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Effect of Nitrogen Fertilization and Zinc Spraying on Growth and Yield Flax

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ABSTRACT

During the 2021–2022 winter growing season, an experiment was carried out in two distinct locations: Field Crops Department Research Station-College of Agriculture and Forestry and Wana sub-district. The study aimed to investigate the influence of 3 levels from nitrogen fertilizer (0 , 75 , 150 kg N/ ha) and 3 zinc rates (0 , 20 , 40 mg/L) on the growth, and flax production (Linata variety). It was factorial experimentation with two factors set in a split-plot design within (RCBD) with three blocks. Main plots included **3** levels from nitrogen fertilizer, while sub-plots included 3 zinc rates. The results showed that the 75 kg N/ha fertilization level significantly outperformed in seeds number/ capsule , capsules number/plant, 1000-seed weight , seed yield, oil percentage in seeds and oil yield in locations the College and Wana, respectively. Meanwhile, 150 kg N/ ha fertilization level excelled in plant height and branch number/ plant for locations. The data also showed that the 20 mg/L zinc concentration significantly outperformed in plant height, branch number/plant, and oil percentage in seeds. Conversely, the 40 mg/L zinc concentration excelled in seeds number/ capsule , capsules number/plant, 1000-seed weight , seed yield and oil yield in both locations. Moreover, there was a significant interaction between the 75 kg N/ha fertilization level and the 40 mg/L zinc concentration in capsules number/plant at the Wana location, and seed yield for locations, respectively.

تأثير التسميد النتروجيني والرش بالزنك في نمو وحاصل الكتان

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الخلاصة

خلال موسم النمو الشتوي 2021-2022، تم إجراء تجربة في موقعين متميزين: محطة ابحاث قسم المحاصيل الحقلية - كلية الزراعة والغابات وناحية وانه. هدفت الدراسة إلى معرفة تأثير 3 مستويات من السماد النتروجيني (0، 75، 150 كغم N/هكتار) و 3 معدلات من الزنك (0، 20، 40 ملغم/لتر) في نمو وانتاج الكتان (صنف ليناتا). لقد تم إجراء تجربة عامليه مع وضع العاملين في تصميم الالواح المنشقة ضمن (RCBD) بثلاث قطاعات. وتضمنت الالواح الرئيسية 3 مستويات من السماد النتروجيني، في حين تضمنت الالواح الثانوية 3 معدلات من الزنك. أظهرت النتائج تفوق مستوى التسميد 75 كغم N/هـ معنوياً في عدد البذور/ علبة، عدد العلب/ نبات، وزن الف بذرة، حاصل البذور، النسبة المئوية للزيت في البذور وحاصل الزيت في موقعي الكلية ووانه على التوالي. وفي الوقت نفسه، تفوق مستوى التسميد 150كغم نيتروجين/ه في ارتفاع النبات وعدد الافرع/ نبات في الموقعين. كما أظهرت البيانات تفوق تركيز الزنك 20 ملغم/ لتر معنوياً في ارتفاع النبات، عدد الافرع/ نبات والنسبة المئوية للزيت في البذور. وعلى العكس من ذلك، تفوق تركيز الزنك 40 ملغم/لتر في عدد البذور/ علبة، عدد العلب/ نبات، وزن الف بذرة، حاصل البذور وحاصل الزيت في كلا الموقعين. علاوة على ذلك، كان هناك تداخل معنوي بين مستوى التسميد 75 كغم N/ه وتركيز الزنك 40 ملغم/ لتر في عدد العلب/ نبات في موقع وانه، وحاصل البذور للموقعين على التوالي.

الكلمات الدالة: الكتان، التسميد النيتروجين، الرش بالزنك، النمو، الحاصل.

INTRODUCTION

Flax crop (*Linum usitatissimum* L.) is a dual-purpose harvest farmed for fiber, oil, or a mixture of the two. The oil content in flax seeds ranges between 30-45% (Jassim and Aziz, 2011). It is classified as a drying oil and is utilized in producing paints, wood polishes, and varnishes (Oomah, 2001). Moreover, it is used in production of soap and printing toner (Al-Raheem and Anees, 2024). During its growth, the flax plant requires adding macronutrients and micronutrients, amid which nitrogen and zinc are crucial. Nitrogen contributes to plant growth, protein, and protoplast formation, cell enlargement, photosynthesis efficiency, and flowers production and buds of vegetative in the plant (Yasari and Patwardhen, 2006; Ali and Mohammed, 2021). Zn plays a crucial role in hormone formation, which aids in plant cell elongation and enzyme activation as a cofactor in oxidation-reduction processes (Sarkees and Mohammed, 2023). It is involved in chlorophyll synthesis, lipids and glycerol composition, and starch formation in seeds (Broadley et al., 2007).

Hassen and Shaker (2013-a) found significant differences among 3 rates of nitrogen (0 , 100 , 200 kg N/ ha) in capsules number/plant, seeds number/capsule, seed yield, oil percentage in seeds, and oil yield. Additionally, Hassen and Shaker (2013-b) reported significant differences among the same nitrogen levels in plant height , branch number/ plant , capsules number /plant , and seeds number/ capsule. Emam (2019) observed significant differences in his study, which involved various nitrogen rates (35, 70, 105, 140 kg N/ha) in plant height , branch number /plant , capsules number/ plant, seeds number/ capsule , 1000-seed weight, oil percentage in seeds, seed yield, and oil yield. El-Gedwy (2020) indicated in their study, that utilized 3 levels of nitrogen fertilizer (30, 50, and 70 kg N/ acre) that the 70 kg N/ha level significantly outperformed in terms of branch number/ plant, capsules number/ plant, seed yield, oil percentage in seeds, and oil yield.

In his experiment using 3 zinc concentrations (0, 35, and 70 mg Zn/L), Al-Juheishy (2020) found important changes among the zinc concentrations. The 70 mg Zn/L concentration outperformed in terms of height of plant, fruiting branch number / plant, capsules number / plant, seeds number/ capsule, 1000-seed weight , seed yield, oil percentage in seeds, and oil yield. Al-Doori (2021), in his study with three zinc concentrations (0, 5, 10 mg Zn/L), noticed important changes among the zinc concentrations as well. The 5 mg Zn/L concentration did extremely well in plant height , branch number/ plant, capsules number/ plant, seeds number/ capsule, 1000-seed weight, seed yield, oil percentage in seeds, oil yield. Likewise, Abdulla et al., (2023), in their experiment using 3 zinc concentrations (0, 200, 400 ppm), observed that the 400 ppm concentration significantly outperformed in height of plant , branch number/ plant , seeds number/ capsule , capsules number / plant , 1000-seed weight, seed yield, oil percentage in seeds, oil yield.

Study aims to govern appropriate level of nitrogen fertilization and the optimal zinc concentration to reach the highest productivity of the flax crop.

MATERIALS AND METHODS

During the 2021–2022 winter growing season, an experiment was carried out in two distinct locations: Field Crops Department Research Station at the College of Agriculture and Forestry and Wana sub-district. The study aimed to investigate the influence of 3 levels from nitrogen fertilizer (0 , 75 , 150 kg N/ ha) and 3 zinc rates (0 , 20 , 40 mg/L) on the growth and flax production (Linata variety).

An experiment was conducted out as a factorial experimentation with two factors arranged in a split-plot design within a (RCBD) with three blocks. Main plots included 3 levels of nitrogen fertilizer, while sub-plots included 3 zinc rates (Al-Rawi & Khalaf-Allah, 2000). The total number of experimental units was 3 × 3 × 3 = 27 units. The planting was done in rows, with each row being 2.5 meters long and spaced 20 cm apart. Each experimental unit included five rows, with a unit area of 2.5 × 1 = 2.5 m². There was a 1-meter space between experimental units and a 1.5-meter space between blocks. Experimental field was plowed using a disc plow in a perpendicular manner, followed by leveling and smoothing operations. The field was then divided into experimental units according to design used, with a seeding rate of 40 kg/ha. The seeds were sown manually (broadcast method) at a depth of 1-2 cm in both locations. The experiment was completed when the plants reached maturity.

RESULTS AND DISCUSSION

Findings in Table 1 show major differences in plant height at both the College and Wana locations regarding nitrogen fertilization levels. The highest values for this trait (59.67 cm and 70.41 cm) were observed at the third fertilization level (150 kg N/ha) compared to the first level (no addition), which resulted in the lowest average plant height (54.87 cm and 63.49 cm) at both study locations, respectively. This may be attributed to role of N in cell division and expansion in the meristematic tissues at the growing tips of the stem, leading to increased plant height. These findings are consistent with those reported by Hassen and Shaker (2013-b).

The data shown in Table 2 demonstrate a major difference in plant height between the zinc concentrations at both study locations. Flax plants sprayed with a zinc concentration of 20 mg/L displayed highest average plant height (59.27 and 69.14cm) compared to control treatment (Without spraying), whose resulted in lowest average plant height (54.75 cm and 63.23 cm) at both locations. This effect may be due to role of zinc in formation of tryptophan, which is a precursor of the hormone auxin (IAA) that is vital for cell elongation (Cakmak and Marchner, 1993). These results align with those reported by Al-Juheishy (2020). The results in Table 3 for both the College and Wana locations show no significant interaction between nitrogen fertilization levels and zinc on plant height.

The outcomes in Table 1 illustrate significant differences among nitrogen fertilization levels in terms of branch number/plant at both study locations. The highest average number of branch for plant (6.42 and 8.00 branch/plant) was spotted at the third fertilization level (150 kg N/ha). In comparison, the lowest average (4.39 and 5.37 branch/plant) was noted in the no-fertilization treatment at both locations. Increase in number of branch for plant can be attributed to role of nitrogen in enhancing vegetative growth, promoting meristematic cell division and elongation, and activating biological processes in the plant, including photosynthesis. Results are consistent with those stated by Hassen and Shaker (2013-b) and El-Gedwy (2020).

The data in Table 2 show substantial differences in branch number/plant among the zinc concentrations at both study locations. Plants sprayed with a zinc concentration of 20 mg/L exhibited highest average branches number (6.03 and 7.30 branch/plant) compared to control treatment, which resulted in lowest averages (4.72 and 6.14 branch/ plant) at both locations, respectively. Increase in number of branch for plant may be attributed to the crucial part, zinc plays in the life cycle of plants. Studies have confirmed that zinc activates more than 300 enzymes, particularly those involved in the synthesis of nucleic acids and protein metabolism (Castrup et al. 1996). These findings are consistent with those reported to Al-Juheishy (2020) and Al-Doori (2021). Results designated in Table 3, for both the College and Wana locations show no significant interaction between nitrogen fertilization levels and zinc in branch number/plant.

The figures shown in Table 1 demonstrate a major difference among nitrogen fertilization levels in terms of capsules number/plant at both the College and Wana locations. The second fertilization level (75 kg N /ha) recorded highest average capsules number for each plant (18.47 and 22.07 capsule/plant), compared to the control treatment (0 kg N/ha), which showed the lowest average (10.39 and 12.36 capsule/plant) at both locations. This growth can be attributed to role of nitrogen in enhancing fruiting branches number in the plant. These results match those found by Hassen and Shaker (2013-a) and El-Gedwy (2020).

In Table 2, the results show noteworthy differences in capsules number/plant among the zinc concentrations at both study locations. The highest average capsule number for each plant (16.26 and 20.04 capsule/plant) was observed with addition of zinc at an average of 40 mg/L. In comparison, lowest average (12.64 and 14.67 capsule/plant) was recorded in control treatment at both locations, sequentially. This phenomenon can be explained by the critical function of zinc in the construction and stabilization of cell membranes, as well as in shielding them from oxidation brought on by specific oxygen hormone reactions. These processes can impact the flow and transport of different substances within the roots, ultimately influencing growth and reproduction with a significant impact on yield. (Rashid and Wafique, 2000). These findings are consistent with Al-Juheishy's (2020) and Abdulla et al., (2023) findings.

Table 1. Nitrogen fertilization averages for growth traits, yield and it’s components

Nitrogen fertilization (kg /ha)	**Plant height (cm)**	**Branch number/ plant**	**Capsules number/ plant**	**Seeds number/capsule**	**1000-seed weight**	**Seed yield (kg/ ha)**	**Oil percent-age (%)**	**Oil yield (kg/ ha)**
				College location				
0	54.87 c	4.39 c	10.39 c	6.66 b	6.38 c	1038.94 c	28.91 c	313.78 c
75	56.91 b	5.33 b	18.47 a	8.81 a	7.79 a	1209.75 a	31.47 a	381.12 a
150	59.67 a	6.42 a	14.46 b	7.67 ab	7.11 b	1176.74 b	29.84 b	351.51 b
				Wana location				
0	63.49 b	5.37 b	12.35c	7.13 c	6.67 c	1103.81 c	29.71 c	328.63 c
75	67.43 ab	6.76 ab	22.06a	8.47 a	7.69 a	1237.13 a	32.46 a	401.69 a
150	70.41 a	8.00 a	17.49b	7.82 b	7.32 b	1198.42 b	30.91 b	371.10 b

At a 5% probability level, there are non-significant differences between similar letters within a single column.

Table 2. Average zinc concentrations for growth traits, yield, and their components.

Zinc (mg /L)	Plant height (cm)	Branch number/ plant	Capsules number/plant	Seeds number/ capsule	1000-seed weight	Seed yield (kg / ha)	Oil percent-age (%)	Oil yield (kg / ha)
College location								
0	54.75 b	4.72 b	12.64 c	7.22 b	6.56 c	103.43 c	28.14 c	310.99 b
20	59.27 a	6.03 a	14.41 b	7.84 ab	7.13 b	1173.97 b	32.06 a	376.94 a
40	57.75 a	5.39 ab	16.26 a	8.08 a	7.59 a	1193.03 a	30.02 b	358.48 a
Wana location								
0	63.23 b	6.14 b	14.67 c	7.08 c	6.82 b	1123.80 c	28.93 c	325.65 c
20	69.14 a	7.30 a	17.22 b	7.73 b	7.25 ab	1205.08 b	33.02 a	398.29 a
40	68.96 a	6.68 ab	20.04 a	8.61 a	7.62 a	1211.49 a	31.12 b	377.48 b

At a 5% probability level, there are non-significant differences between similar letters within a single column.

In Table 3, the results show an important interaction between nitrogen and zinc in capsules number/plant at the Wana location. Interaction between fertilization level of 75 kg N/ha with zinc concentration of 40 mg/L produced the highest capsules number for each plant (28.07 capsules/plant). In contrast, interaction between nitrogen level 0 kg N/ha with zinc rate 0 mg/L resulted in the lowest capsules number/plant (11.31 capsule/plant). However, at College location, In terms of number of capsules/plant, There was no statistically significant interaction between zinc and nitrogen.

Table (3). Interaction between nitrogen and zinc for growth traits, yield and it's components.

Nitrogen fertilization (kg /ha)	Zinc (mg /L)	Plant height (cm)	Branch number/plant	Capsules number/ plant	Seeds number/ capsule	1000-seed weight	Seed yield (kg / ha)	Oil percent-age (%)	Oil yield (kg / ha)
College location									
	0	52.15 a	3.77 a	8.96 a	6.16 a	5.86 a	1012.87 i	27.09 a	274.34 a
0	**20**	56.56 a	5.22 a	10.21 a	6.74 a	6.39 a	1092.91 h	30.57 a	334.08 a
	40	55.92 a	4.17 a	12.01 a	7.09 a	6.91 a	1146.04 f	29.06 a	332.95 a
	0	53.91 a	4.79 a	16.59 a	7.99 a	7.27 a	1163.97 e	29.31 a	341.95 a
75	**20**	60.59 a	5.99 a	17.59 a	8.82 a	7.84 a	1227.41 b	33.66 a	413.01 a
	40	56.22 a	5.22 a	21.24 a	9.62 a	8.27 a	1237.87 a	31.46 a	389.31 a
	0	58.21 a	5.61 a	12.39 a	7.52 a	6.56 a	1133.46 g	28.02 a	317.59 a
150	**20**	60.66 a	6.89 a	15.44 a	7.96 a	7.16 a	1201.61 c	31.94 a	383.74 a
	40	60.16 a	6.77 a	15.54 a	7.54 a	7.61 a	1195.17 d	29.56 a	353.20 a
Wana location									
	0	58.37 a	4.76 a	11.31 e	6.57 a	6.29 a	1029.59 h	27.47 a	282.83 a
0	**20**	66.34 a	5.81 a	12.46 d e	6.66 a	6.66 a	1128.91 g	31.74 a	358.27 a
	40	65.76 a	5.54 a	13.32 de	8.17 a	7.06 a	1152.94 e	29.91 a	344.27 a
	0	63.24 a	6.12 a	17.51 bc	7.66 a	7.16 a	1201.25 d	30.61 a	367.59 a
75	**20**	68.52 a	7.37 a	20.14 b	8.71 a	7.84 a	1240.96 b	34.37 a	426.48 a
	40	70.54 a	6.77 a	28.07 a	9.06 a	8.09 a	1269.19 a	32.39 a	411.01 a
	0	68.07 a	7.56 a	15.19 cd	7.02 a	7.01 a	1137.56 f	28.71 a	326.51 a
150	**20**	72.57 a	8.72 a	18.57 b	7.84 a	7.26 a	1245.37 b	32.94 a	410.15 a
	40	70.57 a	7.72 a	18.74b	8.59 a	7.71 a	1212.34 c	31.07 a	376.65 a

At a 5% probability level, there are non-significant differences between similar letters within a single column.

Data in Table 1, show significant differences among nitrogen fertilization levels in terms of seeds number/capsule at both study locations. Highest number of seeds for each capsule (8.81 and 8.47 seed/ capsule) was observed at second fertilization level. In comparison, lowest number (6.66 and 7.13 seed/capsule) was recorded in the no-fertilization treatment at both locations, respectively. The increase can be attributed to improved plant growth due to enhanced photosynthetic efficiency, resulting in a higher number of seeds for each capsule. These findings are consistent with those that Emam (2019) and El-Gedwy (2020) reported.

In Table 2, the results show important differences in the number of seeds for each capsule amongst the zinc concentrations at both locations. The third zinc concentration (40 mg/L) showed highest average seeds number/capsule (8.08 and 8.61 seeds/capsule), which was not significantly different from the zinc concentration of 20 mg/L, which recorded an average of 7.83 seeds/capsule at the College location. On the other hand, the control treatment (0 mg/L) recorded lowest average seeds number/capsule (7.22 and 7.08 seeds/capsule) at both locations. The positive role of zinc in the growth and production of reproductive parts, resulting in increased fertilization of a larger number of flowers and, subsequently, an increase in the number of seeds for each capsule, can elucidate this increase (Castrup et al., 1996). The findings of Al-Doori (2021) and Abdulla et al. (2023) are consistent with these conclusions.

Results in Table 3 indicate no major interaction between nitrogen fertilization levels and zinc for seed number/ capsule at the College and Wana locations.

The results in Table 1 show significant differences among nitrogen fertilization levels in 1000-seed weight at both the College and Wana locations. The highest average weight (7.79 and 7.69g) was recorded at second fertilization level, whilst lowest average weight (6.38 and 6.56 g) was observed in the no-fertilization treatment at both locations. This may be explained by the part nitrogen plays in the cytokine manufacturing process in plants, which promotes cell division and increases the seeds' ability to store energy, ultimately leading to an increase in weight. This finding is consistent with Emam (2019).

The information in Table 2 indicates important differences among zinc concentrations in 1000-seed weight at both study locations. The highest average weight (7.59 and 8.61 g) was recorded with application of zinc at a rate of 40 mg/l. In comparison, lowest average weight (6.56 and 7.08 g) was observed in the control treatment (0 mg/L) at both locations, respectively. The increase in the weight of 1000 seeds with higher zinc levels can be attributed to zinc's role in nitrogen metabolism in the plant, which extends the effective filling period of seeds by delaying leaf senescence. This results in an increased accumulation of photosynthesis, providing a more efficient source for dry matter production, thus increasing seed weight (Al-Mosuli, 2018). This outcome is consistent with the research conducted by Abdulla et al. (2023) and Al-Doori (2021). According to Table 3, neither location's interaction between nitrogen levels and zinc rates and was statistically significant for 1000-seed weight.

The second nitrogen fertilization level greatly outperformed the others, according to the data in Table 1, showing highest seed yield of 1209.75 and 1237.13 kg/ha at the college and Wana locations. On other hand, lowest seed yield was recorded at 1083.94 and 1103.81 kg/ha with no nitrogen addition at both study locations. The increase in seed yield can be attributed to higher capsules number/plant, seeds number/capsule, and 1000-seed weight (Table 1), which positively impacted seed yield. This outcome agrees with what El-Gedwy (2020) and Emam (2019) found. Additionally, Furthermore, Figures (1 and 2) illustrate how average nitrogen affects seed production at both sites.

Results given in Table 2, illustrate that Zn rates significantly affected seed yield at both locations. Zinc rate of 40 mg/L recorded highest seed yield at 1193.03 and 1211.49 kg/ha at the college and Wana locations. In comparison, the control treatment (0 mg/L) recorded the lowest seed yield at 1103.43 and 1122.80 kg/ha at both locations, respectively. The superior performance of the 40 mg/L zinc concentration in seeds number/ capsule number capsules / plant, and 1000-seed weight, (Table 2) positively impacted the seed yield per unit area. Result is consistent with Al-Juheishy's (2020) and Abdulla et al., (2023) findings. Additionally, Figures 1 and 2 illustrate the effect of zinc means on seed yield at study locations.

The results in Table 3 show a noteworthy interaction between nitrogen fertilization levels and zinc concentrations on seed yield at both experimental locations. Interaction between nitrogen fertilization level of 75 kg N/ ha with zinc concentration of 40 mg/L recorded the highest seed yield, with values of 1237.87 and 1269.19 kg/ha at the college and Wana locations, respectively. In contrast, interaction between first nitrogen level (0 kg N/ha) and first zinc rate recorded the lowest seed yield, with 1012.87 and 1029.59 kg/ha values at both locations, respectively.

The data in Table 1 indicate major differences in oil percentage in seeds between nitrogen fertilization levels at both study locations. The highest average oil percentage was recorded at the 150 kg N/ha fertilization level, with values of 31.47% and 32.46%. In comparison, the lowest average was observed in the control treatment (0 kg N/ha), with values of 28.91% and 29.71% at the college and Wana locations, respectively. This rise in the percentage of oil is explained by nitrogen's ability to promote vegetative growth, which delays seed maturity and filling, leading to an increase in starch and protein compounds and subsequently reducing the oil percentage in the seeds. These findings are consistent with those that Hassen and Shaker (2013-a) and El-Gedwy (2020) reported. In addition, Figures 1 and 2 illustrate the effect of nitrogen averages on the oil percentage at both locations.

In Table 2, the results show noteworthy differences in oil percentage in seeds between the zinc concentrations at both study locations. The highest oil percentage was observed with the application of zinc at a average of 20 mg/L, with values of 32.06% and 33.02%. In comparison, the lowest oil percentage was recorded in the control treatment (0 mg/L), with values of 28.14% and 28.93% at the college and Wana locations, respectively. This rise in oil % can be ascribed to zinc's function in enzymatically boosting oil creation in seeds as well as its involvement in enhancing and increasing photosynthetic products as they are transferred from leaves to seeds (Broadley et al. 2007). These findings support those reported by Al-Doori (2021). Moreover, Figures 1 and 2 illustrate the effect of zinc averages on the oil percentage in seeds at college and wana locations.

Data in Table 3, designate no significant interactions between nitrogen levels and zinc concentrations on oil percentage in seeds at both locations.

Results in Table 1, show significant different in oil yield between nitrogen fertilization levels at the college and Wana locations. highest oil yield was noted in second fertilization level (75 kg N/ha), with values of 381.12 and 401.69 kg/ha, respectively. In contrast, the control treatment (0 kg N/ha) recorded the lowest oil yield, with values of 313.78 and 328.63 kg/ha at both locations, respectively. This increase in oil yield can be attributed to increased seed yield with nitrogen addition. These conclusions are consistent with those reported by Hassen and Shaker (b2013-a) and Emam (2019).

In Table 2, the data show substantial differences in oil yield between zinc concentrations at both locations. At the college site, the zinc rates of 20 and 40 mg/l recorded highest oil yields of 376.94 and 358.48 kg/ha, respectively, while control treatment had lowest oil yield of 310.99 kg/ha. In Wana, the zinc concentration of 20 mg/L resulted in highest oil yield of

398.29 kg /ha, conversely, control treatment recorded lowest oil yield of 325.64 kg/ha. This growth can be credited to the rise in seed yield at the 40 mg/L zinc concentration (Table 2). Result are consistent with findings of Al-Juheishy, (2020) and Al-Doori, (2021).

Data in Table 3, show that statistical significance was not achieved in interaction between nitrogen levels and zinc for the quality of oil yield at both the college and Wana locations.

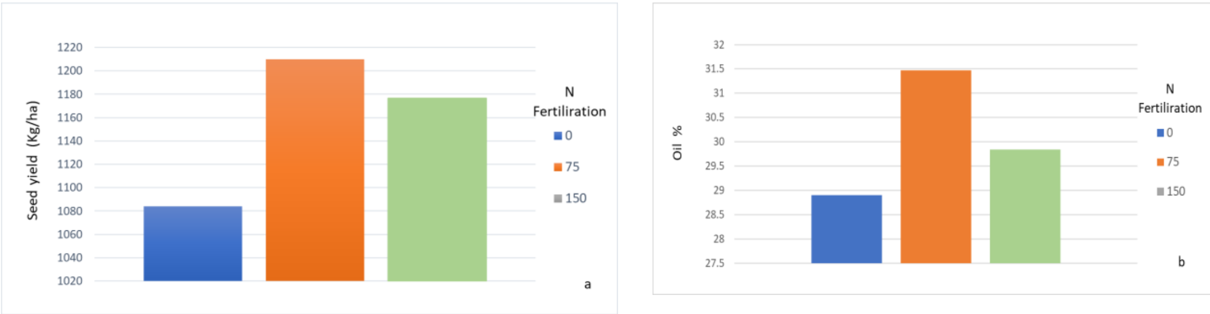

Figure 1. Shows the influence of nitrogen on seed yield (a), oil percentage in seeds (b), and the influence of zinc on seed yield (c), and oil percentage in seeds (d) for college location.

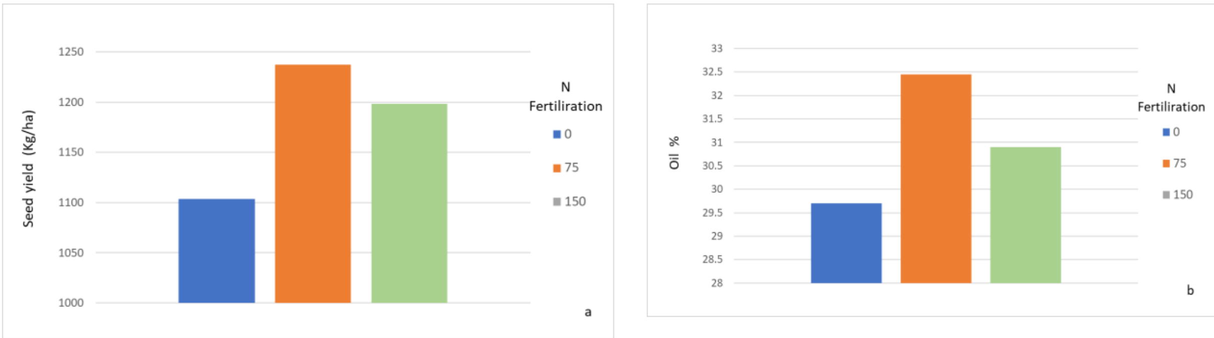

Figure 2. Shows the influence of nitrogen on seed yield (a), oil percentage in seeds (b), and the influence of zinc on seed yield (c), and oil percentage in seeds (d) for wana location.

CONCLUSION

As a result of applying 75 kg N/ha of fertilizer to flax plants, seeds number/ capsule, capsules number/ plant, 1000-seed weight , seed yield , oil percentage in seeds, and oil yield were all raised. In addition, seeds number / capsule, capsules number / plant, 1000-seed weight , and seed yield output rose when 40 mg Zn/l was sprayed on flax plants.

CONFLICT OF INTEREST

Researchers agree that this work does not interfere with the interests of other individuals.

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