

Effect of phosphate fertilization and spraying with seaweed extract on growth and yield of Rapeseed(*Brassica napus* L.)

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I. Abstract

A field experiment was carried out during the 2023/2024 winter season at the Research Station of the College of Agriculture, University of Basrah, to determine the growth, yield, and quality response of rapeseed to three phosphorus levels (35,70, and 105 kg ha⁻¹), and spray with three concentrations of seaweeds extract (4, 8, and 12 g L⁻¹). The results showed that 135 kg P ha⁻¹ gave of the highest seed yield (2.147ton ha⁻¹). Spraying plants with 12 g L⁻¹ of Sea weeds extract produced the highest yield (1.896ton ha⁻¹), which was significantly higher over all other treatments. It can be concluded that application of Phosphorus with 105 g L⁻¹ achieving maximum, seed yield and its components under the environmental conditions of Basrah province

Key words: Rapeseeds, Sea weeds, Phosphorus, seed yield,

II. Introduction

Rapeseed (*Brassica napus* L.) is one of the most important oilseed crops cultivated worldwide because of its high oil content and wide industrial and nutritional uses((Poisson et al., 2019)). Oil seed rape is the second-largest oil seed crop in the world, after soybeans, in terms of cultivation area and production volume. Increasing the productivity and quality of rape has become an essential objective in modern agriculture to meet the growing demand for vegetable oils and agricultural products(Ahmed,2018). Plant nutrition and the application of natural biostimulants are among the key factors affecting plant growth, development, and yield production.

Phosphorus (P) is a basic plant nutrient in the growth of oil seed rape. It is an essential macronutrient required for several physiological and biochemical processes in plants, including energy transfer, photosynthesis, root development, flowering, and seed formation (Hawkesford *et al.*,2012). Adequate phosphorus supply enhances plant vigor and improves both yield quantity and quality. However, phosphorus deficiency can significantly reduce plant growth and productivity. Genetic processes like cell division and plant growth are limited by insufficient phosphorus supplies(Vicianová *et al.*,2020).In modern times, foliar spraying with various compounds, such as seaweed extract, is an organic nutrition method, it gained considerable attention as natural and environmentally friendly biostimulants in sustainable agriculture (Drobek *et al.*,2019). Sea weeds application is a natural regulator that effectively boosts plant development and yield against a variety of environmental conditions. It is a sustainable and eco-friendly practice that significantly contributes to the reduction of environmental issues and the enhancement of product yield (Chanthini *et al.*, 2022) Seaweed extracts contain several beneficial compounds such as plant hormones, amino acids, vitamins, minerals, and antioxidants that stimulate plant growth and improve tolerance to environmental



stresses(Nasmia *et al.*,2021). Several studies have demonstrated that the presence of natural phytohormones and micro and macronutrients in marine algae extracts promotes the growth and increased agricultural productivity of various plant species(Stirk *et al.*, 2014). According to a number of studies, weeds increase plant and nutrient uptake, boost fertility, and are resistant to unfavorable environmental circumstances. (Panda *et al.* 2012,Zamani *et al.* 2013) . Application of seaweed extracts has been reported to enhance vegetative growth, nutrient absorption, chlorophyll content, and yield characteristics in many field crops .Therefore, this study was conducted to investigate the effect of phosphorus and plant extract applications on the growth yield and quality of rape and to determine their role in improving crop performance and productivity.

III. Materials and Methods

A field experiment was carried out during the 2023/2024 winter season at the Research Station of the College of Agriculture, University of Basrah , to determine the growth, yield, and quality response of rapeseed (Pactol variety) to three phosphorus levels (35, 70, and 105 kg ha⁻¹), symbol P1, P2, and P3 respectively, and to spray with three concentrations of seaweed extracts (4, 8, and 12 g L⁻¹), symbol S1, S2, and S3 respectively. Phosphate fertilizer was applied in a single dose application before planting in the form of triple superphosphate (46% P₂O₅). The seaweed extract was applied in two applications: the first 30 days after planting and the second before the tillering stage. The experiment was designed using a randomized complete block design (R.C.B.D.) with three replicates, the phosphorus levels were placed in the main plots and the seaweed extract concentrations in the sub plots. Several soil samples were randomly selected from different locations in the field before planting, from each replicate and from a depth of (0-30) cm, and mixed together. Chemical and physical analyses were performed on them before planting (Table 1).

Table (1):- Physical and chemical properties of the soil before planting.

properties	pH	EC (dS m ⁻¹)	Available N)mg kg ⁻¹ (Available P mg kg ⁻¹ (Available K mg kg ⁻¹ (Soil texture
values	7.50	7.27	36	8.33	125.4	Silty loam

The plowing, harrowing, and leveling process was carried out, and the experimental field was laid out according to the design used. The field was then divided into three replicates, with the area of each experimental unit being (2×2) m². The distance between rows was 40 cm, and between plants was 30 cm, 1 m was left between experimental units and 2 m between replicates to prevent interference between treatments. Urea fertilizer was added as a nitrogen source at a rate of 300 kg N ha⁻¹ (Al-Halfi, 2024) in the form of urea (46% N) in three applications: the first two weeks after planting, the second at the beginning of the elongation stage, and the third at the beginning of the flowering stage. Planting done on 15th /10/2023 (Al-Rikabi, 2021). Irrigation and weeding were carried out as needed. At harvest, five plants were randomly selected from the midlines to study the following traits:

Plant height(cm) :A metric ruler was used to measure it from the top leaf tip to the soil's surface level.

Number of branches per plant :



Number of Siliqua per plant: It was computed using the average number of mustard seeds for five randomly chosen plants at the harvest stage from the midlines of each treatment.

Number of seeds per Siliqua

: 30 mustard seeds were randomly taken from each treatment, threshed, and the average number of seeds per mustard seed was calculated.

Weight of 1000 seeds (g): 1000 seeds were counted and then weighed using a sensitive electronic scale.

Seed yield(ton ha⁻¹): Each plot's seed square meter weight was measured (g m⁻²) and converted to (ton ha⁻¹).

The GenStat statistical software was used to do the statistical analysis of the characteristics.. The averages were compared using the LSD (p≤0.05) (Al-Rawi and Khalafallah, 2000).

IV. Results and Discussion

Plant height (cm)

According to the results table 2 showed there were significant variances in the levels of phosphorus and sea weeds concentration for plant height, while interactions between them showed no significant effect on plant height. The level of 105 kg P ha⁻¹ (P3) achieved the highest plant height of 201.00cm, while the level 35 kg P ha⁻¹ (P1) gave the lowest (171.66cm). This result might be explained by the fact that phosphorus promoted a rise in the total number of roots, which in turn increased vegetative growth and the height of the plant. Results also found that Spraying sea weeds with a concentration of 12 g L⁻¹ (S3)increased plant height (194.18cm), while the concentration of sea weeds 4 g L⁻¹ (S1) gave the lowest value (178.78cm), Sea weeds extract have been found to include humic acid, macronutrients, micronutrients, hormones, and amino acids, all of which have an impact on the growth and assimilation of rape plants and have been shown to enhance this trait.

Number of branches per plant

Results shown (Table 2) that the number of branches per plant was significantly impacted by the addition of phosphorus fertilizer .Higher values were observed on the P3 level (18.171branch plant⁻¹), whereas P1 treatment recorded the lowest value (13.09 branch plant⁻¹), this is due to the phosphorus has an important role in the majority of the plant's essential functions, which in turn promotes plant development and height . Means of the treatments for flag leaf area were significantly affected by spraying of Sea weeds. Higher concentration12 g L⁻¹ (S3) led to an increase in the number of branches and gave16.71 branch plant⁻¹ with an increase by14.45% compared with (S1), which gave 14.60 branch plant⁻¹.The high nutrition availability could be the cause, as it increases the products of photosynthesis and, consequently, the number of branches.Interactions between phosphorus fertilizer and of sea weeds concentration showed no significant effect. The influence of interaction on number of branches was significant, the maximum number were obtained from P3S3 which gave 19.00 branch plant⁻¹,while the combination P1S1 gave the lowest value(11.27 branch plant⁻¹).

Number of siliqua per plant



Among of the three phosphor levels, P3 had the most Number of siliqua per plant, followed by P2 and P1, and there was a significant differences between them. The highest no. of siliqua plant⁻¹ (667.78 siliqua plant⁻¹) was observed at the level (P3) followed by P2(507.56 siliqua plant⁻¹) whereas, lowest was observed from P1(408.50 siliqua plant⁻¹). This may be attributed to the role of phosphorus in increasing the efficiency of photosynthesis and the transfer of its products to new growth areas in the plant (emerging siliqua), which is reflected in their continued survival and prevention of their shedding, thus increasing their number. There was a significant effect of sea weeds on siliqua number per plant (Table 2). Data showed that maximum siliqua per plant (563.89siliqua plant⁻¹) were recorded in plants which received 12 g L⁻¹ (S3) ,while the minimum (477.28siliqua plant⁻¹) was obtained by (S1) plots. The increased nutrient availability in sea weed extract may be the cause, as it increases the products of photosynthesis, which in turn increases the number of siliqua. Table 2 shows the significant effect of the interaction between the factors, the interaction of P3×S3 achieved the highest averages of the number of siliqua were 699.67 siliqua plant⁻¹, While the combination P1×S1 gave the lowest values (311.83 siliqua plant⁻¹).

Number of seeds per siliqua

The number of seeds per siliqua were affected significantly by different application levels of phosphor and sea weeds concentrations and their interaction . The level P3 of phosphor application gave the highest amount of seeds number of 17.73seed siliqua⁻¹, whereas the P1 recorded the lowest values of 13.22 seed siliqua⁻¹. This may be because increased phosphorus leads to increased seed maturation and a greater number of seeds, as phosphorus is an essential compound in seeds, serving as a source of stored energy in the form of Phytin . Phosphorus also plays a role in regulating plant hormone levels, which indirectly affects developmental processes such as floret production and, consequently, the ability to produce a certain number of seeds(Ignateva and Tokareva,1976).Spraying plants with 12 g L⁻¹ of sea weeds affected significantly the seed number, of 18.14 seeds siliqua⁻¹ compared to the lowest average of 13.22 seed siliqua⁻¹ when plants were sprayed with S1 treatment. This may be attributed to the role of sea weeds extract in stimulating enzymatic reactions and activating vital processes, thus increasing the percentage of seeds set in the flower siliqua, which positively impacts the number of seeds .The interaction was significant, with the highest average number of seeds reaching 18.18 seed siliqua⁻¹ at the fertilizer level of 105 kg P ha⁻¹ and spraying at a concentration of 12 g L⁻¹. It did not differ significantly from the interaction between the levels 105 kg P ha⁻¹ when spraying with sea weeds at concentrations of 4 and 8 g L⁻¹, while the lowest average number of seeds was 10.53 seed siliqua⁻¹ at the interaction P1×S1.

1000 Seed weight (g)

Data on revealed that 1000 Seed weight was significantly influenced by phosphorus rates and spraying sea weeds extract, On the other hand, the interaction between the two factors had no significant impact on this characteristic (Table 2). The results showed that the weight of 1000 seeds increased with increasing levels of phosphate fertilizer. The application level of 105 kg P ha⁻¹ resulted in the highest average seed weight reaching 1.99g however, it did not differ from P2(1.62g),while the P1 treatment, gave the lowest average seed weight of 1.02 g. This may be explained by the role of phosphorus in increasing the efficiency of photosynthesis, thereby accelerating and improving the production and transport of dry matter from the source to the sink, leading to an increase in seed weight, also (Table 2) show that 1000 Seed weight increased

significantly as foliar spraying of sea weeds increased. It is clear that treatment of 12 g L⁻¹ gave the highest weight of 1.65g with no significant differences with 8g L⁻¹ (1.56 g) and the minimum was found in the S1 treatment which gave lowest Seed weight (1.42g). This could be because of the Sea weeds function, Moreover, a rise in cell division and growth, as well as an increase in photosynthetic activity and the transfer of photosynthesis material to grains, resulted in filling seeds and an increase in weight of 1000 seed .

Seed yield (ton ha⁻¹)

The impact of P fertilizer application and sea weeds concentrations were found to be highly significant Seed yield, while, the interaction between the two factors had no significant impact on this characteristic (Table 2). (Table 2)The application of P3 recorded the best values of seed yield reaching 2.147 ton ha⁻¹ , when minimum Seed yield (1.372 ton ha⁻¹) was found P1 level. Data in Table 2 also revealed that the highest seed yield was observed at S3 seaweed extract (1.896 ton ha⁻¹), with no significant differences with S2(1.763 ton ha⁻¹) while , the lowest ones were noticed by S1 treatment (1.602 ton ha⁻¹). An increase in seed yield is usually consistent with an increase in the components of the yield. Since the addition of phosphate fertilizer and spraying with seaweed extract increased the number of siliqua per plant, the number of seeds per siliqua, and the weight of 1000 seeds (Table 2), this increase was reflected in an increase in the total seed yield.

Table.2.The effect of Phosphorus and Sea weeds extract on growth, yield components and yield of Rape

Treatments	Plant height (cm)	Branches Plant-1	Siliqua plant -1	seed siliqua ⁻¹	1000 Seed weight (g)	Seed yield ton ha-1
Phosphorus (Kg P ha⁻¹)						
P1	171.66	13.09	408.5	13.22	1.02	1.372
P2	187.03	16.07	507.56	16.46	1.62	1.742
P3	201.00	18.17	667.78	17.73	1.99	2.147
L.S.D. (p≤ 0.05)	7.881	1.832	15.675	0.797	0.442	0.2738
Sea weeds (g L⁻¹)						
S1	178.78	14.6	477.28	13.22	1.42	1.602
S2	186.73	16.01	542.67	16.46	1.56	1.763
S3	194.18	16.71	563.89	18.14	1.65	1.896
L.S.D. (p≤ 0.05)	6.857	0.464	37.093	0.565	0.110	0.1560
P1S1	157.67	11.27	311.83	10.53	0.92	1.133
P1S2	172.87	13.53	463.67	14.07	1.03	1.434

P1S3	184.44	14.47	450.00	15.07	1.11	1.548
P2S1	186.33	15.20	483.33	15.90	1.41	1.631
P2S2	185.17	16.33	497.33	16.53	1.69	1.737
P2S3	189.60	16.67	542.00	16.93	1.76	1.859
P3S1	192.33	17.33	636.67	17.57	1.92	2.042
P3S2	202.17	18.17	667.00	17.46	1.96	2.118
P3S3	208.50	19.00	699.67	18.18	2.08	2.282
L.S.D. (p≤ 0.05)	NS	1.793	53.327	0.994	NS	NS

Conclusions

It was observed that the application of 105 Kg P ha⁻¹ recorded the best values for almost all of the studied characters, while the lowest level (35 Kg P ha⁻¹) recorded the minimum value. Also foliar application of Sea weeds with the concentration of 12 g L⁻¹ improved plant growth, yield components and yield of Rape. , It can be concluded that, the application of 105 Kg P ha⁻¹ + 12 g L⁻¹ recorded significantly higher growth, yield and yield components.

V. References

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