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Some Yield Components, Active Compounds, And Oil Properties of the Genotypes Black Seed Plant Using Different Sea Extracts

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ABSTRACT: A conducted a factorial experiment according to the randomize complete block design and with three repetitions during the winter season (2025) at the Agricultural Research Station of the Faculty of Agriculture - The study influence of foliar spraying with four types of sea extracts and in four namely (Seaweed Extract at a concentration of 1 g/l), (Organic products at a concentration of 1.5 ml/L), (alga 600 at a concentration of 1.250 g/L), and (Combe one at a concentration of 1 g/l). estimation of some effective compounds of six genotypes of the black seed, namely (local, Turkish, Syrian, Indian, Pakistani, and Bengali). The results of the statistical analysis showed that the treatment with sea extracts was significantly superior, as the spraying treatment with sea extract (Alga 600) at a concentration of 1.250 g / L outperformed in the number of capsules per plant (9.03) capsules.plant-1 Nigellone (15.160)% p-cymene (17.255)% oil percentage (39.533) % refractive index (1.522) specific density (0.9452). The genotypes (Indian) were distinguished by superiority in the number of capsules per plant (9.0)capsules. plant-1, Nigellone (16.091)%, p-cymene (18.144)%, percentage of oil (39.837) %, specific density (0.961), genotype (Pakistan), and the number of seeds in the capsule (63.05) seeds. capsule-1, Weight of 1000 seeds (2.56) g, and refractive index (1.544). The interaction between the sea extract (Alga 600) with a concentration of 1.250 g/ L with genotype (Indian)was superior in the number of capsules per plant (13.8) capsule. plant-1 excels in all effective compounds and properties of the oil.

INTRODUCTION:

The seeds are used locally and are characterized by their versatility, most notably the extraction of oil and resins for medicinal purposes, in addition to their importance in export, crop diversity and increasing income, which made them suitable Agricultural Alternatives in small lands, as is the case in Ethiopia (Bessalegn and Wubeshat, 2019).

The seeds were used in traditional medicine for various diseases, including (obesity, heart disease, back pain, asthma, cough, chest, bronchitis, fever, dizziness, congestion, cardiovascular diseases, congestion, chronic headaches, paralysis, digestive disorders, infections), as well as seed oil is used for healing(swollen joints, nasal ulcers, abscess, eczema, testicular infections) and the oil is combined with honey to treat asthma problems, chest congestion and bronchospasm (gholamnezhad et al., 2016).

One of the recently adopted methods in plant nutrition, marine algae are used and they are known as tricarbon chlorophilic plants that do not have roots, stems or real leaves, their locations vary, they may live in sea or fresh water or even high humidity places and develop abundantly thanks to the mineral elements available in the water and it is added in low concentrations to provide plants with essential nutrients and (Al-Ealayaw and Al-Dulaimy, 2023).

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Sea algae also include phytohormones, which lead to increased resistance to stressful conditions to which the plant may be exposed, and marine algae may reduce the oxidation of Vitamin C and vitamin E available in chloroplasts, which increases the efficiency of carbon metabolism and thereby improve plant growth and development (Almousaei et al., 2024).

The genotypes of plants vary significantly, as some have a greater ability to adapt and grow in certain conditions, while others may show weakness in the same conditions, so the study and analysis of genotypes, taking into account environmental and nutritional factors, is necessary to improve and develop new varieties possessing desirable qualities such as increased productivity, improved oil quality, and tolerance to difficult environmental conditions (Singh et al., 2024). A study conducted on the Black Seed Plant in the province of Kirkuk When evaluating performance and some genetic indicators of black seed) Mohammed et al, 2022) and when using the effect of nano-composting with the presence of spaces between the lines (Mohammed et al, 2023**)** The study aimed at the components of the yield, and some effective compounds and the properties of the oil.

MATERIALS AND METHODS

The experiment according to the coordinates of the experiment location (35 28 North,44 23 east) was conducted at the Agricultural Research Station of the Faculty of Agriculture, University of Kirkuk, for the winter season 2025 he experiment was carried out as a split-factor experiment with the randomize complete block design in three replication to study the role of four sea extracts (seaweed extract, Organic products, Alga600, Combe one) in the performance of six genotypes of black seed (local, Turkish, syrain, Indian, Pakistan, Bengali), each block contains (24) experimental unit, date planted on 2025/11/10, the area of the experimental unit is(6) m2 with a dimension of 2×3 m, where the distance between the line and the last 0.5 m and the distance between the plant and the last 0.25 m, and the extracts were sprayed by a back sprinkler in the morning to a degree of coverage and the plants will be sprayed until wetness at a rate of(3-4) sprays during the season, provided that the first spraying was a month after planting and between one spray and another two weeks, and for each genotypes applied to 24 transactions per repeater, the experience was harvested on 27/5/2026. The data were statistically analyzed according to the design used in the experiment, as stated by (Al-Zubaidy and Al-Falahy 2016), then the differences between the averages were compared according to the Tukey test at the probability level (0.05) and regardless of the calculated value (F), excel, and Agri analyzes were program used to perform the statistical analysis.

RESULTS AND DISCUSSION

The data analyzed Table (1) analysis of the variance and the differences between the sea extracts were significant in the traits (number of seeds per capsule, number of capsule per plant, percentage of oil, active compounds), sea extracts improve the absorption of nutrients and reflects positively on plant growth and productivity because they contain vital compounds and natural growth regulators that activate physiological processes and increase the efficiency of photosynthesis (Al-fraihat et al., 2023).

This may be due to the genetic difference and the associated discrepancy in the efficiency of exploitation of environmental and genetic resources between the genotypes and the difference in their susceptibility to growth and production and the composition of the effective compounds of the studied traits (Thani et al., 2024).

The interaction between sea extracts and genotypes was significant in (number of capsule per plant, number of seeds in a capsule, weight of 1000 seeds, and Nigellone), which indicates the existence of an interaction between genetic and environmental factors, which indicates a different response of genotypes to sea extract, and the difference of genotypes in their ability to produce and accumulate volatile oils and its components(Mohammadi et al., 2019).

Table (1) analysis of the variance of the studied traits

SOV	d.f	No of capsule per plant (capsule plants^{-1})	No of seeds per capsule (seed per capsule^{-1})	Weight of 1000 seeds (g)	p_cymene) (%
Block	2	1114.00**	1612.12**	1.24**	0.02NS
Sea extract	3	11.59**	178.76**	0.09NS	34.34**
Error (a)	6	0.47	7.90	0.02	0.07

Genotypes	5	9.39*	198.20**	0.14*	43.81**
Sea extract× genotypes	15	5.89**	51.40**	0.25**	0.06NS
Error (b)	40	3.45	16.45	0.06	0.04
SOV	d.f	Nigellone) (%	Oil percentage(%)	Specific density	Refractive index
Block	2	0.00004NS	23.43**	0.048**	0.11**
Sea extract	3	32.61**	7.08**	0.0014NS	0.0049NS
Error (a)	6	0.02	0.53	0.0010	0.0055
Genotypes	5	40.20**	8.01**	09.0035**	0.01**
Sea extract× genotypes	15	0.11**	0.10NS	0.0002NS	0.0012NS
Error (b)	40	0.03	0.56	0.0003	0.0021

(**), (*), and (n.s) Significant at 1%, 5%, and not significant respectively

1. **Number of capsules per plant (capsule plant^{-1}):**

The results of Table(2) show the effect of sea extract, genotype and interaction between in the number of capsule per plant (plant capsule^{-1}) to the presence of significant differences when spraying using sea extract (Alga 600) outperformed the rest of the extracts gave an average of (9.03) capsule plant^{-1}, while the sea extract (seaweed Extract) gave the lowest average of (7.11)capsule plant^{-1}, the superiority is due to the extract that flowering and holding of cans with high efficiency reduced the percentage of flowering shedding and increased the plant's ability to retain the number of completed cans, and this results are consistent with what was indicated (belagumpi et al., 2024).

As for the genotypes, it exceeded the (Turkish) genotype by an average of(8.8) capsule plant^{-1}, while the lowest value gave the (local) genotype an average of (6.6)capsule plant^{-1}, and this superiority is due to the genetic difference between genotypes in response to the processes of growth and floral development, where the (Turkish) genotype has a higher efficiency of converting representative products into packs and increasing them compared to other genotypes(Can et al., 2021).

As for the interaction, the treatment between the sea extract (Alga 600) and the genotype (Indian) gave an average of (13.8) capsule plant^{-1}, the opposite of the treatment of the sea extract(Liquid Seaweed) with the genotype (local), giving the lowest average(5.7) capsule plant^{-1}, indicating that all genotypes responded closely to the treatment combine, or this may be due to the fact that the genetic variation has the branching ability of the plant as the genotypes differ in the number of branches and the composition of the cans, and the extract leads to an increase in the number of cans as a result of stimulating vegetative growth and activating cell division through cytokines and auxins, it is considered the most sensitive characteristic For genetic and environmental changes(Kizil and tonker 2005).

Table: 2 influences of the sea extract, genotypes and interaction on the number of capsules per plant (capsule plant^{-1})

Genotypes	Types of Sea extracts				Mean of genotypes
	Seawead Extract g/l	Liquid Seaweed ml/ l	Alga600 l / g	Combe one l/ g	
Local	7.6 b	5.7 b	6.6 b	6.5 b	6.6 b
Turkish	7.2 b	10.1 ab	9.1 ab	8.8 ab	8.8 a
Syrian	6.9 b	7.5 b	7.3 b	10.2 ab	7.97 ab

Indian	7.2 b	6.5 b	13.8 a	8.5 ab	9.0 a
Pakistan	6.9 b	9.2a b	9.1 ab	8.9 ab	8.52 ab
Bengali	6.9 b	9.4a b	8.3 b	9.3 ab	8.47 ab
Mean sea extract	7.11 c	8.06 b	9.03 a	8.7 ab	8.225

(Similar letters between treatments not have significant differences at 5% according to Tukey's test)

2. The number of seeds per capsules (seed capsules^{-1}):

The results of Table (3) show the effect of sea extract with the genotype and the interaction between them in the number of seeds per capsule to the presence of significant differences when spraying with sea extract (Liquid seaweed) has given the most number of seeds in the capsule with an average of (61.56) seed capsules^{-1}, as for the rest of the extracts there are no significant differences between them, the superiority is due to the space available for the formation and development of seeds inside one can, which led to increasing the amounts of carbohydrate sugars transferred to storage represented by the Can, has reduced the process of shedding syphilis and cans and the completion of a number of Larger than seeds (Matter et al., 2015).

As for the genotypes, the (Pakistan) genotype exceeded the average(63.05) seed capsules^{-1}, while the genotype (Indian) gave fewer seeds on average(54.72) seed capsules^{-1}, the superiority may be due to the difference between heredity and the environment, making the genotype (Pakistan) physiologically more efficient in exploiting available resources, indicating the presence of genes responsible for regulating hormones auxins that ensure the filling of the box with seeds (Mohebodinia et al., 2025).

Table: 3 influences of the sea extract, genotypes and interaction on the seeds per capsule (seed capsule^{-1})

Genotypes	Types of Sea extracts				Mean of genotypes
	Seawead Extract g/l	Liquid Seaweed ml/l	Alga600 g/l	Combe one g/l	
Local	52.2 cde	55.45 b-e	52.0 cde	47.0 e	**51.67 c**
Turkish	48.4 de	66.4 ab	53.1 cde	53.2 cde	**55.3 bc**
Syrian	51.3 de	61.1 a-d	57.1 a-e	56.9 a-e	**56.6 bc**
Indian	53.1 cde	58.6 a-e	54.3 b-e	52.9 cde	**54.72 c**
Pakistan	64.9 abc	68.9 a	57.9 a-e	60.5 a-d	**63.05 a**
Bengali	66.2 ab	58.8 a-e	54.1 a-e	61.2 a-d	**60.07 ab**
Mean sea extract	56.01 b	61.56 a	54.75 b	55.28 b	**56.90**

(Similar letters between treatments not have significant differences at 5% according to Tukey's test)

As for the interaction, the treatment combine of sea extract (Liquid Seaweed) with the genotype (Pakistan) exceeded the average (68.9) seed capsules^{-1}, the opposite of the treatment combine of sea extract (Combe one) with the genotype (local), giving the lowest average(47.0) seed capsules^{-1}, the genetic difference in the formation of fertilization efficiency and seed formation inside the box may be due to the role of the extract in improving the physiological processes of the plant and increasing the efficiency of the seeds are inside the can (Ejigu, 2025).

3. Weight of 1000 seeds (g):

The results of Table (4) show the effect of the sea extract with the genotypes and the interaction between them in the weight of 1000 seeds (g) there are no significant differences between them, the plants maintained the convergence in the weight of 1000 seeds and are considered morphological traits with high stability and tolerate genetic factors and are less responsive to the marine extract (Hassan et al ., 2023).

As for the genotypes, (local) genotype exceeded the genotype (Pakistan) by an average of (2.56)g, while the genotype (local) gave the lowest average (2.23) g. this superiority is due to the fact that the genotype (Pakistan) has a higher efficiency in the transfer and distribution of Representative substances and their storage in seeds and that the difference in seed weight within the genotype is a trait associated with genetic ability under certain environmental conditions and the genetic material is the determining factor for seed weight (Gebremedin et al., 2025).

Table: 4 influences of the sea extract, genotypes and interaction on the weight 1000 seeds (g)

Genotypes	Types of Sea extracts				Mean of genotypes
	Seawead Extract g/l	Liquid Seaweed ml/l	Alga600 g/l	Combe one g/l	
Local	2.15 b	2.1 b	2.6 ab	2.1 b	**2.23 b**
Turkish	2.15 b	2.2 ab	2.3 ab	2.8 ab	**2.36 ab**
Syrian	2.65 ab	2.55 ab	2.15 b	2.45 ab	**2.45 ab**
Indian	2.6 ab	2.4 ab	2.67 ab	2.2 ab	**2.46 ab**
Pakistan	2.2 ab	2.73 ab	2.4 ab	2.91 a	**2.56 a**
Bengali	2.78 ab	2.15 b	2.15 b	2.65 ab	**2.43 ab**
Mean sea extract	2.42 a	2.35 a	2.37 a	2.52 a	**2.41**

(Similar letters between treatments not have significant differences at 5% according to Tukey's test)

As for the interaction, the treatment combine of the sea extract (Combe one) with the genotype (Pakistan) exceeded an average of (2.91) g, the rest of the treatment combine have no differences between them, the reason may be the coincidence of rainfall negatively affected the formation of seeds in addition to this environmental conditions, morphological characteristics and genetic compositions of the plant are effective factors in the weight of 1000 seeds, the genetic differences in the efficiency of seed fullness and the role of the extract in improving the hormonal balance of the plant and increasing the efficiency of seeds, which leads to an increase in the weight of seeds and improve their quality(Khan et al., 2021).

4. Nigellone (%):

The results of Table (5) show the effect of the type of sea extract and the genotypes and the interaction between them in the nigellon compound to the presence of significant differences in marine extracts, as the highest concentration of nigellon was recorded when spraying the marine extract (Alga 600) an average of (15.166)% for its growth regulators, amino acids and elements led to a significant increase in the concentration of this compound, unlike the (local) extract, which gave the lowest concentration of (11.10)% of the same compound.

As for the genotypes, there are significant differences between the genotypes, the genotype (Indian) exceeded the highest concentration of the neglon compound, where the average was (16.091)%, unlike the genotype (local), which reached the lowest concentration (11.10)%, and this superiority may be due to the genetic genes that made the concentration of this compound the highest concentration .

Table: 5 influences of the sea extract, genotypes and interaction on the Nigellone (%)

Genotypes	Types of Sea extracts				Mean of genotypes
	Seawead Extract g/l	Liquid Seaweed ml/l	Alga600 g/l	Combe one g/l	
Local	11.705 h	9.76 j	12.66 g	10.285 ij	**11.102 f**
Turkish	12.715 g	10.56 i	13.76 e	11.825 h	**12.215 e**

Syrian	13.56 e	11.395 h	14.71 d	12.93 ef	**13.149 d**
Indian	16.435 b	14.655 d	17.55 a	15.725 c	**16.091 a**
Pakistan	15.565 c	13.455 ef	16.495 b	14.395 d	**14.978 b**
Bengali	14.93 d	12.45 g	15.82 c	13.35 ef	**14.138 c**
Mean sea extract	14.152b	12.04 6d	15.166 a	13.085 c	**13.612**

(Similar letters between treatments not have significant differences at 5% according to Tukey's test)

As for the interaction, the most compatible treatment is the sea extract (Alga 600) with the genotype of the (Indian) medium (17.55)%, the opposite of the compatible treatment of the extract (Liquid Seaweed) with the genotype (local), which took the lowest concentration.(9.76)%.

5. p-cymene (%)

The results of Table (6) show the effect of the type of sea extract, the genotypes and the interaction between them in the p-cymene compound to the presence of significant differences in marine extracts, the highest concentration of p-cymene was recorded when spraying with sea extract (Alga 600) with an average of(17.255)%, unlike the extract (Liquid Seaweed), which gave the lowest concentration of this compound reached (13.99)% and may be due to the role of this extract in employing its compounds in increasing the concentration of this compound.

As for the genotypes, there were significant differences between the genotypes of the (Indian) variety, which gave an increase in the concentration of p-cymene, with an average of (18.144)%, unlike the (local) genotype, which gave the lowest concentration of (12.96)%. this superiority may be due to the genetic factor and its content of genes leading to an increase in this composition. As for the interaction between the treatment combine, there are no significant differences (Chatterjee et al., 2025.)

Table: 6 influences of the sea extract, genotypes and interaction on the p-cymene (%)

Genotypes	Types of Sea extracts				Mean of genotypes
	Seawead Extract g/l	Liquid Seaweed ml/l	Alga600 g/l	Combe one g/l	
Local	13.395 a	11.28 a	14.64 a	12.53 a	**12.961 f**
Turkish	14.805 a	12.6 a	15.765 a	13.45 a	**14.155 e**
Syrian	15.67 a	13.615 a	16.695 a	14.645 a	**15.156 d**
Indian	18.35 a	16.435 a	19.93 a	17.86 a	**18.144 a**
Pakistan	17.56 a	15.715 a	18.715 a	16.55 a	**17.135 b**
Bengali	16.35 a	14.345 a	17.785 a	15.615 a	**16.024 c**
Mean sea extract	16.022 b	13.998 d	17.255 a	15.108 c	**15.595**

(Similar letters between treatments not have significant differences at 5% according to Tukey's test)

6. Oil percentage %

The results of Table (7) show the effect of the type of sea extract and the genotypes and the interaction between them in the percentage of oil to the presence of significant differences between sea extracts, as the highest percentage of sea extract oil was recorded (Alga 600) with an average of (39.533)%, this superiority may be due to the sea extract and its growth regulators that increase the plant's ability to accumulate oil percentage (Moussawi et al.2024).

As for the genotypes, there are significant differences between the genotype (Indian) exceeded the highest percentage of oil, which reached (39.837)%, the opposite of the (local) genotype, which gave the lowest percentage of oil, (37.50%) and is due to the difference between the genotypes, which led to a disparity in the efficiency of fatty acid biosynthesis, as well as environmental conditions that directly affected the percentage of oil, (Barut et al. 2023) and (Gebremedin et al. 2025).

As for the interaction between the treatment combine, there are no significant differences.

Table: 6 influences of the sea extract, genotypes and interaction on the oil percentage (%)

Genotypes	Types of Sea extracts				Mean of genotypes
	Seawead Extract g/l	Liquid Seaweed ml/l	Alga600 g/l	Combe one g/l	
Local	37.2667 a	37.1833 a	38.2267 a	37.3333 a	**37.502 d**
Turkish	38.8033 a	37.4267 a	39.0267 a	38.0 a	**38.314 cd**
Syrian	38.81 a	37.7533 a	39.48 a	38.31 a	**38.588 bc**
Indian	40.0633 a	39.19 a	40.6233 a	39.47 a	**39.837 a**
Pakistan	39.53 a	38.7233 a	40.1733 a	39.0333 a	**39.365 ab**
Bengali	39.0 a	38.1933 a	39.6667 a	38.55 a	**38.852 bc**
Mean sea extract	38.912 ab	38.078 b	39.533 a	38.449 b	**38.743**

(Similar letters between treatments not have significant differences at 5% according to Tukey's test)

7. Refractive index:

As for the genotypes, there were significant differences between the genotypes, as the genotype (Pakistan) achieved an increase in the refractive index ratio by an average of (1.544), the opposite of the genotype (local), which gave the lowest refraction of (1.46). the disparity in the degrees of unsaturation of fatty acids and the coefficient is directly related to the instauration and the length of the carbon chain, as for the interaction between the treatment combine, there are no significant differences**.**

Table: 6 influences of the sea extract, genotypes and interaction on the Refractive index .

Genotypes	Types of Sea extracts				Mean of genotypes
	Seawead Extract g/l	Liquid Seaweed ml/l	Alga600 g/l	Combe one g/l	
Local	1.4233 a	1.466 a	1.4793 a	1.4837 a	**1. 463 c**
Turkish	1.4357 a	1.4933 a	1.46 a	1.498 a	**1.472 c**
Syrian	1.4407 a	1.496 a	1.5367 a	1.4747 a	**1.487 bc**
Indian	1.5267 a	1.529 a	1.547 a	1.5413 a	**1.536 ab**
Pakistan	1.54 a	1.5373 a	1.5537 a	1.5433 a	**1.544 a**
Bengali	1.5377 a	1.5167 a	1.5557 a	1.5487 a	**1.54 ab**
Mean sea extract	1.485 a	1.5064 a	1.5221 a	1.5159a	**1.507**

(Similar letters between treatments not have significant differences at 5% according to Tukey's test)

8. Specific density (g):

The results of table (7) show the effect of the type of sea extract and the genotypes and the interaction between them in the qualitative density to the absence of significant differences between sea extracts .

As for the genotypes, there are significant differences between the genotypes, as the (Indian) genotype exceeded the highest increase in the value of the specific density by an average of (0.961)g, unlike the (local) genotype, which gave the lowest average of (0.92) g. this may be due to the genetic genes that each genotype possesses.

As for the interaction between the treatment combine, there are no significant differences.

Table: 7 influences of the sea extract, genotypes and interaction on the Specific density(g)

Genotypes	Types of Sea extracts				Mean of genotypes
	Seawead Extract g/l	Liquid Seaweed ml/l	Alga600 g/l	Combe one g/l	
Local	0.914 a	0.9157 a	0.9267 a	0.9237 a	**0.92 c**
Turkish	0.92 a	0.9137 a	0.9267 a	0.93 a	**0.923 c**
Syrian	0.9387 a	0.9207 a	0.9307 a	0.922 a	**0.928 c**
Indian	0.9693 a	0.935 a	0.9713 a	0.9677 a	**0.961 a**
Pakistan	0.954 a	0.943 a	0.9683 a	0.951 a	**0.954 ab**
Bengali	0.941 a	0.9203 a	0.9477 a	0.933 a	**0.935 bc**
Mean sea extract	0.9395 a	0.9247 a	0.9452 a	0.9379 a	**0.936**

(Similar letters between treatments not have significant differences at 5% according to Tukey's test)

CONCLUSIONS

The spraying treatment with marine extract (Alga 600) with a concentration of exceeded 1.250 g / L, the number of capsules in the plant, Nigellone and p-cymene exceeded the proportion of oil refractive index and specific density. The genotype (Indian) was by a superiority in the number of capsules per plant, Nigellone and p-cymene, the percentage of oil, specific density and genotype (Pakistan) in the number of seeds in the capsule, Weight of 1000 seeds and refractive index. The significant interaction was between the sea extract (Alga 600) at a concentration of 1.250 g / L with the genotype (Indian)and the number of capsules per plant excels in onigellone and p-cymene, oil percentage, refractive index and specific density.

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