COMPARATIVE ANALYSIS OF THE OILSEED CROPS IN ORGANIC SYSTEMS AREA IN THE WORLD

JURJESCU ANDREEA LIDIA[1], SALA FLORIN[1,2*]
[1]Agricultural Research and Development Station Lovrin, Lovrin, 307250, Romania
[2]University of Life Sciences "King Mihai I" from Timisoara, Timișoara, 300645, Romania
*Corresponding author's e-mail: florin_sala@usvt.ro

Abstract: *The comparative analysis of the area of oilseed crops in organic systems in the world was made in the present study. With an average area of 567035 ha (37.50%), Asia occupied the first position, followed by Europe (34.45%), Africa (15.50%), North America (8.80%), and Latin America (3.75%). Moderate variability was recorded for North America (CV = 23.28), for Latin America (CV = 24.22), and for Asia (CV = 22.29), respectively. Very high variability was recorded for Europe (CV = 46.28) and for Africa (CV = 67.60). The ANOVA test indicated significant differences in the mean values ($p<0.001$), and the Kruskal-Wallis test indicated significant differences between the median values, $H(chi^2) = 44.94$, H_c (tie corrected) = 44.94, $p<0.001$. The Mann-Kendall trend test indicated an increasing trend in the data series over the study period, within each continent. Compared to the multiannual average value, in the first part of the study interval, negative differences with statistical certainty were recorded, respectively positive differences with statistical certainty, towards the end of the study period.*

Key words*: comparative analysis, increasing trend, oilseed crops, organic system, Mann-Kendall trend test.*

INTRODUCTION

Oilseed crops are important for their high oil content, and include a number of plants such as palm, rapeseed, soybean, sunflower, peanut, cotton (seeds), sesame, flax (seeds), castor, and safflower [6,22].

The cultivated area, sustainable use and yield of these crops are of global interest, and represent a major challenge for food security [6].

Oilseed crops play an important role in human nutrition, animal feed and industrial uses [1,20].

In organic crops and organic production, oilseed crops represent an important component worldwide [21].

Different cropping systems, conventional and organic, have been studied comparatively for oilseeds, in order to increase yield, oil quality and bioactive compound profile, and water resource efficiency [4,15,16,17].

Oilseed crops have been studied, along with other crop categories, in different cropping systems, in relation to water resource efficiency and climate resilience [9,12]. Different strategies were evaluated to support the performance of oilseed crops under conditions of water and thermal stress generated by climate change [2].

Organic oilseed crops have expanded worldwide, in a differentiated manner from one continent to another, from one country to another, in relation to plant species, ecological, economic and social conditions [13,18,21].

Previous studies have indicated growth trends in oilseed crops, with different growth rates over study intervals and levels of statistical confidence [19].

The study aimed to evaluate oilseed crops in organic systems in the world, during the period 2013 - 2023, by evaluating the evolutionary trend of the cultivated area, the level of variability and the comparative analysis of annual values with the multi-annual average for the period considered.

MATERIALS AND METHODS

The area of oilseed crops in organic systems in the world was analyzed during the period 2013 - 2023. The study used data recorded in the FiBL database [5] for Africa, Asia, Europe, Latin America and North America.

The data series were first analyzed to assess statistical reliability and the presence of variance. The variability of the data over time (coefficient of variation, CV) was evaluated. The statistical reliability was assessed in the comparative analysis of the mean and median values (ANOVA, t Test, Kruskal-Wallis test).

The trend of the data variation in each data series was assessed (Mann-Kendall trend test). The comparative analysis was made between the annual values and the multiannual average value, within each data series (for each continent).

To assess the reliability of the results, appropriate statistical safety parameters were used for each applied test. For the reliability of the calculated differences, the parameter thresholds $p<0.05$, $p<0.01$, $p<0.001$ were used.

In relation to the purpose of the study, the calculation module in EXCEL and the PAST software v.4.17 [8] were used for the statistical analysis of the data.

RESEARCH RESULTS

Oilseed crops in organic systems had variable areas in the world, by continent, as well as annual variations over the analysis period (2013 – 2023), Table 1.

Based on analysed data, Asia ranked first, with an average area of 567035 ha (37.50%), followed by Europe (34.45%), Africa (15.50%), North America (8.80%), and Latin America (3.75%), Figure 1.

Table 1.

Area of oilseed crops in organic system, period 2013 - 2023

Year	Africa	Asia	Europe	Latin America	North America	World total
	(ha)					
2013	125861	325126	190419	34523	103657	779586
2014	123646	443878	245700	46583	123902	983709
2015	155899	637581	298856	42337	101105	1235778
2016	195532	582069	339630	67282	102075	1286588
2017	236419	341379	449439	51910	118039	1197186
2018	193684	634479	496099	45261	115063	1484586
2019	183884	640235	653600	60805	137978	1676502
2020	184769	577955	821708	76007	134704	1795143
2021	219851	723168	921718	73619	160199	2098555
2022	264487	611075	694774	57038	195232	1822606
2023	694363	720451	618430	68819	171654	2273717
Mean	234399.5	567036	520943	56744	133055.3	1512178

Source: FiBL database [5]

Statistical analysis indicated differentiated variability for oilseed areas in organic systems during the study period, according to the coefficient of variation (CV) values. Thus, moderate variability was recorded for North America (CV = 23.28), for Latin America (CV = 24.22), and for Asia (CV = 22.29), respectively. Very high variability was recorded for Europe (CV = 46.28) and for Africa (CV = 67.60).

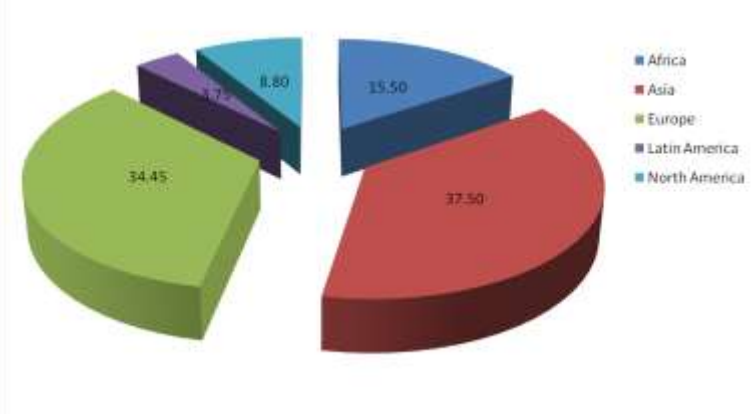

Figure 1. Share of areas cultivated with oilseeds in organic systems in the world

A comparative analysis of oilseed crop areas between continents was performed during the study period. The ANOVA test indicated statistical reliability in the analysis of mean values, Table 2.

Table 2.

ANOVA test results

Statistical Parameters	Sum of sqrs	df	Mean square	F	p (same)
Between groups	2.33E+12	4	5.81E+11	28.13	2.92E-12
Within groups	1.03E+12	50	2.07E+10	Permutation p (n=99999)	
Total	3.36E+12	54	1.00E-05		
Components of variance (only for random effects)					
Var(group)	5.10E+10	Var(error):	2.07E+10	ICC:	0.711502
omega2	0.6636				
Levene´s test for homogeneity of variance, from means	p (same):	2.19E-05			
Levene´s test, from medians	p (same):	0.0002526			
Welch F test in the case of unequal variances	F=56.56, df=21.62, p=3.851E-11				
Bayes factor	3.948E09 (decisive evidence for unequal means)				

Kruskal-Wallis test (for equal medians) indicated significant differences between median values, H(chi^2) = 44.94, H_c (tie corrected) = 44.94, p<0.001.

Mann-Kendall trend test indicated an increasing trend in the data series over the study period, within each continent, according to the results in Table 3.

Table 3.

Mann-Kendall test results

Statistical parameters	Africa	Asia	Europe	Latin America	North America
S	35	27	43	29	37
Z	2.6469	2.0241	3.2697	2.1798	2.8026
p	0.0081	0.0430	0.0011	0.0293	0.0051

The comparative analysis of the areas cultivated with oilseeds in organic systems in the world was made for each continent. The results in Table 4 showed the differences between the annual values and the calculated multi-annual average, as well as the statistical significance of the differences.

Table 4.

Results of the comparative analysis of oilseed crops area in organic systems

Statistical parameters	Period										
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
	Africa										
Given mean	125861	123646	155899	195532	236419	193684	183884	184769	219851	264487	694363
Sample mean	234400										
Difference	-108540	-110750	-78501	-38868	-2020	-40716	-50516	-49631	-14549	30087	459960
p (same mean)	0.0464	0.0429	0.1314	0.4349	0.9671	0.4140	0.3152	0.3234	0.7670	0.5430	<0.001
Significance of differences	o	o	ns	ns	ns	ns	ns	ns	ns	ns	***
	Asia										
Given mean	325126	443878	637581	582069	341379	634479	640235	577955	723168	611075	720451
Sample mean	567040										
Difference	-241910	-123160	70545	15033	-225660	67443	73199	10919	156130	44039	153420
p (same mean)	0.0002	0.0141	0.1202	0.7249	0.0003	0.1354	0.1084	0.7979	0.0037	0.3139	0.0041
Significance of differences	ooo	o	ns	ns	ooo	ns	ns	ns	**	ns	**
	Europe										
Given mean	190419	254700	298856	339630	449439	496099	653600	821708	921718	694774	618430
Sample mean	520940										
Difference	-330520	-266240	-222090	-181310	-71504	-24844	132660	300770	400780	173830	97487
p (same mean)	0.0011	0.0044	0.0121	0.0318	0.3485	0.7396	0.0980	0.0020	0.0003	0.0379	0.2096
Significance of differences	oo	oo	o	o	ns	ns	ns	**	***	*	ns
	Latin America										
Given mean	34523	46583	42337	67282	51910	45261	60805	76007	73619	57038	68819
Sample mean	56744										
Difference	-22221	-10161	-14407	10538	-4834	-11483	4061	19263	16875	294	12075
p (same mean)	0.0003	0.0341	0.0060	0.0292	0.2705	0.0198	0.3502	0.0009	0.0022	0.9448	0.0155
Significance of differences	ooo	o	oo	*	ns	o	ns	***	**	ns	*
	North America										
Given mean	103657	123902	101105	102075	118039	115063	137978	134704	160199	195232	171654
Sample mean	133060										
Difference	-29398	-9153	-31950	-30980	-15016	-17992	4923	1649	27144	62177	38599
p (same mean)	0.0104	0.3502	0.0065	0.0078	0.1390	0.0830	0.6097	0.8634	0.0157	0.0001	0.0020
Significance of differences	o	ns	oo	oo	ns	ns	ns	ns	*	***	**

Note: Given mean – annual average for each reference area; Sample mean – multiannual average for each reference area.

Comparative analyses for oilseed crops have been made, in relation to organic and integrated crop systems, crop technologies, cultivated genotypes, life cycle, yields and quality of seed production, side effects through biomass content, soil quality, etc. [3,7], [14]. Various factors that influenced agricultural systems, oilseed crops and their yield were studied and evaluated [11]. The impact of climate change has been recorded on the soil, with negative effects on the yield and quality of oilseed crops [10]. For all data series considered in the study for oilseed crops in organic systems, on continents, negative differences with statistical certainty were recorded, compared to the multiannual average value, in the first part of the study interval, and positive differences with statistical certainty, compared to the multiannual average values, towards the end of the study period. According to the data in Table 3, the Mann-Kendall trend test indicated an increasing trend in the data series for all continents, and this trend was confirmed by the differences resulting from the calculation, in the comparative analysis (Table 4). The results obtained

in this study showed the interest in organic oilseed crops, the cultivated area registered variations during the analysis period, but in general an increasing trend was observed.

CONCLUSIONS

Differentiated temporal variability was recorded in the data series over the study period on each continent, namely very high variability for Africa (CV = 67.70), and for Europe (CV = 46.28) and moderate variability for Asia (CV = 24.29), for Latin America (CV = 24.22) and for North America (CV = 23.28). Significant differences were found between the mean values (ANOVA Test) and between the median values (Kruskal-Wallis test) calculated based on the data series for each continent, under conditions of statistical safety. The increasing trend was recorded in the data series for each continent, according to the Mann-Kendall trend test. In the first part of the study interval, negative differences were found between the annual average values and the multiannual average value at the level of each continent, and at the end of the study interval, positive differences were found, in conditions of statistical safety. The results of the study highlighted the trend of increasing the area cultivated with oilseeds in the organic system, which showed the interest in this category of crops and product categories.

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