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Response of rapeseed varieties (*Brassica napus* L.) to foliar application of zinc.

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ABSTRACT

A field experiment was conducted during winter season of 2021-2022 in two sites, in Field Crops Department - College of Agriculture and Forestry/ University of Mosul and other in Badoush Dam site, to assess response of three varieties of rapeseed to foliar spraying of zinc and its impact on the qualities of growth and yield. The experiment was applied in a split plot design. With three replications according to Randomized complete Block Design, as the main Plot contained three verities of rapeseed (Pactol, Srew, Rendy), while the secondary Plot contained three concentrations of zinc (0, 25, 50 mg L^{-1}). The findings showed that the Pactol variety give the tallest mean height of plant. Conversely, the Srew variety gave the most branches on for plant, siliques number for plant, a thousand seeds' weight, plant yield, oil percentage, oil yield and for both sites. Findings indicated 25 mg L^{-1} concentration, which yielded the tallest mean plant height, branch number for plant and oil percentage. On the contrary, zinc concentration resulted in 50 mg L^{-1}, which amounted to the maximum overall mean dry weight of plant, siliques number for plant, seed number for silique, a thousand seeds' weight, seed yield and oil yield for both sites. The findings also established that the cultivation of the Srew variety, complemented by zinc at 50 mg L^{-1} concentration, yielded the highest outcomes concerning the dry weight of the plant in the dam site, siliques number for plant, seed yield and oil yield in both sites.

KEYWORDS: Rapeseed; varieties; zinc; yield; oil.

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استجابة اصناف من السلجم (*Brassica napus* L.) للتغذية الورقية بالزنك

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الملخص

أجريت تجربة حقلية خلال الموسم الزراعي الشتوي 2021-2022 في موقعين، قسم المحاصيل الحقلية - كلية الزراعة والغابات / جامعة الموصل والاخر في موقع سد بادوش، لتقييم استجابة ثلاثة أصناف من السلجم للرش الورقي بالزنك وتأثيره على صفات النمو والحاصل. أجريت التجربة الحقلية بترتيب الالواح المنشقة باستخدام تصميم القطاعات العشوائية الكاملة بثلاثة قطاعات، حيث احتوت الألواح الرئيسية على ثلاثة اصناف من السلجم (**Pactol**، **Srew**، **Rendy**)، بينما احتوت الألواح الثانوية على ثلاثة تراكيز من الزنك (0، 25، 50 ملغم لتر$^{-1}$). أظهرت النتائج أن صنف **Pactol** أعطى أعلى متوسط لارتفاع النبات. وعلى العكس من ذلك، اعطى صنف **Srew** أكبر عدد لأفرع النبات، عدد الخردلات للنبات ، ووزن الألف بذرة، حاصل البذور، نسبة المئوية للزيت وحاصل الزيت ولكلا الموقعين. أشارت النتائج إلى أن تركيز 25 ملغم لتر$^{-1}$ أعطى أعلى متوسط لارتفاع للنبات عدد الافرع للنبات ونسبة المئوية للزيت، وعلى العكس من ذلك أعطى تركيز الزنك 50 ملغم لتر$^{-1}$ اعلى متوسط للوزن الجاف للنبات وعدد الخردلات للنبات وعدد البذور للخردلة، وزن الف بذرة، حاصلي البذور والزيت لكلا الموقعين. كما أثبتت النتائج أن زراعة صنف **Srew** مع الزنك بتركيز 50 ملجم/لتر أعطت أعلى النتائج فيما يتعلق بالوزن الجاف للنبات في موقع السد وعدد الخردلات للنبات وحاصل البذور وحاصل الزيت في كلا الموقعين.

الكلمات المفتاحية: السلجم، الأصناف، الزنك، الحاصل، الزيت.

INTRODUCTION

As the world's second-largest oil crop after soybeans in less than 20 years, Rapeseed (*Brassica napus* L.) is regarded as one of the primary oil crops and a major source of vegetable oils (FAO, 2014). There is an estimated 33.82 million hectares of cultivated land on Earth, of which production is estimated at 66.54 million tons (USDA, 2016). In Iraq, rapeseed is cultivated on a small scale and limited to the level of experiments. Rapeseeds have a high oil content of 40-50% and protein of up to 39% (Eskandari and Kazemi, 2012).

Due to its importance as a critical oil crop for future agricultural investments, we must carefully analyze and research its growing methods under various environmental conditions to increase its cultivation.

Zinc concentrations and variety differences have the greatest effects on seed and oil output because they affect the development of vegetative growth (photosynthesis area), the buildup of dry matter, and the yield. According to studies, one of the main causes of the drop in crop output and quality is nutrient deficiencies, particularly those involving micronutrients (Al-Zyadi, 2023).

Genetic and environmental factors are crucial in the growth and yield of rapeseeds, including the differences between varieties, which affect their components and the oil content of the seeds.

As a catalyst in oxidation and reduction processes, zinc plays a crucial role in production of hormones, which contribute to elongation of plant cells and the activation of enzyme activity. It contributes to the production of glycerol, lipids, and chlorophyll. It also contributes to the conversion of CO2 to HCO3 during photosynthesis and the production of starch in seeds. Additionally, it causes the plant to accumulate more dry matter, and when soil levels fall, the plant becomes stunted and its leaves become brown and yellow (Alloway, 2008).

In his investigation of three canola varieties (Show, Licord and Oscar), Al-Doori (2011) found that the cultivars differed greatly in terms of the plant height, number of branch, dry weight, siliques number for plant, seeds number for silique, a thousand seeds' weight, seed yield, oil percentage, oil yield. Al-Doori (2013) discovered in his analysis of three canola cultivars (Tantal , Kroko and Rapol) that Kroko was superior in terms of plant height, number of branch, seed number, seed yield and oil percentage and yield. Monfared et al. (2019) noted in their examinations in which they utilized a few assortments of canola (RGS003, Sarigol, Zafar, Dalgan, Julius) that Sarigol had prevalence in siliques number for plant, seeds number for silique, a thousand seeds' weight, seed yield and oil percentage contrasted with different cultivars. The outcomes got by Afsahi et al. (2020) during their investigation of two assortments of rapeseed (Okapi and Tassilo) showed that the Okapi cultivars was essentially prevalent in seeds number for silique, a thousand seeds' weight, seed yield, oil % contrasted and the other assortment. Ghareeb et al. (2024) demonstrated that the Pionner cultivar had the greatest values for plant height, head diameter, and quantity of seeds per head in their investigation of four sunflower cultivars (HS360, Flamme, Dakota, and Pionner) .

In his investigation of three zinc concentrations (0, 35, and 70 mg L^{-1}) on the flax plant, Al-Juheishy (2020) observed that there was a variation in zinc concentrations in plant height, branch number for plant, pods number for plant, seeds number for pod, Weight of 1000 seeds, seed yield, oil percentage and oil yield. Outcomes came to by Afsahi et al. (2020) during their investigation of a few concentrations of zinc that surpassed the convergence of 5 g L^{-1} showed critical in seeds number for mustard, a thousand seeds' weight, seed yield, oil ratio. Outcomes came to by El-Sayed et al. (2021) investigation of three zinc concentrations (0, 50, and 100 ppm) revealed statistically significant variations in zinc concentrations with respect to plant height, branch number, mustards number for plant, a thousand seeds' weight, seed yield. Mumivand et al. (2021) tracked down in their trial for two concentration of zinc (0.3 and 0.6%) that the level 0.6% give weight value for number of branch, a thousand seeds' weight and seed yield. In their study of zinc concentrations (0, 150, and 300 mg L^{-1}), Shaaban et al. (2023) found that the concentration of 300 mg L^{-1} was higher in number of siliques and seed yield.

The goal of this study is to investigate the resonance of rapeseed varieties to foliar zinc nutrition and how this affects growth and production characteristics

MATERIALS AND METHODS

A field experiment was conducted during winter season of 2021-2022 in two sites, in Field Crops Department - College of Agriculture and Forestry/ University of Mosul and other in Badoush Dam site, to assess response of three varieties of rapeseed to foliar spraying of zinc and its impact on the growth and yield. The experiment was applied in a split plot design, with three replications according to Randomized Complete Block Design, as main plot contained three verities of Rapeseed (Pactol, Srew, Rendy), while the secondary plot contained three concentrations of zinc (0, 25, 50 mg L^{-1}) in the form of zinc sulphate (ZnSo4.7H2O 35% Zn). Zinc concentrations were added at the beginning of flowering. In two doses, 160 kg of nitrogen fertilizer (N 46%) was given to the experiment at a rate of 160 kg urea ha^{-1}, Half of it at planting, and the remaining half a month later. Additionally, a dose 120 kg ha^{-1} of triple calcium superphosphate fertilizer (P2O5 48%) was applied during plowing. Land of the experiment was ploughed with a disc plough in a perpendicular manner, then smoothed and levelled, followed by their division into experimental units, each of which had five lines spaced 30 cm apart. An experimental unit's area was (2 × 1.5 = 3 m2). At a depth of 0–30 cm, physical and chemical characteristics of experimental soil were examined. The land of the experiment was planted on 11/20/2021, crop service operations were applied whenever necessary, and harvesting was carried out when plants reached the stage of full growth. 10 plants were taken randomly from central lines of each experimental unit, and following features were studied: plant height (cm), branch number for plant, dry weight for plant (g), siliques number for plant, seeds number for silique, weight of 1000 seeds, seed yield (kg ha^{-1}), oil percentage (%), and oil yield (kg/ha).

The means were compared using Duncan's multiple range test at the 1 and 5% probability levels after the data had been statistically analyzed according to the experiment's design (Al-Rawi and Khalaf-Allah, 2000).

Physical and chemical characteristics of the experimental soil.

Physical characters	planting location	
	Faculty site	Badoush Dam site
Sand (%)	21.80	53.39
Silt (%)	35.68	27.30
Clay (%)	42.52	19.31
Texture	clay	sandy loam
Chemical characters		
Nitrogen (ppm)	50	57
Phosphorus (ppm)	6.0	3.4
Potassium (ppm)	176	117.5
Electrical conductivity (dS/cm)	0.46	0.14
pH	7.3	7.5

RESULTS AND DISCUSSION

Plant height (cm):

The Pactol variety recorded highest mean for this characteristic, reaching 114.48 and 115.55 cm for both locations, while the Rendy variety recorded lowest mean, reaching 103.56 and 110.37 cm and for both experimental sites, respectively as Table (1) makes evident. Genetic heterogeneity among the varieties could be the cause of this. It is in line with the findings of Al-Juheishy (2020), Al-Doori (2011), and Al-Doori (2013).

Information in Table (2) shows that the maximum plant height was 113.10 cm and 117.22 cm when exposed to a concentration of zinc of 25 mg L^{-1}. In contrast, the lowest measured was 107.04 cm and 106.49 cm in the control treatment that did not use zinc 0 mg L^{-1} in each respective place and for both experimental sites, respectively. This is a result of the function of zinc in tryptophan biosynthesis, a precursor to auxin hormone (IAA), a key regulator of cellular elongation in a plant (Cakmak and Marschner, 1993). According to the findings, Mumivand et al. (2021) and El-Sayed et al. (2021).

In addition, Table (3) shows that there was no significant interaction between different varieties of plants and concentration of zinc in plant height and for both experimental sites.

Branches number for plant:

According to Table (1)'s findings, the Srew variety had highest number of branches 4.96 and 4.98 branches $plant^{-1}$, while the Rendy variety had lowest mean branch number 3.77 and 4.00

branches plant^{-1} and for both experimental sites. The genetic differences could be the cause of this. This outcome is in line with what Al-Doori (2011), Al-Doori (2013), and Al-Juheishy (2020) found.

According to the findings in Table (2), the highest value branch number for plant 5.22 and 5.50 branches per plant occurred at a zinc concentration of 25 mg L^{-1}, while non-addition treatment had lowest mean branch number for plant 3.30 and 3.30 branches per plant and for both experimental sites. Given that zinc is necessary for plant life and has been shown in studies to activate over 300 enzymes, particularly those involved in protein and cell metabolism and nucleic acid synthesis, the rise in plant branches may be caused by zinc (Castrup et al., 1996). This is consistent with what was indicated by El-Sayed et al., (2021) and Mumivand et al., (2021).

According to Table (3), the number of plant branches and for both experimental sites does not significantly alter depending on the interaction between verities and zinc concentrations.

Dry weight of plant (g):

Results of Table (1) mention that Pactol and Srew verities were superior in giving the highest significant mean for this feature, reaching 20.82 and 21.96 g at the college site, and the Srew verity was superior 23.47 g at the dam site, while the Rendy verity gave the lowest mean for this feature, reaching 19.56 and 20.06 g and for both experimental sites, respectively. The Srew variety's physiological and morphological capacity to develop leaves may be the cause of its capacity to store dry materials, thus increasing the leaf area and its index, this increased photosynthetic efficiency and, thus, the pace at which dry matter accumulated. This aligns with the points made by Al-Doori (2011).

The findings presented in Table (2) demonstrate that the zinc concentrations of 25 and 50 mg L^{-1} had the highest mean for this characteristic, achieving 21.16 and 22.44 g at the college site and 23.47 g at the dam site, respectively. The treatment without addition had the lowest mean for this characteristic, achieving 18.75 and 19.27 g and for both experimental sites. This could be explained by zinc's function in enhancing the plant's vegetative development, in addition to the lack of competition for food, which in turn positively affects increase in dry weight of plant.

Based on the findings in Table (3), the highest mean for this characteristic was attained when the Serw variety was sprayed with 50 mg L^{-1} of zinc added, while the lowest mean for this feature was (18.73 g) when planting the Rendy variety without adding zinc at dam site. As for the college site, the overlap did not reach the level of statistical significance.

Number of siliques per plant:

According to Table 1's results, the Srew variety had the largest mean number of siliques

146.78 and 151.35 siliquae per plant, while the lowest mean number 118.04 and 119.42 siliquae per plant was in the Rendy variety and for both locations, respectively. The superiority could be attributed to the Srew variety's growth characteristics, genetic composition, and number of branch. This is consistent with what was found by Monfared et al. (2019), Afsahi et al. (2020), and Al-Juheishy (2020).

According to Table (2)'s findings, in a zinc rate of 50 mg L^{-1}, greatest number of siliques was 143.56 and 146.13 siliquae per plant, while lowest value for number of siliques was 125.97 and 129.35 silique per plant in the control treatment and for both experimental sites. The observed impact can be explained in terms of the role of zinc in cell membrane synthesis that increases their functionality and protects them from oxidative harm that can be caused by different routes of oxygen reaction processes. In addition to that, zinc plays a protective function in cellular systems that prevents such oxidative processes in cellular membranes (Alghamdi, 2009). The results of this work agree with those found in studies carried out by Al-Doori (2013), El-Sayed et al., (2021), and Shaaban et al., (2023).

Results presented in Table (3) evidently indicate that growing the Srew variety using a treatment of 50 mg L^{-1} of zinc provided the maximum mean for this trait, having 163.28 and 168.13 silique seeds per plant. Growing the Rendy variety in a condition without a supplement of zinc provided the minimum mean for this trait, having 107.95 and 109.78 silique seeds per plant in their respective experiment plots.

Number of seeds per silique:

the Pactol variety recorded the greatest value, reaching 16.49 and 16.93 seeds per silique, while The Rendy variety recorded the lowest mean for this feature, reaching 12.63 and 13.16 seeds per silique and for both experimental sites, respectively, as can be seen from the data in Table 1. One possible explanation for this could be that as the quantity of siliques decreased, the number of seeds in silique increased, which led to the advantage of the Pactol variety. Al-Doori (2011), Afsahi et al. (2020) and Al-Juheishy (2020) all got similar results.

Data in Table (1) also display that maximum seed number per silique of 15.75 and 15.85 were observed when there was application of zinc concentration of 25 and 50 mg L^{-1}, respectively, in the college experimental site. The maximum count of 17.35 of seeds per silique was observed when there was application of 50 mg L^{-1} of zinc in the Dam site. In contrast, minimum counts of 12.05 and 11.92 of seeds per silique were observed in the control (without application of zinc) and for both experimental sites. This is explained by the function of zinc in improving the yield of nutrient required in seed formation in plants (Soomro et al., 2000). The results agree with those of Afsahi et al. (2020).

Table (2) also shows that there is no notable interaction between varying varieties and concentration of zinc in respect of number of seeds per silique and for both experimental sites.

Weight of 1000 seeds (g):

The data presented in Table (1) display a high incidence of the Srew variety in terms of maximum weight of 1000 seeds, standing at 3.29 and 3.46 g. Further, this variety was found to be in no statistically significant variance with that of the Pactol variety at the dam location, standing at 3.17 g. In contrast, the Rendy variety displayed a minimum weight of 1000 seeds, standing at 2.80 and 2.88 g and for both experimental sites, respectively. This result is likely to be a reflection of the high adsorption and storage capacity of photosynthesis products in the seeds of the Srew variety, compared to that of the Pactol and Rendy varieties. The results concur with those of Al-Doori (2013), Monfared et al. (2019) and Al-Juheishy (2020).

Results presented in Table (2) point to a concentration of 50 mg L^{-1} of zinc to yield a maximum measurement of this trait, standing at 3.37 and 3.66 g. In contrast, a treatment that was lacking in zinc was found to yield lower measurements of this trait, standing at 2.54 and 2.67 g and for both experimental sites, respectively. This result is likely a reflection of the non-compete nature of the seeds in acquiring the nutrient components of the plant to limit stress effects on the seeds and hence to boost the percentage of flowering pollination. Afsahi et al., (2020), El-Sayed et al., (2021), and Mumivand et al., (2021) all conducted studies that support this finding.

The results presented in Table (3) point to a failure to detect a significant interaction between concentration of zinc and varieties in terms of weight of 1000 seeds and for both experimental sites.

Seed yield (kg ha^{-1}):

According to the information in Table 1, the Srew variety provided the highest mean seed yield, measuring 1276.81 and 1342.43 kg ha^{-1}, whereas the Rendy variety produced the lowest mean seed yield, measuring 11115.86 and 1199.22 kg ha^{-1}, and for both experimental sites. This discrepancy is explained by the Srew variety's superior performance in terms of plant dry weight, siliques number for plant, and weight of 1000 seeds (Table 1), all of which combined to produce a higher yield of seeds. The results support the results in studies carried out by Al-Doori, (2013) and Afsahi et al., (2020).

Results shown in Table (2) also indicate that a rate of 50 mg L^{-1} of zinc led to the maximum readings of this parameter, measured at 1304.38 and 1365.67 kg ha^{-1}, while that of the control treatment was found to be the lowest at 1065.26 and 1137.06 kg ha^{-1} and for both experimental sites, respectively. One explanation for this is that zinc's role in raising yield components, shown in Table

2, in a way that results in an improvement in the yield of seeds. This is in support of the results found in studies carried out by Afsahi et al. (2020), El-Sayed et al. (2021), Mumivand et al. (2021), and Shaaban et al. (2023).

The information in Table (3) shows that the Srew variety exhibited the maximum mean yield for this trait when given a supplement of zinc of 50 mg L^{-1}, namely 1368.80 and 1427.63 kg ha^{-1}. The lowest mean yield of this trait was shown by the Rendy variety when it was not given any supplement of zinc, registering 107.93 and 1058.53 kg ha^{-1} and for both experimental sites, respectively.

Oil percentage (%):

The data in Table (1) shows that the Srew variety had the highest mean for the trait, recording 36.92% and 37.60%. The opposite was true for the Rendy variety, which had the lowest mean for this trait, 30.48% and 37.60% for both experimental sites. The high percentage of oil in the Srew variety is a result of its genetic makeup. These results align with those of Al-Doori (2013), Monfared et al. (2019) and Al-Juheishy, (2020).

Results in Table (2) offer that maximum levels of oil in the seeds, 36.5% and 37.48%, were realized when there was a concentration of zinc of 25 mg L^{-1}, while minimum levels, 31.67% and 32.68%, were found in control treatments for both experimental sites. This is explained by the fact that zinc enhances the process of photosynthesis in plants, increases transportation of photosynthesis products to the seeds, and catalyzes oil synthesis in crop seeds (Martin et al., 2007). This result is in support of claims by Afsahi et al. (2020).

Table (3) shows that there is no interaction between varieties and concentration of zinc that influences oil percentage and for both experimental sites.

Oil yield (kg ha^{-1}):

Data in Table 1 evidently indicate that the Srew variety produced a maximum oil yield per hectare measured in terms of 474.56 and 507.58 kg ha^{-1}, while a minimum oil yield per hectare of 341.00 and 379.58 kg ha^{-1} was observed and for both experimental sites. This is attributed to the high oil percentage and high seed yield of the Srew variety. The results of this work concur with Monfared et al. (2019), Afsahi et al. (2020), and Al-Juheishy (2020).

Results shown in Table (2) indicate that a maximum oil yield per hectare of 449.95, 449.54 and 486.58, 489.61 kg ha^{-1} was observed after applying a concentration of 25 and 50 mg L^{-1} of zinc, while a minimum oil yield per hectare of 338.88 and 372.84 kg ha^{-1} was observed in the control treatment without any added zinc and for both experimental sites. This improvement is attributed to a boost in oil percentage and seed yield of these particular concentrations of zinc (Table 3), resulting in a higher oil yield.

Results shown in Table (3) also mention that growing Srew variety after adding a concentration of 25 and 50 mg L^{-1} of zinc resulted in maximum mean values of this trait measured at 529.70, 525.14 and 560.25, 559.63 kg ha^{-1}, compared to minimum mean values of this trait measured in the Rendy variety of 277.99 and 312.98 kg ha^{-1}, when no zinc was administered and for both experimental sites.

Table 1. Varieties' effects on growth, yield and its constituents.

Varieties	Plant height (cm)	Branch number/ plant	Dry weight of plant (g)	Siliques number/ plant	Seeds number/ silique	Weight of 1000 seeds (g)	Seed yield (kg ha^{-1})	Oil percent-age (%)	Oil yield (kg ha^{-1})
Faculty site									
Pactol	114.48a	4.46b	20.82a	139.32b	16.49a	3.00b	1200.73b	35.17b	422.80b
Srew	112.89b	4.96a	21.96a	146.78a	14.52b	3.29a	1276.81a	36.92a	474.56a
Rendy	103.56c	3.77c	19.56b	118.04c	12.63c	2.80c	1115.86c	30.28c	341.00c
Dam site									
Pactol	115.55a	4.41b	21.41b	143.16b	16.93a	3.17ab	1254.65b	36.76b	461.87b
Srew	113.04b	4.98a	23.47a	151.35a	15.46b	3.46a	1342.43a	34.60a	507.58a
Rendy	110.37c	20.06c	20.06c	119.42c	13.16c	2.88c	1199.22c	31.56c	379.58c

No discernible difference exists between values in a column that are followed by the same letter.

Table 2. Zinc effect on growth, and its components.

zinc concentrations (ml L^{-1})	Plant height (cm)	Branch number/ plant	Dry weight of plant (g)	Siliques number/ plant	Seeds number/ silique	Weight of 1000 seeds	Seed yield (kg ha^{-1})	Oil percent-age (%)	Oil yield (kg ha^{-1})
Faculty site									
0	107.04c	3.30c	18.75b	125.97c	12.05b	2.54c	1065.26c	31.67c	338.88b
25	113.10a	5.22a	21.16a	134.56b	15.75a	3.17b	1223.76b	36.57a	449.95a
50	110.80b	4.67b	22.44a	143.61a	15.85a	3.37a	1304.38a	34.34b	449.54a
Dam site									
0	106.49c	3.30c	19.27c	129.35c	11.92c	2.67c	1137.06c	32.68c	372.84b
25	117.22a	5.50a	21.83b	138.46b	16.28b	3.19b	1293.57b	37.48a	486.58a
50	115.25b	23.84a	23.84a	146.13a	17.35a	3.66a	1365.67a	35.75b	489.61a

No discernible difference exists between values in a column that are followed by the same letter.

Table 3. Varieties' and zinc concentrations' interactions with growth, yield, and its components.

Varieties	zinc concentra-tions L^{-1}) (ml	Plant height (cm)	Branch number/ plant	Dry weight of plant (g)	Siliques number/ plant	Seeds number/ silique	Weight of 1000 seeds (g)	Seed yield (kg ha^{-1})	Oil percent-age (%)	Oil yield (kg ha^{-1})
Faculty site										
	0	112.00	3.28	19.43	154.70c	13.06	2.43	1104.96g	33.46	369.81c
Pactol	**25**	115.80	5.23	21.46	121.06e	18.00	3.13	1206.88e	37.51	452.78b
	50	115.66	4.88	21.58	151.20b	18.41	3.43	1290.35c	34.55	445.82b
	0	107.78	5.85	18.86	124.30e	11.78	2.80	1113.81f	33.11	368.85c
Srew	**25**	115.91	5.85	21.91	152.78b	15.16	3.55	1347.81b	39.30	529.70a
	50	114.98	5.45	25.11	163.28a	16.18	3.53	1368.80a	38.36	525.14a
	0	101.35	3.03	17.95	107.93g	11.30	2.40	977.00h	28.45	277.99d
Rendy	**25**	107.58	4.60	20.11	129.85d	13.66	2.85	1116.58f	32.90	367.37c
	50	101.75	3.68	20.63	116.35f	12.95	3.15	1254.01d	30.11	377.66c
Dam site										
	0	110.46	3.48	19.50d	151.40c	13.60	2.75	1158.53h	34.76	402.68c
Pactol	**25**	118.88	5.21	22.23bc	125.00e	18.48	3.23	1255.93e	39.10	491.18b
	50	117.30	4.55	22.50bc	22.50bc	18.73	3.55	1349.73c	36.43	491.75b
	0	105.05	3.58	19.60de	126.86e	11.78	2.86	1194.36g	33.73	402.86c
Srew	**25**	117.21	6.68	23.23b	159.06b	16.53	3.55	1405.31b	39.86	560.25a
	50	116.86	4.68	27.10a	168.13a	18.08	3.98	1427.63a	39.20	559.63a
	0	103.96	2.85	18.73e	109.78g	10.40	2.41	1058.53i	29.56	312.98d
Rendy	**25**	115.56	4.60	20.03b-d	131.33d	13.85	2.80	1219.48f	33.48	408.32c
	50	111.58	4.55	21.43b-d	117.16f	15.23	3.45	1319.66d	31.63	417.45c

No discernible difference exists between values in a column that are followed by the same letter.

CONCLUSION:

The findings of this study showed that Srew variety was superior in giving high, yield of seeds and oil percentage. In addition to that, it was found that a treatment of a zinc concentration of 50 mg L^{-1} brought improvements in the yield of seeds and oil.

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