ºC. The chemical characteristics including also ratio of humic (HA) and fulvic acids (FA), amount of carbonyl groups and bisection of humic substances between polyethylene and water ($K_{PEG/W}$) of peat and vermicompost extracts are presented in Table 1.

The field experiments were carried out at the State Stende Cereals Breeding Institute (Latvia) on sand loamy and silt loam podzolic soil with near neutral acidity during the vegetation seasons of 2011-2012. The effect of OOE application was examined in two agricultural systems: conventional and organic. Soil chemical characteristics are presented in Table 2.

Weather data collection. The meteorological conditions in 2011-2012 were different compared to average long-term observations and this difference influenced plant development of yield. The year 2011 was characterized with very wet and warm July, beginning of August, but in 2012 all season was comparatively wet. Weather characterizations are presented in Table 3 and 4.

Obtained results statistically were processed by Anova Single Factor analysis.

## RESULTS

As a result of the research, we concluded that the yield is mainly affected by the agricultural system: in 2011, the average crop yield in the conventional agricultural system was 56 % larger than in the organic agricultural system, and in 2012 – even 98 % larger. Importance of season: in 2011, yield of oats under conventional growing conditions was approximately 31 % larger than in 2012 but the yield under organic growing conditions – 66 % larger respectively. The maximum differences in conventional agricultural system when spraying with OOE were 6.9 % in year 2011 and 7 % in year 2012; under organic agricultural conditions – 29.5 % in year 2011 and 8.8 % in year 2012. All obtained harvest data are measured on 14 % moisture which can be seen in Table 5,

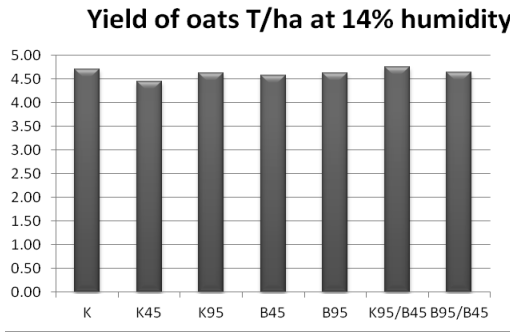


Fig.3. Yield of oats in year 2012 under conventional growing conditions.

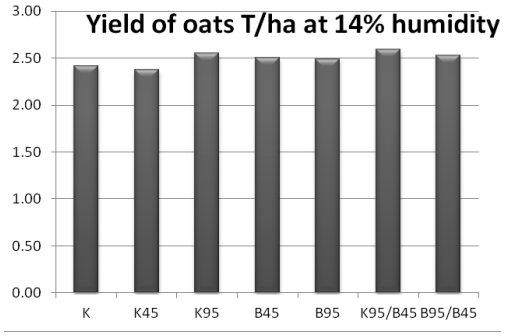


Fig.4. Yield of oats in year 2012 under organic growing conditions.

while individual years and agricultural systems are reflected in diagrams 1, 2, 3 and 4.

## DISCUSSION

The findings clearly show that the most important factors affecting yield of oats are the following: the agricultural method used, namely, the use of effective and right fertilization, and agroclimatic conditions of the season. The effects of OOE that we examined statistically mattered only in year 2011 under organic growing conditions ($F=6.19>F_{0.05}=2.57$). Comparing to control measurement we used, all types of extracts used yielded crop increase, but the most obvious one was with earthworm biohumus extracts variations. (Fig.2). (Anova single factor analysis results: conventional growing system in 2011: $F=0.88>F_{0.05}=2.57$; conventional growing system in 2012: $F=0.57>F_{0.05}=2.57$; organic growing system in 2012: $F=0.28>F_{0.05}=2.57$).

From results obtained we can draw conclusions that the use of OOE can be effective when growing conditions are not close to optimum, oats grow in poor soil, lack fertilization, while the OOE spraying has no effect on oats growing in rich soil and with fertilization.

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## REFERENCES

Canellas L.P., Olivares F.L., Okorokova-Facanha A.L., Facanka A.R. 2002. Humic acids isolated from earthworm compost enhance root elongation, lateral root emergence, and plazma membrane $H^+$ - ATPase activity in maize roots. *Plant Physiology*, 130:1951 - 1957.

Eyheraguibel B., Silvestre J., Morard P. 2008. Effects of humic substances derived from organic waste enhancement on the growth and mineral nutrition of maize. *Bioresource Technology,* 99: 4206 – 4212.

Seyedbagheri M.M. 2010. Influence of humic products on soil health and potato production. *Potato Research*, 53: 341 – 349.

Wang D., Shi Q., Wang X., Wei M., Hu J., Liu J., Yang F. 2010. Influence of cow manure vermicompost on the growth, metabolite

contents, and antioxidant activities of Chinese cabbage (Brassica campestris ssp. Chinensis). *Biol Fertil Soils,* 46: 689 – 696.

Xu D.B., Wang Q.J., Wu Y.C., Yu G.H., Shen Q.R., Huang Q.W. 2012. Humic-like substances from different compost extracts could significantly promote cucumber growth. *Pedosphere,* 22(6): 815 – 824.

Zaller J.G. 2007. Vermicompost as a substitutive for peat in potting media: effects on germination, biomass allocation, yields and fruit quality of three tomato varieties. *Scientia Horticulturae,* 112:191 – 199.

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