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EVALUATION OF SOME QUALITY CHARACTERISTICS OF FLAXSEED IN RESPONSE TO FOLIAR APPLICATION OF ZINC AND MANGANESE

Jwan J. Hashim [1], Arian M. Abdullah [2], Bahar J. Mahmood [3]
Field Crops and Medicinal Plants Department, College of Agricultural Engineering Sciences, Salahaddin University, Erbil, Iraq 1, 2, 3

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Correspondence Email:
jwan.hashim@su.edu.krd

ABSTRACT

This research was conducted at Grdarsha Field, College of Agricultural Engineering Sciences, Salahaddin University, Erbil with a GPS reading of (Latitude: 36° 4' N and Longitude: 44° 2' E- elevation 415 Meters above sea level). The factorial experiment based on a randomized complete block design using three replicates was done to study the influence of three levels (0, 200, and 400 mg L-1) of each of Zinc and Manganese as foliar application and their combination on their concentration, uptake and fatty acids profile in flaxseed. The results indicate that the Zinc application effect on Zn and Mn concentration with values (0.0032 and 0.0068) % in the treatment (Zn200 and Mn200) additionally caused an increase in the uptake for the two micronutrients in Zn400 and Mn200 with values (15.74 and 14.90) mg plant-1. The treatment combination Zn200 Mn400 caused an increase in palmitic, oleic, linoleic and linolenic acid while the treatment combination of Zn400 Mn200 gained the lowest value. Cluster analysis or dendrogram classified the combination of the two micronutrients Zn and Mn into four main clusters depending on Zn, Mn and the fatty acids profile. The Principal Component Analysis (PCA) shows the angle value between each of the fatty acids and between the two micronutrients is ≤ 90 ° which means there was a significant correlation between them and vice versa. There is a very high correlation between linoleic acid & linolenic and F6 while F7 correlated with oleic, stearic and palmitic acid for the vectors for studied traits.

College of Agriculture and Forestry, University of Mosul.

Salahaddin University
College of Agricultural Engineering Sciences
Field Crops and Medicinal Plants Department

زانکۆی سەلاحەدین - هەولێر
Salahaddin University-Erbil

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Bahar Jalal Mahmood

Introduction

- **Flax (*Linum usitatissimum* L.) is an annual plant grown in many countries all over the world. It is one of the oldest crop planted as a dual purpose types for seeds and fiber.**
- **Flax is rich in protein (20%), oil (41%) and dietary fiber (28%). The higher amount of linoleic acid and omega-3 fatty acid with amounts of 50-60% is also present in it (Oomah, 2001).**

- **Flax is vulnerable to micronutrient deficits, particularly in calcic soils, because of the high pH and precipitation of these elements in carbonic and hydroxyl forms, resulting in limited solubility.**

- **Numerous studies prove that foliar application of certain micronutrients might overcome nutrient deficiency, as foliar treatment enhances flaxseed quality and yield (Esmail, 2018).**

- **Zinc is a cofactor in enzyme synthesis, and activation and influences electron transport, it is a critical element in glucose metabolism and protein formation in plants (Martin et al., 2006).**

- **Manganese is regarded as an activator of many different enzymatic reactions and takes part in photosynthesis in addition to cell elongation and division and fatty acid formation (Diedrick, 2010 and Hakala et al., 2006).**

The aim of the study

This study aimed to evaluate the oil quality in response to some micronutrients applied as a foliar spray application of flaxseed (*Linum usitatissimum L.*).

Materials and Methods

- **The experiment was conducted at Grdarasha Field, College of Agricultural Engineering SciencesSalahaddin University- Erbil, Kurdistan Region-Iraq.**

- **The experiment unit area was $4m^2$ each replicate consisted of nine experimental units, recommended fertilizer urea (46% N) at a rate of 100 kg N ha^{-1} and triple superphosphate (46% P_2O_5) at a rate of 80 kg ha^{-1} was applied at sowing time (Esmail et al., 2017).**

- **A factorial experiment based on Randomized Complete Block Design (RCBD) using three replications.**

- **Flaxseed (Lider) genotypes obtained from Agricultural Research Center in Erbil - Iraq were sown on November 2019 manually at a row spacing of 10 cm and plant spacing of 5 cm, at a depth of 3 cm.**

- **Three levels (0, 200, and 400) mg L^{-1} for each of Zn and Mn as a foliar application applied. The foliar application of Zn and Mn was done twice, 30 days from sowing and at the flowering stage.**

- **Seeds of five plants in each experimental unit were randomly selected to study the chemical concentration and the fatty acids estimation was done.**

- **The oil was estimated using the Soxhlet apparatus for oil extraction and the fatty acid compounds were analyzed using a gas chromatography device (GC-2010)**

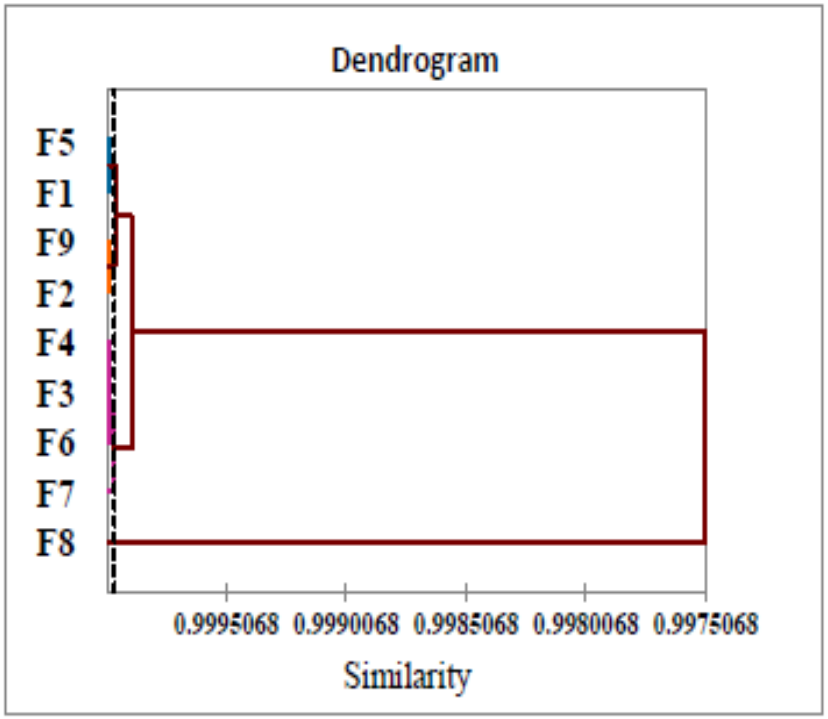
Fatty Acids (%)Profile:

Table (3): Interaction effect of Zn and Mn foliar application on fatty acids of flaxseed.

Treatment	Palmitic	Stearic	Oleic	Linoleic	Linolenic
	(%)				
Zn_0 Mn_0 (F1)	5.47	4.74	17.01	13.99	50.66
Zn_0 Mn_{200} (F2)	5.20	4.33	16.74	13.65	50.30
Zn_0 Mn_{400} (F3)	5.62	5.00	17.32	14.24	50.98
Zn_{200} Mn_0 (F4)	5.59	4.90	17.18	14.11	50.80
Zn_{200} Mn_{200} (F5)	5.33	4.52	16.90	13.84	50.48
Zn_{200} Mn_{400} (F6)	5.78	5.12	17.50	14.35	51.15
Zn_{400} Mn_0 (F7)	5.89	5.29	17.66	14.59	51.30
Zn_{400} Mn_{200} (F8)	5.98	5.40	17.78	17.77	51.45
Zn_{400} Mn_{400} (F9)	5.11	4.19	16.58	13.55	50.12

Table (4): Classifying the treatment combination into clusters

Obse.	F_1 Zn_0 Mn_0	F_2 Zn_0 Zn_{200}	F_3 Zn_0 Mn_{400}	F_4 Zn_{200} Mn_0	F_5 Zn_{200} Mn_{200}	F_6 Zn_{200} Mn_{400}	F_7 Zn_{400} Mn_0	F_8 Zn_{400} Mn_{200}	F_9 Zn_{400} Mn_{200}
Class	1	2	3	3	1	3	3	4	2



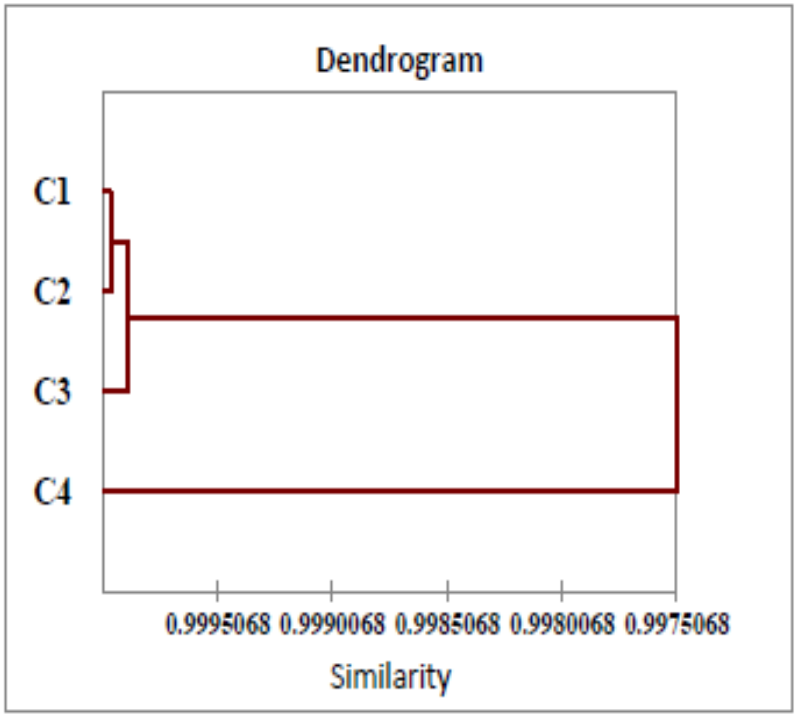


Figure (5): Dendrogram for the cluster of flax fatty acids (%) and two heavy metals

Table (5): The eigenvalue and the variability among the genotypes

	F1	F2	F3	F4	F5	F6	F7
Eigenvalue	4.79	1.51	0.44	0.25	0.01	0.00	0.00
Variability (%)	68.45	21.50	6.31	3.61	0.09	0.03	0.00
Cumulative %	68.45	89.95	96.27	99.88	99.97	99.99	100

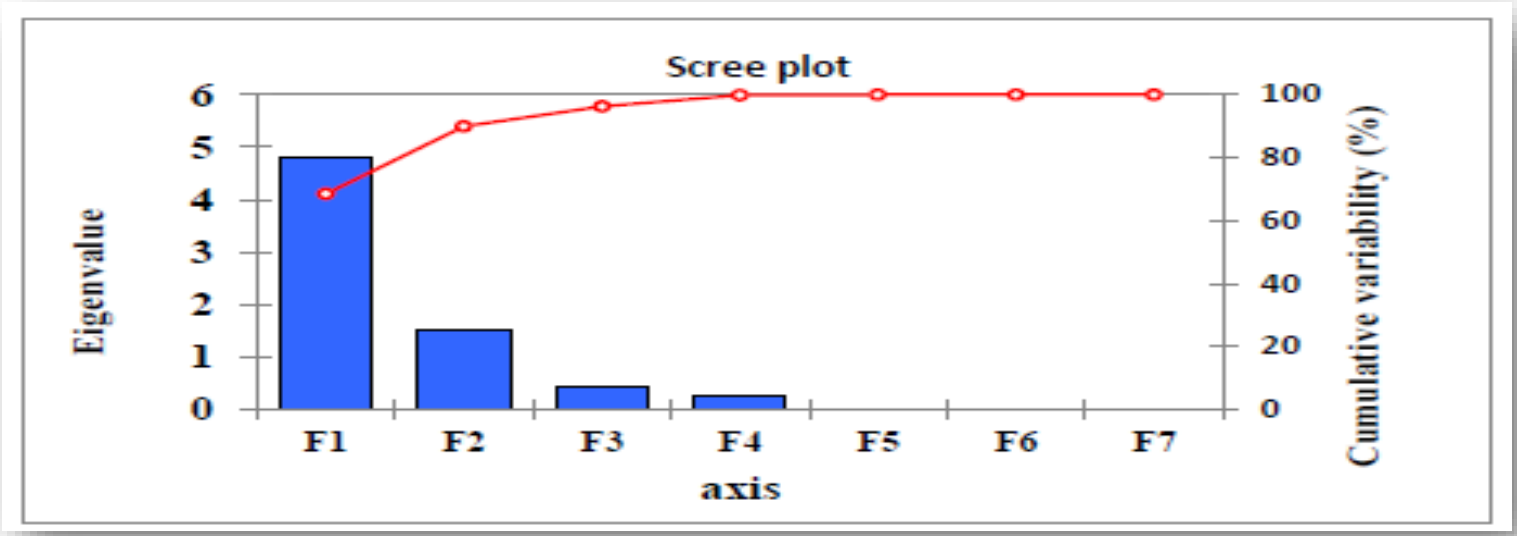


Figure (7): Shows the decrease in slope for the scree plot after F2

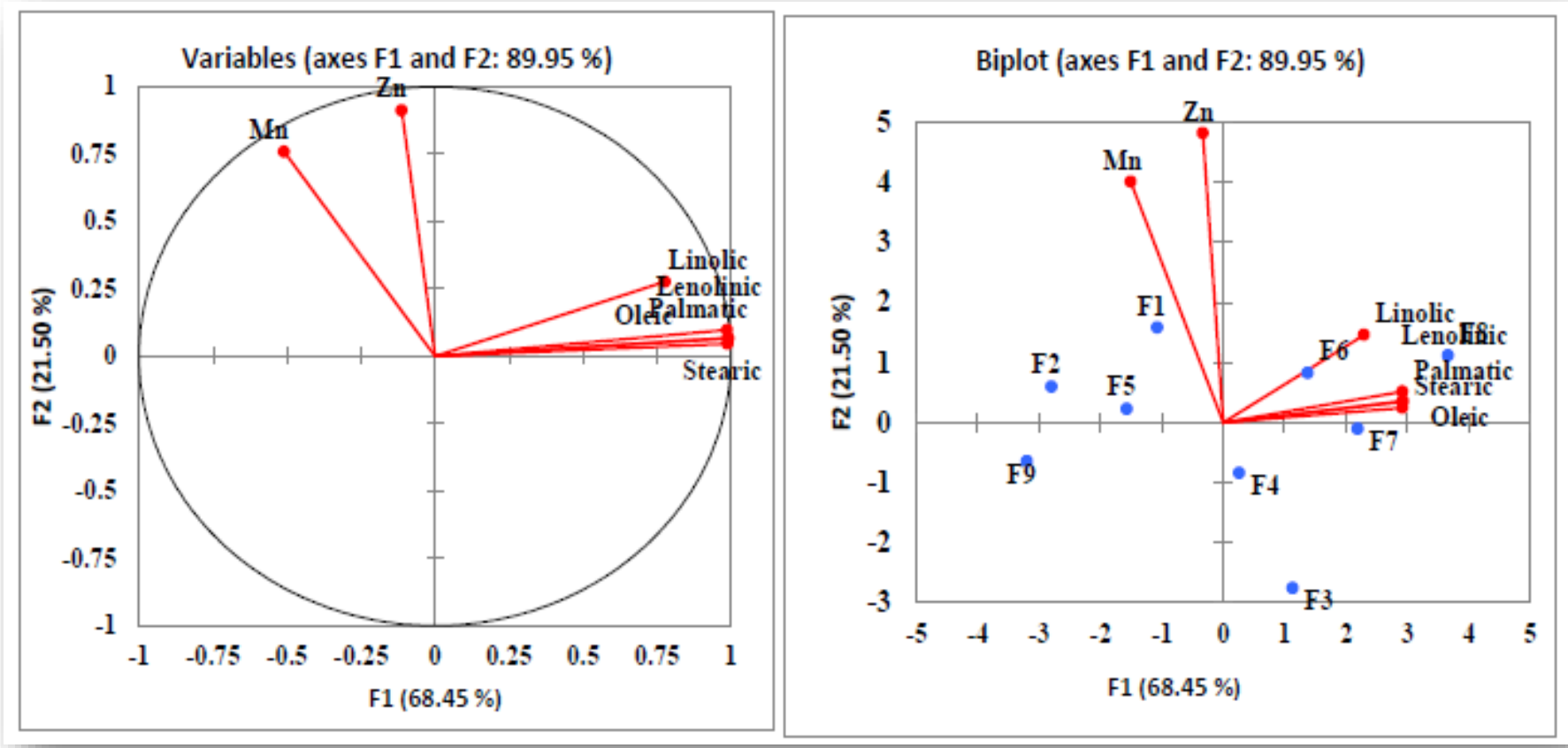


Figure (8): a. The vectors for the studied traits b. The vectors for the studied traits and fertilizers