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Response of two broccoli varietys *Brassica oleracea* Var. italica to seaweed extract Stimax nature and dried baker's yeast

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Abstract

The experiment was conducted at the Research Station of the College of Agriculture and Marshlands/University of Thi Qar during the 2024-2025 agricultural season with the aim of studying the response of two broccoli varieties (*Brassica oleracea* Var. italica) to the seaweed extract Stimax nature and dry baker's yeast. The study included three factors: the first factor was two broccoli varieties, Jasmin and Sidra; the second factor was three concentrations of the seaweed extract Stimax nature (0, 1.5, and 3) ml L^{-1}, and the third factor was three concentrations of dry baker's yeast (0, 3, and 6) g L^{-1}. Thus, the experiment included eighteen treatments with three replicates for each and a number of experimental units of (54). It was implemented as a factorial experiment using split-split plots twice within Randomized Complete Block Design (Split-Split plot design in RCBD). The results were statistically analyzed using the statistical program (Genstat), and the test was performed the significance of the differences between the means was determined using the least significant difference (LSD) test at a probability level of 0.05. The results showed the significant superiority of the Sidra variety in (leaf content of total chlorophyll, floral cruds content of vitamin C, and percentage of nitrogen and potassium) at averages of (69.915 and 71.789) mg $100g^{-1}$ f. w., (1.835 and 1.499) %, respectively, no significant differences were observed in the percentage of phosphorus. The concentration of 3 ml L^{-1} of seaweed extract (Stimax) was significantly superior in (leaf content of total chlorophyll, floral cruds content of vitamin C, and percentage of nitrogen, phosphorus, and potassium) at averages of (70.252 and 69.694) mg $100g^{-1}$ f. w., (1.873, 0.460, and 1.548) %, respectively. The results also showed the significant effect of the concentration of 6 g L^{-1} of yeast suspension dry bread in (leaf content of total chlorophyll, floral cruds content of vitamin C and percentage of each of nitrogen, phosphorus and potassium) at averages of (75.025 and 75.956) mg $100g^{-1}$ f. w. and (2.023, 0.523 and 1.668) % respectively. The two-way interaction treatments, were significantly superior to the interaction treatment between the Sidra variety and the seaweed extract (Stimax nature) at a concentration of 3 ml L^{-1} and achieved the highest averages in (leaf content of total chlorophyll, floral cruds content of vitamin C, and percentage of each of nitrogen, phosphorus, and potassium) at averages of (71.327 and 74.989) mg $100g^{-1}$ f. w. and (1.932, 0.460 and 1.547) %, respectively. Also, the two-way interaction treatment between the Sidra variety and the dry baker's yeast suspension at a concentration of 6 g L^{-1} was significantly superior in (leaf content of total chlorophyll, floral cruds content of vitamin C, and percentage of each of nitrogen, phosphorus, and potassium) at averages of (77.317 and 81.411) mg $100g^{-1}$ f. w. and (2.132, 0.531 and 1.672) % respectively, in addition to the significant superiority of the two-way interaction treatment between spraying with seaweed extract (Stimax nature) at a concentration of 3 ml L^{-1} and dry baker's yeast at a concentration of 6 g L^{-1} in (leaf content of total chlorophyll, floral cruds content of vitamin C and percentage of each of nitrogen, phosphorus and potassium) at averages of (77.307 and 79.567) mg $100g^{-1}$ f. w. and (2.218, 0.590 and 1.708) %, respectively. The triple interaction treatments between the Sidra variety and the seaweed extract (Stimax nature) at a concentration of 3 ml L^{-1} and the dry baker's yeast suspension at a concentration of 6 g L^{-1} had a significant effect and achieved the highest averages in (the content of the floral cruds of vitamin C and the percentage of each of nitrogen, phosphorus and

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potassium) amounting to (84.400 mg 100 g^{-1} f. w.) and (2.333, 0.630 and 1.713) %, respectively, and no significant differences were observed in the content of chlorophyll in the leaves.

Keywords: Broccoli, varieties, seaweed, yeast.

I. Introduction

Broccoli, whose English name is Broccoli, is scientifically known as *Brassica oleracea* Var. italicum, it is a vegetable belonging to the Brassicaceae family, it is considered an important vegetable grown during the winter season, and its nutritional source is the flowering inflorescence, which is eaten during the flowering stage, in addition to the thick stalks (Abbas, 2022). Broccoli is considered the richest plant in the Brassicaceae family in nutritional value and is the most widely used crop for medicinal purposes, as it contains many vitamins, including vitamins A, C, B1, B2, B6, and B17, as well as many minerals such as calcium, sodium, iron, zinc, and manganese, broccoli is also used as a treatment, regulator, and antibiotic for many common diseases, it works as a blood sugar regulator and reduces cholesterol in the blood, it also works to reduce high blood pressure, helps build bones, and has an important role in preventing heart and urinary tract diseases (Al-Jabouri, 2020). Broccoli cultivation has recently spread in many continents of the world, such as Europe, America, and Asia, due to its medical benefits and delicious taste, consumption by citizens has increased, the largest broccoli-producing country is China, where its production average was about (9,030,990) tons in 2011, India came after it, with a production average of about (6,745,000) tons, Spain came after it, with a production average of about (527,500) tons, global broccoli production recorded about (20,842,200) tons (FAO, 2011). Seaweed is a plant extract that has the same components and natural properties of the materials contained in plants, it is extracted using special methods and is used as organic fertilizers, it encourages growth and is added to the soil or sprayed on the plant and is used as a complement to fertilizers and is not used as a substitute for them (Saudi, 2017). Seaweed extracts contain the basic materials that the plant needs because they contain major and minor nutrients as well as growth hormones such as auxins, cytokinins and gibberellins (Mohammed and Saeid, 2024). Seaweed has a great benefit when sprayed foliarly because it contains vitamins and organic matter at high averages (Abdullah and Al-Ibrahimi, 2023). Saccharomyces cerevisiae is a natural bio stimulant and bio fertilizer that increases the growth and productivity of many types of crops, it is a natural source of cytokinins that stimulate cell division and differentiation, protein synthesis, nucleic acids, and chlorophyll formation, it has a beneficial role during stress due to its cytokinin content (Nassar *et al*., 2011). In 1870, Meyen gave the scientific name Saccharomyces cerevisiae to yeast, it is considered the most important means used in plant nutrition, as it is environmentally safe, economically feasible, and inexpensive, it is effective in a number of crops, as studies have proven that it leads to an increase in growth characteristics and yield. Yeast is considered a microorganism, and it is a single-celled, eukaryotic microorganism, its method of reproduction is budding, it is considered a fungus that is safe for plants and does not cause any environmental damage (Dababou *et al*., 2018).

II. Materials and Methods

The experiment was conducted at the Agricultural Research Station in the Mustafawiyya area, affiliated with the College of Agriculture and Marshlands, University of Thi Qar, during the 2024-2025 agricultural season. The experiment aimed to determine the response of two broccoli (*Brassica oleracea* Var. italica) varieties to the seaweed extract (Stimax nature) and dried baker's yeast. The experiment was carried out using split-split plot design in RCBD (Al-Rawawi and Khalaf Allah, 2000). Which included three factors: the main plot, two broccoli varieties, SADRA and JASSMINE, the second (important) factor, the seaweed extract (Stimax nature) at three concentrations (0, 1.5 and 3) ml L^{-1}, and the third (most important) factor, the split plot, dry baker's yeast at three concentrations (0, 3 and 6) g L^{-1}. Spraying was done using a 5-liter sprayer with the addition of drops of a spreading substance to reduce surface tension, it was sprayed on the first day with the seaweed extract, and the dry baker's yeast was sprayed on the second day after fermenting for 24 hours before spraying with the addition of an equal amount of sugar. Both factors were sprayed in the early morning until the first drop of the solution fell on the ground, once every 10 days, and reached 5 sprays during the crop growing s

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eason and precautions were taken by placing a barrier to prevent the transfer of spray between treatments in the experimental units. The experiment started on 23/10 /2024 and ended on 25/2 /2025. 6 plants were randomly selected from each experimental unit to study the chemical characteristics and the leaf content of chlorophyll unit spad and the content of vitamin C in the flower cruds (mg $100g^{-1}$ f. w.) and the percentage of each of nitrogen, phosphorus and potassium were measured.

III. Results and Discussion

1. Total leaf chlorophyll content (unit spad):

The results in table (1) showed that the Sidra variety significantly outperformed the other variety, achieving the highest total chlorophyll content of 69.915 units spad, compared to the Jassmin variety, which recorded the lowest average of 65.647 units spad. It also showed that spraying Stimax Nature seaweed extract at a concentration of 3 ml L^{-1} had a significant effect on increasing the total leaf chlorophyll content, achieving the highest average of 70.252 units spad, compared to the control treatment, which produced the lowest average of 65.445 units spad. Significant differences in total leaf chlorophyll content were also evident when spraying with a dried baker's yeast suspension, the concentration of 6 g L^{-1} achieved the highest average of 75.025 units spad, compared to the control treatment, which produced the lowest average of 60.323 units spad. The results in the same table showed significant differences in the total chlorophyll content of leaves between the interaction treatments between the variety and spraying with concentrations of dry baker's yeast suspension, where the interaction treatment between the Sidra variety and spraying with a concentration of 6 g L^{-1} of dry baker's yeast suspension was significantly superior and achieved the highest average of 77.317 units Spad, compared to the control treatment of the Jassmin variety, which recorded the lowest average of 58.223 units Spad. The interaction treatment between the Sidra variety and the Stimax nature seaweed extract at a concentration of 3 ml L^{-1} was also significantly superior and achieved the highest average of 71.372 units Spad, compared to the control treatment of the Jassmin variety, which recorded the lowest average of 67.674 units Spad. It was also noted that there was a significant superiority of the interaction treatment between spraying with the Stimax nature seaweed extract at a concentration of 3 ml L^{-1} and the dry baker's yeast suspension at a concentration of 6 g L^{-1} and achieved the highest average of 77.307 units Spad, compared to the control treatment, which recorded the lowest average of 58.168 units Spad. The results showed no significant differences in the triple interaction between the variety, seaweed extract, and dried baker's yeast suspension.

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Variety	Dry baker's yeast concen. (g L^{-1})	Stimax nature concen. (ml L^{-1})			Variety and dry baker's yeast interaction
		0	1.5	3	
Jassmin	0	55.923	57.433	61.313	**58.223**
	3	63.367	65.847	68.743	**65.986**
	6	70.357	72.303	75.540	**72.733**
Sidra	0	60.413	62.363	64.490	**62.422**
	3	67.260	70.403	72.353	**70.006**
	6	75.350	77.527	79.073	**77.317**
Stimax nature average		**65.445**	**67.646**	**70.252**	
Variety and Stimax nature interaction		**0**	**1.5**	**3**	**Variety average**
Jassmin		63.216	65.194	68.532	**65.647**
Sidra		67.674	70.098	71.972	**69.915**
Stimax nature and dry baker's yeast interaction		**0**	**1.5**	**3**	**Dry baker's yeast average**
0		58.168	59.898	62.902	**60.323**
3		65.313	68.125	70.548	**67.996**
6		72.853	74.915	77.307	**75.025**
L.S.D≤ 0.05					

Variety	Dry baker's yeast	Stimax nature	Variety+ Dry baker's yeast	Variety +Stimax nature	Stimax nature+ Dry baker's yeast	Variety +Stimax nature+ Dry baker's yeast
0.2385	0.2622	0.1995	0.3182	0.2588	0.3641	N.S.

Table (1) The effect of Stimax nature seaweed extract, dry baker's yeast, and their interaction on the leaf content of total chlorophyll (unit spad) for two broccoli varieties.

2. Vitamin C content of flower cruds (mg $100g^{-1}$ f. w.):

The results in Table (2) show significant differences in the vitamin C content of flower cruds between the varieties, the Sidra variety was significantly superior and achieved the highest vitamin C content of flower cruds, reaching 71.789 mg $100g^{-1}$ f. w, compared to the Jassmin variety, which recorded the lowest average of 60.770 mg $100g^{-1}$ f. w. . The results also showed the significant superiority of the spraying treatment with Stimax nature seaweed extract at a concentration of 3 ml L^{-1} and achieved the highest average of 69.694 mg $100g^{-1}$ f. w., compared to the control treatment, which gave the lowest average of 62.639 mg $100g^{-1}$ f. w.. Spraying with a 6 g L^{-1} dry baker's yeast suspension caused a significant increase in the vitamin C content of flower cruds, achieving the highest average of 75.956 mg $100g^{-1}$ f. w., compared to the control treatment, which recorded the lowest average of 56.511 mg $100g^{-1}$ f. w.. The two-way interaction between the study factors had a significant effect on the vitamin C content of the floral cruds, The interaction between the Sidra variety and the dry baker's yeast suspension at a concentration of 6 g L^{-1} was significantly superior and achieved the highest average of 81.411 mg $100g^{-1}$ f. w., while the lowest average was recorded in the control treatment of the Jassmin variety and reached 50.744 mg $100g^{-1}$ f. w.. The significant superiority of the interaction between the Sidra variety and

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Variety	Dry baker's yeast concen. (g L^{-1})	Stimax nature concen. (ml L^{-1})			Variety and dry baker's yeast interaction
		0	1.5	3	
Jassmin	0	44.900	52.200	55.133	**50.744**
	3	58.333	61.533	63.333	**61.067**
	6	66.400	70.367	74.733	**70.500**
Sidra	0	59.400	62.133	65.300	**62.278**
	3	65.400	71.367	75.267	**71.678**
	6	78.400	81.433	84.400	**81.411**
Stimax nature average		**62.639**	**66.506**	**69.694**	
Variety and Stimax nature interaction		**0**	**1.5**	**3**	**Variety average**
Jassmin		56.544	61.367	64.400	**60.770**
Sidra		68.733	71.644	74.989	**71.789**
Stimax nature and dry baker's yeast interaction		**0**	**1.5**	**3**	**Dry baker's yeast average**
0		52.150	57.167	60.217	**56.511**
3		63.367	66.450	69.300	**66.372**
6		72.400	75.900	79.567	**75.956**
L.S.D≤ 0.05					

Variety	Dry baker's yeast	Stimax nature	Variety+ Dry baker's yeast	Variety +Stimax nature	Stimax nature+ Dry baker's yeast	Variety +Stimax nature+ Dry baker's yeast
0.3040	0.2127	0.1830	0.2875	0.2667	0.3177	0.4448

Table (2) The effect of seaweed extract (Stimax nature) and dry baker's yeast and the interaction between them on vitamin C (mg 100g-1 f. w.) in the flower cruds of two broccoli varieties.

the Stimax nature seaweed extract at a concentration of 3 ml L^{-1} was also noted, and it achieved the highest average of 74.989 mg $100g^{-1}$ f. w., compared to the control treatment of the Jassmin variety, which recorded the lowest average of 56.544 mg $100g^{-1}$ f. w. . The significant superiority of the interaction between the Stimax nature seaweed extract and dry yeast suspension was also noted, the 3 ml L^{-1} the Stimax nature seaweed extract and the 6 g L^{-1} dry yeast suspension achieved the highest average of 79.567 mg $100g^{-1}$ f. w., compared to the control treatment, which recorded the lowest average of 52.150 mg $100g^{-1}$ f.w.. The triple interaction treatment, consisting of the Sidra variety, Stimax Nature seaweed extract at a concentration of 3 ml L^{-1}, and the 6 g L^{-1} dry yeast suspension, achieved the highest average, with a significant difference, in the flower cruds vitamin C content of 84.400 mg $100g^{-1}$ f. w., compared to the control treatment of the Jassmin variety, which recorded the lowest average of 44.900 mg $100g^{-1}$ f. w. .

3. Nitrogen Percentage (%) in Floral cruds:

The results in table (3) showed that the Sidra variety significantly outperformed the floral cruds nitrogen percentage, achieving the highest average of 1.835%, compared to the Jassmin variety, which recorded the lowest average of 1.733%. The 3 ml L^{-1} treatment with Stimax Nature seaweed extract was also found to be significantly superior, achieving the highest average of 1.873%, compared to the control treatment, which recorded the lowest average of 1.609%. The results showed significant differences in the percentage of nitrogen when spraying with dry baker's yeast suspension, the

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Variety	Dry baker's yeast concen. (g L^{-1})	Stimax nature concen. (ml L^{-1})			Variety and dry baker's yeast interaction
		0	1.5	3	
Jassmin	0	1.546	1.596	1.630	**1.591**
	3	1.656	1.693	1.730	**1.693**
	6	1.810	1.853	2.083	**1.915**
Sidra	0	1.586	1.633	1.663	**1.627**
	3	1.706	1.750	1.780	**1.745**
	6	1.936	2.106	2.353	**2.132**
Stimax nature average		**1.707**	**1.772**	**1.873**	

Variety and Stimax nature interaction	0	1.5	3	Variety average
Jassmin	1.671	1.714	1.814	**1.733**
Sidra	1.743	1.830	1.932	**1.835**

Stimax nature and dry baker's yeast interaction	0	1.5	3	Dry baker's yeast average
0	1.566	1.615	1.646	**1.609**
3	1.681	1.721	1.755	**1.719**
6	1.873	1.980	2.218	**2.023**

L.S.D≤ 0.05

Variety	Dry baker's yeast	Stimax nature	Variety+ Dry baker's yeast	Variety +Stimax nature	Stimax nature+ Dry baker's yeast	Variety +Stimax nature+ Dry baker's yeast
0.02778	1.01669	0.01258	0.02415	0.02177	0.02305	0.03302

Table (3) The effect of Stimax nature seaweed extract, dry baker's yeast, and the interaction between them on the percentage of nitrogen (%) in the flower cruds of two broccoli varieties.

\concentration of 6 g L^{-1} achieved the highest average of 2.023%, compared to the control treatment, which gave the lowest average of 1.609%. It was noted that the interaction treatment between the Sidra variety and a 6 g L^{-1} dry baker's yeast suspension significantly outperformed, achieving the highest average of 2.132%, compared to the control treatment of the Jassmin variety, which recorded the lowest average of 1.591%. The interaction between the Sidra variety and spraying with Stimax nature seaweed extract at a concentration of 6 g L^{-1} was also significantly superior, achieving the highest average of 1.932%, compared to the control treatment for the Jassmin variety, which recorded the lowest average of 1.671%. The results of the statistical analysis showed a significant effect of the interaction between spraying with Stimax nature seaweed extract at a concentration of 3 ml L^{-1} and dried baker's yeast suspension at a concentration of 6 g L^{-1}, achieving the highest average of 2.218%, compared to the control treatment, which recorded the lowest average of 1.566%. The results showed significant differences between the triple interaction treatments between the variety and spraying with seaweed extract and dry baker's yeast suspension, the interaction treatment between the Sidra variety and Stimax nature at a concentration of 3 ml L^{-1} and the dry baker's yeast suspension at a concentration of 6 g L^{-1} was superior and achieved the highest average of 2.333%, compared to the control treatment of the Jassmin variety, which gave the lowest average of 1.546%.

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4.Phosphorus percentage (%) in flower cruds:

Table (4) shows the effect of Stimax nature seaweed extract and dry baker's yeast, and their interaction on the percentage of phosphorus (%), indicating no significant differences between the varieties. However, significant differences in the percentage of phosphorus were observed when spraying with Stimax nature seaweed extract, achieving the highest average at a concentration of 3 ml L^{-1}, reaching 0.460%, compared to the control treatment, which yielded the lowest average of 0.378%. Significant differences were also observed when spraying with dry baker's yeast suspension concentrations, with the highest average recorded at a concentration of 6 g L^{-1}, reaching 0.523%, compared to the control treatment, which yielded the lowest average of 0.313%. As for the two-way interaction coefficients between the study factors, most of them were significant. The interaction treatment between the Jassmin variety and spraying with a dry baker's yeast suspension at a concentration of 6 g L^{-1} was significantly superior, achieving the highest average of 0.531%, compared to the control treatment for the Sidra variety, which recorded the lowest average of 0.315%. The interaction treatment between the Sidra variety and the Stimax nature seaweed extract at a concentration of 3 ml L^{-1} was also significantly superior, achieving the highest average of 0.465%, compared to the control treatment for the Jassmin variety, which recorded the lowest average of 0.313%. The interaction treatment between the Stimax nature seaweed extract at a concentration of 3 ml L^{-1} and the dry baker's yeast suspension at a concentration of 6 g L^{-1} was also significantly superior, achieving the highest average of 0.590%, compared to the control treatment, which gave the lowest average of 0.2717%. The results in the same table also showed the significant superiority of the triple interaction treatment between the Sidra variety and the Stimax nature seaweed extract at a concentration of 3 ml L^{-1} and the dry baker's yeast suspension at a concentration of 6 g L^{-1}, achieving the highest average of 0.630%, compared to the control treatment of the Jassmin variety, which recorded the lowest average of 0.266%.

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Variety	Dry baker's yeast concen. (g L^{-1})	Stimax nature concen. (ml L^{-1})			Variety and dry baker's yeast interaction
		0	1.5	3	
Jassmin	0	0.266	0.313	0.353	**0.311**
	3	0.413	0.430	0.463	**0.4356**
	6	0.483	0.516	0.550	**0.5167**
Sidra	0	0.276	0.316	0.353	**0.3156**
	3	0.380	0.390	0.413	**0.3944**
	6	0.4500	0.5133	0.6300	**0.5311**
Stimax nature average		**0.378**	**0.413**	**0.460**	
Variety and Stimax nature interaction		**0**	**1.5**	**3**	**Variety average**
Jassmin		0.387	0.420	0.455	**0.421**
Sidra		0.368	0.406	0.465	**0.413**
Stimax nature and dry baker's yeast interaction		**0**	**1.5**	**3**	**Dry baker's yeast average**
0		0.271	0.315	0.353	**0.313**
3		0.396	0.410	0.438	**0.415**
6		0.466	0.515	0.590	**0.523**

L.S.D≤ 0.05

Variety	Dry baker's yeast	Stimax nature	Variety+ Dry baker's yeast	Variety +Stimax nature	Stimax nature+ Dry baker's yeast	Variety +Stimax nature+ Dry baker's yeast
NS	0.00981	0.00691	0.01371	0.01193	0.01307	0.01848

Table (4) The effect of Stimax nature seaweed extract, dry baker's yeast, and the interaction between them on the percentage of phosphorus (%) in the flower cruds of two broccoli varieties.

5. Percentage of potassium (%) in flower cruds:

The results of table (5) show the effect of the variety, Stimax Nature seaweed extract, and dry baker's yeast, and their interaction on the percentage of potassium (%) in the flower cruds of two broccoli varieties. There were significant differences between the varieties, with the Sidra variety achieving the highest potassium percentage at 1.499%, compared to the Jassmin variety, which recorded the lowest percentage at 1.490%. Significant differences were also found in the percentage of potassium when spraying with seaweed extract, with the highest percentage achieved at a concentration of 3 ml L^{-1}, reaching 1.548%, compared to the control treatment, which recorded the lowest percentage at 1.440%. Significant differences were also found in the percentage of potassium when spraying with dry baker's yeast suspension, with the highest percentage achieved at a concentration of 6 g L^{-1}, reaching 1.668%, compared to the control treatment, which recorded the lowest percentage at 1.312%. The interaction coefficients between the study factors had a significant effect, the interaction between the Sidra variety and a 6 g L^{-1} dry baker's yeast suspension significantly outperformed, achieving the highest potassium percentage average of 1.672%, compared to the control treatment for the Jassmin variety, which recorded the lowest average of 1.286%. The interaction between the Sidra variety and the Stimax nature seaweed extract at a concentration of 3 ml L^{-1} also significantly outperformed, achieving the highest average of 1.547%, compared to the control treatment for the Jassmin variety, which recorded the lowest average of 1.428%. The interaction between the Stimax nature seaweed extract at a concentration of 3 ml L^{-1} and the 6 g L^{-1} dry baker's yeast suspension also significantly outperformed, achieving the highest average of 1.708%, compared to the control treatment,

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Variety	Dry baker's yeast concen. (g L^{-1})	Stimax nature concen. (ml L^{-1})			Variety and dry baker's yeast interaction
		0	1.5	3	
JassmIn	0	1.236	1.276	1.346	**1.286**
	3	1.413	1.546	1.596	**1.518**
	6	1.636	1.653	1.703	**1.664**
Sidra	0	1.286	1.350	1.380	**1.338**
	3	1.433	1.480	1.550	**1.487**
	6	1.633	1.670	1.713	**1.672**
Stimax nature average		**1.440**	**1.496**	**1.548**	
Variety and Stimax nature interaction		0	1.5	3	Variety average
Jassmin		1.428	1.492	1.548	**1.490**
Sidra		1.451	1.500	1.547	**1.499**
Stimax nature and dry baker's yeast interaction		0	1.5	3	Dry baker's yeast average
0		1.261	1.313	1.363	**1.312**
3		1.423	1.513	1.573	**1.503**
6		1.635	1.661	1.708	**1.668**
L.S.D≤ 0.05					

Variety	Dry baker's yeast	Stimax nature	Variety+ Dry baker's yeast	Variety +Stimax nature	Stimax nature+ Dry baker's yeast	Variety +Stimax nature+ Dry baker's yeast
0.00969	0.01220	0.00962	0.01459	0.01203	0.01728	0.02312

Table (5) The effect of Stimax nature seaweed extract, dry baker's yeast, and the interaction between them on the percentage of potassium (%) in the flower cruds of two broccoli varieties

which recorded the lowest average of 1.261%. The results of the statistical analysis of the same table showed the significant superiority of the triple interaction treatment between the Sidra variety and the Stimax nature seaweed extract at a concentration of 3 ml L^{-1} and the dry baker's yeast suspension at a concentration of 6 g L^{-1}, achieving the highest average of 1.713%, compared to the control treatment of the Jassmin variety, which recorded the lowest average of potassium in the flower cruds, reaching 1.236%.

It is noted from the results in tables (1, 2, 3, 4 and 5) that there are significant differences between the varieties in the chlorophyll content of the leaves, the vitamin C content of the flower cruds, and the percentages of nitrogen, phosphorus and potassium, this may be due to differences in their genetic makeup, gene expression and ability to withstand different environmental conditions (Al-Burhan and Taey, 2018). These results are consistent with the results of the studies of (Hammoud *et al*., 2018), where they observed significant differences between the varieties in the percentage of nitrogen, and (Toman, 2024), where significant differences were found between the varieties in the percentages of nitrogen, phosphorus and potassium, and with (Al-Lami *et al*., 2018), where they observed significant differences between the varieties in the chlorophyll content of the leaves, and with (Zaki *et al*., 2015), where they found significant differences between the varieties in the vitamin content. C.

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The results in the tables above show significant differences in the total chlorophyll content of leaves, the vitamin C content of floral cruds, and the percentages of nitrogen, phosphorus, and potassium when sprayed with Stimax nature seaweed extract, this may be due to the fact that it contains natural growth hormones, which improve plant physiological processes and photosynthesis, and enhance protein production (Hayat and Ahmed, 2007). Seaweed extracts affect the plant's chemical content, as the plant responds to them as a fertilizer that enters the plant through the epidermal layers to the sites where it is used via the cell membranes (Abdul Amir and Al-Salami, 2016). These results are consistent with the results obtained by (Wolsk and Spizewskit, 2013), who observed significant differences in the effect of seaweed extracts on the percentage of dry matter, phosphorus, and potassium, and with (Al-Salihi and Hamoud, 2024), who found significant differences in the chlorophyll content of leaves were observed, as well as with (Taha and Abdelaziz, 2015), who observed significant differences in the percentage of nitrogen, phosphorus, and potassium, and (Attallah *et al*., 2021), who found significant differences in vitamin C content. The results also showed significant differences in the effect of spraying with a dry baker's yeast suspension, this may be due to the fact that yeast provides plants with nutrients that are essential for growth and increased yield, such as oxyanions and cytokinins, it also increases carbohydrates, amino acids, and organic matter, which are essential for cell growth and division, which in turn leads to increased yield (Al-Eissawi, 2015). Baker's yeast is considered safe for plants, does not cause any harm to the environment, and is rich in nutrients such as phosphorus, potassium, and iron (Barnett *et al*., 1983). These results are consistent with the results of studies by (Abu Khadir *et al*., 2020), who observed significant differences in the chlorophyll content of leaves and the percentages of nitrogen, phosphorus and potassium, with (Al-Moussawi, 2023), who noted significant differences in the percentages of nitrogen, phosphorus and potassium, and with (Zain Al-Abidin, 2024), who found significant differences in the chlorophyll content of leaves.

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