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EFFECT OF FISH PROTEIN HYDROLYSATE ON GROWTH, YIELD AND STORABILITY OF SOME FEMALE CUCUMBER HYBRIDS (Cucumis Sativus L) GROWN IN PLASTIC HOUSE IN BASRA

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ABSTRACT

General Background: Cucumber (Cucumis sativus L.) is a widely cultivated vegetable, valued for its nutritional and economic significance. **Specific Background:** The application of biostimulants, such as fish protein hydrolysate, has gained attention for enhancing plant growth and yield. However, the impact of varying concentrations of fish protein hydrolysate on different cucumber hybrids remains underexplored. **Knowledge Gap:** Despite existing research on biostimulants, the specific effects of fish protein hydrolysate on hybrid cucumber performance, particularly in unheated plastic houses, are inadequately documented. **Aims:** This study aimed to evaluate the effects of different concentrations of fish protein hydrolysate on the growth and yield of three cucumber hybrids ("Super Faris," "Ballistic," and "Darina") during the winter agricultural season of 2023/2024. **Results:** Conducted in a randomized complete block design with six factorial treatments and three replicates, the results indicated that the "Darina" hybrid significantly outperformed the other hybrids in key growth parameters, including plant height, stem diameter, leaf count, fruit number, fruit weight, individual plant yield, total yield, and total dissolved solids. Additionally, concentrations of fish protein hydrolysate at 2 and 4 ml L-1 demonstrated significant benefits over control treatments for most vegetative and yield indicators, although no effect on vitamin C content was observed. **Novelty:** This study provides new insights into the synergistic effects of hybrid selection and biostimulant application in cucumber cultivation. **Implications:** The findings suggest that the strategic application of fish protein hydrolysate can enhance cucumber production, highlighting its potential as a sustainable agricultural practice to improve crop yield and quality.

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INTRODUCTION

Cucumber, known by its scientific name Cucumis sativus L., is one of the most important crops of the Cucurbitaceae family in various countries of the world, including Iraq. The original home of this plant is India and Africa. Cucumber is a summer crop with a high economic return, and the demand for its cultivation has increased significantly after the spread of protected agriculture, which enables the provision of the crop outside its natural season [1]. Cucumber is grown for its fruits, which are consumed fresh in salads or cooked, and are also used in pickling [2]. Cucumbers can be used medicinally, as they help maintain the clarity of human skin, alleviate nervous disorders, purify the body of toxins, and as a headache reliever and thirst quencher [3]. Despite the lack of nutrients in cucumbers such as carbohydrates and proteins, they are a cheap source of some vitamins such as C, B1, B2, A, and niacin, in addition to containing important minerals such as calcium, phosphorus, potassium, and iron [4]. In order to grow cucumber genotypes commercially in greenhouses, plant breeders must understand how to produce female cucumber seeds. Seedless cucumbers are more important to consumers around the world, as cucumbers grown in open fields are usually prickly or rough to the touch, while cucumbers grown in plastic greenhouses have more desirable specifications [5]. In 2015, the area of land planted with this crop in Iraq was about 82,160 dunums. Total production reached 156,334 tons, with a low production rate of 1.902 tons per dunum-1 [6]. Since the genetic makeup of the parthenogenetic cucumber does not require pollination and fertilization to produce fruits, it has a higher productivity compared to traditional cucumber types. In addition, its economic value is higher because seedless fruits are sold at higher prices than fruits containing seeds [7]. Many developed countries have started to switch to organic agriculture, reducing the use of chemical compounds as much as possible. This trend aims to produce plants free of toxins resulting from pesticides and chemical fertilizers, thus providing clean and healthy crops [8]. Fish meat contains minerals such as calcium, phosphorus, sodium, magnesium, in addition to rare elements such as iodine, iron, copper, and vitamins such as B, A, and D. Fish is the main food for many peoples living on the coasts of seas and oceans. Fish waste is also of great importance, as many studies have shown that this waste, which includes bones, entrails, skin, scales, and fins, constitutes about 50% of the weight of the fish and is a good source of protein including enzymes and fats[9]. Waste is the remains of everything we use and is considered one of the main pollutants of our environment. The types of waste vary depending on its source. For example, slaughterhouse waste contributes to the spread of flies and pathogenic microbes, as it provides an ideal environment for the growth of these harmful organisms and the transmission of diseases. This waste can be easily decomposed by a group of microbes known as decomposers[10]. Looking to the future, strategies must be developed that enhance crop productivity and provide optimal nutrition for plants, in

order to preserve soil biodiversity and reduce environmental pollution, which contributes to high-quality food production and increase harvests in a sustainable manner[11].

Objective of the study

1- Study the effect of irrigation with a solution of decomposed fish extract on the growth and yield of three hybrids of female cucumbers with three concentrations of the solution (2, 4 and 6) ml. L-1 in addition to the comparison treatment (distilled water only).

2- Production of an organic crop free of chemical pollutants.

3- Ridding the environment of fish waste and the unpleasant odors emitted from it in places where it is sold.

4- Testing the duration of cold storage of cucumbers to reach the longest possible storage period.

METHODS

1- Experimental site and preparation of cultivated land

Cultivation was carried out on 10/20/2023 at the Agricultural Experimental Station affiliated to the College of Agriculture - University of Basra, which is located at longitude 〖47˚ 45〗^- 11¬¬ north and latitude 〖30˚ 34〗^- 07 west, where the effect of irrigation with fish protein hydrolysate solution at different levels on the growth and productivity of three hybrids of cucumber plants was studied during the fall season 2023-2024 under greenhouses. The study included plowing the land three times perpendicularly, smoothing and leveling it, with random samples of field soil taken at a depth of 0-30 cm to analyze the physical and chemical properties of the soil and irrigation water before starting the study (Table No. 1). The land was divided on 10/15/2023 into six lines of 30 meters long and one meter apart, with a distance of 1.28 meters between the two lines and 1.25 meters between the two end lines and the greenhouse structure. The lines were opened 30 cm deep in the direction of the wind from north to south to avoid any damage to the greenhouse covers due to the wind. After that, the lines were covered with a layer of greenhouse soil 15 cm above the soil surface, and then the drip irrigation system was installed. Important agricultural services operations were carried out to produce the crop, where a transparent polyethylene cover with a thickness of 125 microns was placed on 10/25/2023 to protect the plants from low temperatures. After that, on 11/5/2023, a green Saran cover was placed to protect the plants from high temperatures. Foliar fertilization was applied using Basfoliar Active as a growth stimulant at a concentration of 0.5 mg per liter one month after planting. The second batch of foliar fertilization was carried out using Volacro fertilizer at the same concentration two weeks after the first batch, and this process was repeated for three batches with two weeks between each batch. A comprehensive preventive program was implemented to protect plants from fungal diseases using the fungicide (Ono) at a concentration of 1 ml per liter-1 three weeks after planting, followed by another spraying after 50 days of planting. To prevent insect diseases, the fungicide (Actara Pro) was used at a concentration of 1 ml

per liter-1 30 days after planting. At the stage of 5-6 true leaves, the plants were incubated with field soil to enhance the formation of lateral roots. The experiment ended on 20/3/2024.

Table (1) Physical and chemical properties of field soil and irrigation water*.

Characteristic	Unity	Value
Electrical conductivity (EC)	ds m^{-1}	4.14
Soil pH	-	7.25
Total nitrogen	غم كغم$^{-1}$	1.77
Available phosphorus	غم كغم$^{-1}$	0.024
ready potassium	غم كغم$^{-1}$	45.8
sand	%	60
Silt	%	30
Clay	%	10
Soil texture	-	Sandy Loam
Fe (in soil)	ppm	8.278

*The analyses were conducted in the laboratories of the Department of Soil and Water Resources - College of Agriculture - University of Basra.

Table (2) Monthly averages of maximum and minimum temperatures in Celsius and relative humidity*.

Month	Maximum temperature (°C)	Minimum temperature (°C)	Maximum relative humidity (%)	Minimum relative humidity (%)
October 2023	39.38	21.64	31.84	8.43
November 2023	21.84	7.54	75.55	19.56
January 2024	21.87	12.07	83.2	24.03
December 2023	17.39	9.5	89.6	50.4
February 2024	19.66	7.35	80.6	24.21
March 2024	20.82	4.67	65.15	8.93

Meteorology Department at Basra International Airport.

2- Experimental design and treatments

The experiment was implemented according to a complete randomized block design, with three replicates as an experimental factor, where hybrids were considered as

a major factor and fish protein hydrolysate as a secondary factor in the study design with a (3*4*3) model, resulting in 36 experimental units. The length of each experimental unit was 4 meters, and each unit was planted with ten plants with a distance of 40 cm between each plant. The experiment was implemented inside a plastic house with dimensions of 26.50 × 9 meters, resulting in a total experimental area of 235.8 m2, with a plant density estimated at 1.953 plants m-2. After planting, the breeding process was carried out with a single stem, where the flowers and lateral branches of the plants were removed up to a height of 30 cm, and the growing tip of the branches was cut to stimulate the growth of lateral roots. It bore 2-3 fruits up to the height of the upper wire, which was 1.8 meters. The main stem was spliced using nylon threads, which were tied from the base of the stem and wrapped around the plants, then tied to the upper wire.

A randomized complete block design (R.C.B.D.) was used for a three-factor factorial experiment, and the results were statistically analyzed using Genstst 2010 analysis of variance and the least significant difference test, comparing the averages at a significant level of 0.05.

3-Planted hybrids

Three hybrids of cucumber plants were planted and were indeterminate in growth:

1- Ballistic F1 produced by the French company Clause.

2- Super Faris F1 produced by the German company Vanguard Seeds.

3- Darina F1 produced by the Dutch company Seminis.

4- Preparation of fish protein hydrolysate

The fish protein hydrolysate solution was prepared by following the following steps: Cut 10 kg of tilapia into small pieces, then add 10 kg of molasses and 30 liters of chlorine-free water. All ingredients were placed in a 60-liter container and mixed well by stirring daily. The container was tightly closed, leaving a small hole for gases to escape. A plastic tube was connected to the container and its end was placed in a small container filled with water to allow for anaerobic reaction. The container was placed in a shaded place. After 3 months, the unpleasant odor disappeared and bubbles stopped coming out of the container filled with water, indicating that the decomposition process was complete. After the decomposition was complete, the resulting liquid was extracted and filtered using a piece of muslin cloth before use.

Table (3): Some characteristics found in fish protein hydrolysate*.

Parameters	Result Values
P^H	**6.23**
E.C. (dsm^{-1})	**0.14**
N (%)	**193.2**
P (%)	**3.72**
K (%)	**1.24**
Organic matter (%)	**29.54**
Protein (%)	**1.20**

Na (ppm)	**71**
S (ppm)	**424**
Mg (ppm)	**639**
Fe (ppm)	**41**
Ca (ppm)	**527.9**
Mn (ppm)	**7.6**
Zn (ppm)	**11.53**
B (ppm)	**4.86**
Cu (ppm)	**3.25**

* The analysis was carried out in the laboratories of the Department of Soil and Water Resources - College of Agriculture - University of Basra.

5- Studied indicators

Five plants were randomly selected from each experimental unit to measure vegetative growth indicators and estimate the elements and floral growth indicators. As for the yield indicators and their components, they were calculated on the basis of the entire experimental unit.

6- Vegetative growth characteristics

Five homogeneous plants were randomly selected for each experimental unit and the following measurements were made:

7- Plant height (cm)

Five plants were taken at the end of the experiment from each experimental unit and the height of the selected plants was measured using a tape measure from the point of contact with the soil to the growing tip and their average was recorded.

8- Total number of leaves (leaf-1 plant)

The total number of leaves of the plants from each experimental unit was calculated and then the average was extracted.

9- Leaf area (cm2)

The leaf area was calculated using the weight method and as mentioned by [12], where five leaves were taken from each plant to represent the plant as much as possible for each experimental unit, then the weight of each leaf was recorded separately and discs of known area (8.04 cm) were cut from the leaves and then dried using an electric oven at a temperature of 70 °C until the weight was stable, then the dry weight of the leaves and discs was recorded, and the leaf area was calculated according to the following equation:

The leaf area of the plant (cm2) = (number of leaves × (2 cm) square cut area × dry leaf weight average) / (((g) cut area dry weight)

10- Fresh weight of the plant vegetative mass (g plant-1)

At the end of the season, the five selected plants were pulled out of the soil and cleaned well. Then the vegetative mass was separated from the root mass, and the

vegetative mass was weighed, after which the average fresh weight of each plant was extracted.

11- Dry weight of the plant vegetative group (gm plant-1)

The average dry weight of the plant vegetative group was calculated by drying the vegetative group of the five plants that were naturally uprooted at the end of the season until the weight stabilized, then the plants were weighed after drying and the average that represents the average dry weight of the plant vegetative group was extracted.

12- Fresh weight of the plant root group (gm plant-1)

It was calculated at the end of the season by weighing the root group of the five selected plants after cleaning them well, then the average weight of one plant was extracted.

13- Dry weight of the plant root group (gm plant-1)

The average dry weight of the plant root group was calculated by drying the root group of the five separated plants at the end of the season until the weight stabilized, then the root group was weighed after drying and the average that represents the average dry weight of the plant root group was extracted.

14- Chemical components

The properties of the chemical components were measured 60 days after planting.

15-Total chlorophyll (mg 100 g-1)

Total chlorophyll pigment in the leaves was estimated using the extraction method described by [13], where chlorophyll was extracted from the fourth fresh leaf [14] by grinding 10 g of it in a ceramic mortar in the presence of 10 ml of acetone at a concentration of 80%, then the precipitate was separated from the filtrate using a centrifuge at a speed of 166 rpm for 15 minutes, then the solution was placed in test tubes with a capacity of 10-25 ml covered with sterile paper to block light and prevent photooxidation of the pigment. The optical density of the solution was measured using a spectrophotometer at wavelengths of 663 nm and 645 nm, then the amount of chlorophyll (mg L-1) was calculated using the following equation:

Total Chlorophyll (mg L-1)=20.2D) 645 nm(+8.02D (663 nm)

To convert the amount of chlorophyll from mg L-1 to mg 100 g-1 sample weight, we use the relationship assumed by [15] and [16], which is as follows:

mg 100 g-1 = — × —

Leaf content of mineral elements

Sample preparation

To estimate the content of cucumber leaves of mineral elements, the fourth leaf was taken from the growing tip of the main stem of the plant for five previously marked plants randomly from each experimental unit. The samples were placed in marked plastic bags and then transferred to the laboratory and washed with distilled water To get rid of dust and impurities stuck to them, after drying, they were placed in perforated paper bags in an electric oven at a temperature of 70º C for 48 hours until the dry weight was fixed, then the samples were ground and stored in plastic containers until use.

Digestion of samples

2.0 g of samples were taken and placed in special glass flasks for digestion, and 5 ml of concentrated sulfuric acid H2SO4 (98%) was added to them and placed on a thermal heater at a temperature of 0120 C for half an hour, then the samples were cooled and 3 ml of the acidic mixture consisting of concentrated sulfuric acid and concentrated perchloric acid (H2SO4 + HCIO4) at a concentration of (96 + 4)% was added to them, then the temperature was raised to 0350 C until a clear, transparent solution was obtained, the solution was cooled and then transferred volumetrically to a 50 ml volumetric flask and the volume was completed with distilled water to 50 ml, after which the samples were ready for estimation of mineral elements. Total soluble carbohydrate content of leaves (mg/100 g-1 dry matter) The total soluble carbohydrate content of leaves was estimated using the Modification of Phenol - Suipnuric Acid Colorimetric Method described by [17], where 0.5 g of the leaf sample was taken from the fourth dry and ground leaf and placed in a 100 ml volumetric flask, then 70 ml of distilled water was added to it, then it was tightly closed and the samples were heated in a water bath for an hour and left to cool at room temperature. The solution was filtered using filter paper and 5 ml of the filtrate was taken and 25 ml of distilled water was added to it, then 1 ml was taken from it and 1 ml of 5% phenol and 5 ml of concentrated sulfuric acid were added to it, then the

RESULT AND DISSCUSION

Table (4): Effect of variety and protein hydrolysate on some vegetative growth indicators of.

class		Transactions	Plant height (cm)	Number of leaves (1 leaf)	Leaf area (cm2 plant-1)	Fresh weight of vegetative mass (g plant-1)	Dry weight of vegetative mass (in plant-1)	Fresh weight of root system (g plant-1)	Dry weight of root system (g plant-1)
Hybrid and concentration overlap	Super Faris	control	160.7	31.52	95.83	153.3	47.07	6.15	3.010
		ml-1 liter 2	164.6	34.45	119.49	153.8	51.27	7.45	3.747
		ml-1 liter 4	181.7	36.63	111.81	240.7	52.00	6.70	3.303
		ml-1 liter 6	192.5	38.30	145.33	145.6	42.67	5.70	2.993
	Ballistic	control	158.3	31.09	114.89	130.7	45.03	5.53	2.920
		ml-1 liter 2	190.9	31.89	157.18	221.9	63.03	7.57	4.240
		ml-1 liter 4	187.9	36.88	198.58	214.3	55.90	6.03	4.080
		ml-1 liter 6	214.4	43.32	175.89	291.9	62.03	6.82	4.047
	Darina	control	192.4	37.33	115.21	242.5	55.90	6.73	3.217
		ml-1 liter 2	258.2	46.40	139.37	315.2	73.83	8.13	4.823
		ml-1 liter 4	185.5	36.93	136.17	221.5	43.63	6.43	3.117
		ml-1 liter 6	217.0	43.56	130.26	242.2	59.43	6.73	3.407
L. S. D. 0.05			**12.04**	**1.944**	**7.834**	**30.64**	**5.29**	**0.68**	**0.38**
Average effect of protein degradant concentrations		control	170.4	33.32	108.64	175.5	49.33	6.13	3.049
		ml-1 liter 2	204.6	37.58	138.68	230.3	62.71	7.72	4.270
		ml-1 liter 4	185.0	36.82	148.85	225.5	50.51	6.39	3.500
		ml-1 liter 6	208.0	41.73	150.49	226.6	54.71	6.42	3.482

L. S. D. 0.05		**6.95**	**1.122**	**4.523**	**17.69**	**3.05**	**0.39**	**0.22**
Average effect of hybrids	Super Faris	174.9	35.23	118.11	173.3	48.25	6.50	3.263
	Ballistic	187.9	35.80	161.63	214.7	56.50	6.49	3.822
	Darina	213.3	41.06	130.25	255.3	58.20	7.01	3.641
L. S. D. 0.05		**6.02**	**0.972**	**3.917**	**15.32**	**2.64**	**0.34**	**0.19**

It is clear from Table (4) that the hybrids had a significant effect on plant height, as the hybrid plants Darina and Ballistic outperformed the hybrid Super Faris with an increase rate of (13.51 and 7.43)%, respectively. It is noted from the same table that the fish protein hydrolysate solution had a significant effect, as the concentrations (2 and 6) ml L-1 were significantly superior compared to the comparison treatment with an increase of (12.43 and 10.59)%, followed by the concentration 4 ml L-1, respectively, with an increase of (8.56)% compared to the comparison treatment. It is clear from the same table that the two-way interaction was significant, as the hybrid plants Darina treated with the fish protein hydrolysate solution at a concentration of 2 ml L-1 gave the highest plant height rate, which reached 258.2 cm, while the hybrid plants Ballistic in the comparison treatment gave the lowest rate for this trait, which reached 158.3 cm. The data in Table (4) indicate that hybrids have a significant effect on the number of leaves, as Darina hybrid plants were significantly superior in this trait compared to the other two hybrids, with an increase rate of (14.69 and 16.54)%. The reason for this is due to the special genetic factors in this hybrid and its response to environmental factors. The same table also shows that plants treated with fish protein hydrolysate solution at a concentration of 6 ml L-1 were significantly superior to concentrations (2 and 4) ml L-1, with an increase rate of (11.04 and 13.33)%, followed by concentrations (2 and 4) ml L-1, in comparison with the control treatment, with an increase rate of (12.78 and 10.50)%. As for the interaction, it showed a significant effect on this trait, as the Darina hybrid plants treated with fish protein hydrolysate solution at a concentration of 2 ml L-1 gave the highest average number of leaves, reaching 46.40 leaves per plant-1, while the Ballistic hybrid plants in the comparison treatment gave the lowest average number of leaves, reaching 31.09 leaves per plant-1. The table shows that the hybrids had a significant difference, as the Ballistic hybrid plants were significantly superior compared to the Darina and Super Faris hybrids, with an increase rate of (24.09 and 36.84)%. The two hybrids also differed significantly from each other, as the Darina hybrid plants were superior compared to the Super Faris hybrid, with an increase rate of (10.27)%. The results in the same table indicate that the plants treated with concentrations (4 and 6) ml L-1 were significantly superior compared to the concentration of 2 ml L-1, with an increase rate of (8.51 and

7.33)%, respectively. The plants treated with concentration 2 ml L-1 were also significantly superior compared to the control treatment, with an increase rate of (27.65)%. As for the interaction, it showed a significant effect, as the Ballistic hybrid plants treated with concentration 4 ml L-1 had the highest average leaf area, reaching 198.58 cm2 plant-1, while the Super Faris hybrid plants gave the lowest average, reaching 95.83 cm2 plant-1. The table shows that the hybrids had a significant difference between them, as the hybrid plants Darina and Ballistic were significantly superior with an increase rate of (47.31 and 23.88)% compared to the hybrid Super Faris. The same table also shows that the plants treated with a concentration of (2, 4 and 6) ml L-1 were significantly superior compared to the comparison treatment, respectively, with an increase rate of (31.22, 29.11 and 28.49)%. As for the interaction, the hybrid plants Darina and the treatment with a concentration of 2 ml L-1 gave the highest rate, which reached 315.2 g plant-1, while the hybrid plants Ballistic in the comparison treatment gave the lowest rate, which reached 130.7 g plant-1. The same table shows that the hybrids had a significant effect on the dry weight of the vegetative group, as the hybrid plants Darina and Ballistic were significantly superior in this trait compared to the hybrid plants Super Faris, with an increase rate of (20.62 and 17.09)%, respectively. It is also noted from the same table that the plants treated with a concentration of 2 ml L-1 were significantly superior compared to the concentrations (0, 4 and 6) ml L-1, with an increase rate of (14.62, 24.15 and 27.12)%. The concentrations also differed among themselves, as the plants treated with a concentration of (2 and 6) ml L-1 were significantly superior compared to the concentrations (0 and 4) ml L-1, with an increase rate of (8.31 and 10.90)%. As for the interaction, it showed a significant effect on this trait, as the Darina hybrid plants treated with a concentration of 2 ml L-1 gave the highest rate, reaching 73.83 g plant-1, while the Super Faris hybrid plants treated with a concentration of 6 ml L-1 gave the lowest rate, reaching 42.67 g plant-1. The results in the same table indicate that the Darina hybrid plants were significantly superior to the other two hybrids, with an increase of (7.84 and 8.01)%. The table also shows that the plants treated with a concentration of 2 ml L-1 were superior compared to the concentrations (0, 4 and 6) ml L-1, with an increase of (20.24, 20.81 and 25.93)%. As for the other concentrations, they did not differ significantly among themselves. As for the interaction, the results showed a significant effect, as the Darina hybrid plants treated with a concentration of 2 ml L-1 gave the highest value, reaching 8.13 g plant-1, while the Ballistic hybrid plants in the comparison treatment gave the lowest value, reaching 5.23 g plant-1. From the same table, it is noted that the Ballistic hybrid plants were significantly superior compared to the Darina and Super Faris hybrid plants, with an increase rate of (4.97 and 17.13)%. The table also shows that the plants treated with a concentration of 2 ml L-1 were superior compared to the concentrations (0, 4 and 6) ml L-1, with an increase rate of (22.00, 22.63 and 40.04]%). The concentrations also differed among themselves, as the plants treated with the concentrations (4 and 6) ml L-1 were significantly superior compared to the comparison treatment, with an increase rate of (14.79 and 14.20)%. As for the interaction,

the results showed a significant effect, as the Darina hybrid plants treated with a concentration of 2 ml L-1 gave the highest value, reaching 4.823 g plant-1, while the Ballistic hybrid plants in the comparison treatment gave the lowest value, reaching 2.920 g plant-1. The results indicate that the hybrids differed with

Table (5): Effect of variety, fish protein decomposer and interference on some chemical components of cucumber plant grown in greenhouse.

hybrid		Transactions	Total chlorophyll (mg/100g)	Soluble carbohydrates (mg g-1)	Leaf content of nitrogen, (%) phosphorus and potassium		
					N	P	K
Hybrid and concentration overlap	Super Faris	control	38.33	1.490	2.12	0.300	2.37
		ml-1 liter 2	48.92	1.890	2.31	0.336	2.33
		ml-1 liter 4	47.72	1.830	1.94	0.325	2.23
		ml-1 liter 6	47.35	1.480	2.27	0.384	1.78
	Ballistic	control	54.06	1.093	2.30	0.281	2.87
		ml-1 liter 2	46.93	2.393	2.55	0.290	1.89
		ml-1 liter 4	43.18	1.827	1.85	0.281	2.25
		ml-1 liter 6	52.89	1.807	2.15	0.382	2.98
	Darina	control	54.16	1.147	1.88	0.247	1.67
		ml-1 liter 2	54.30	2.060	1.67	0.273	2.89
		ml-1 liter 4	56.52	1.103	2.61	0.333	ز34
		ml-1 liter 6	56.37	1.723	2.49	0.413	2.48
L. S. D. 0.05			**9.66**	**0.82**	**0.063**	**1.05**	**1.17**
Average effect of protein degradant concentrations		control	48.85	1.243	0.276	2.10	2.30
		ml-1 liter 2	50.05	2.114	0.300	2.18	2.37
		ml-1 liter 4	49.14	1.587	0.313	2.14	2.61

	ml-1 liter 6	53.58	1.670	0.393	2.30	2.41
L. S. D. 0.05		**5.57**	**0.47**	**0.063**	**0.61**	**0.67**
Average effect of hybrids	Super Faris	45.58	1.673	0.336	2.16	2.18
	Ballistic	49.27	1.780	0.309	2.21	2.50
	Darina	56.37	1.508	0.317	2.16	2.59
L. S. D. 0.05		**4.83**	**0.41**	**0.054**	**0.52**	**0.58**

It is noted from Table (5) that there are significant differences between the hybrids, as the Darina hybrid plants significantly outperformed the Ballistic and Super Faris hybrids, with an increase rate of (14.41 and 23.67)%. The same table also shows that there are no significant differences between the concentrations. As for the interaction, it showed a significant effect, as the Darina hybrid plants treated with a concentration of 6 ml L-1 gave the highest value, reaching 60.51 mg, while the Super Faris hybrid plants in the comparison treatment gave the lowest value, reaching 38.33 mg. The data in the table indicate that the hybrids did not affect the carbohydrate level, while the treatment with the fish protein hydrolysate solution showed that the plants treated with a concentration of 2 ml L-1 were significantly superior compared to the concentrations (0 and 4) ml L-1, with an increase rate of (33.20 and 70.07)%. As for the interaction, it showed a significant effect, as the Ballistic hybrid plants treated with a concentration of 2 ml L-1 gave the highest value, reaching 2.393 mg, while the plants of the same hybrid in the comparison treatment gave the lowest value, reaching 1.093 mg. It is noted from the results in the table that the hybrids had no effect on phosphorus in the leaves. Regarding the effect of the fish protein hydrolysate solution, the results show significant differences between the plants that were treated with different concentrations of the solution, as the plants treated with a concentration of 6 ml L-1 were significantly superior compared to the comparison treatment plants, with an increase rate of (42.39)%. As for the interaction, it showed a significant effect, as the Darina hybrid plants treated with a concentration of 6 ml L-1 gave the highest value, reaching 0.413 mg, while the same hybrid plants in the comparison treatment gave the lowest value, reaching 0.247 mg.

It is clear from the table that the hybrids have no effect on phosphorus in the leaves, and regarding the effect of the fish protein hydrolysate solution, there are no significant differences between the concentrations. As for the interaction, it showed a significant effect, as the Darina hybrid plants treated with a concentration of 4 ml L-1 gave the highest value, reaching 3.34 mg, while the same hybrid plants in the comparison treatment gave the lowest value, reaching 1.67 mg. The table shows that the hybrids

differed significantly in the chlorophyll content of the leaves only, with the hybrid Darina outperforming the hybrid Super Faris and Ballistic. This may be attributed to the genetic effects of the two hybrids and the extent of their interaction with environmental factors, which is consistent with what was concluded by [35], [36] and [37]. As for the fish protein decomposer, although its addition to the cucumber plant did not have a clear significant effect on all chemical content characteristics of the plants except phosphorus, the interaction treatments between the two fertilizers had a significant effect on some chemical characteristics of the plant leaves. The results in the table also showed that the positive changes in the chemical content of the cucumber plant as a result of adding these types of organic fertilizers may be due to their containing the necessary major and minor nutrients such as nitrogen, phosphorus, potassium, iron, magnesium, copper and some plant growth regulators, which led to an increase in the readiness of the nutrients and their rapid absorption by the roots and their accumulation in the leaves [38]. This was evident through the significant increase in the percentage and phosphorus. Potassium in the leaves, and will certainly reflect the noticeable increase in the percentage of chemical components in the leaves as a result of adding these organic fertilizers, especially fertilizers resulting from fish and their waste due to their high content of amino acids [39]. There are many studies that support the results of this study in which these fertilizers were used and on different agricultural crops [40]. The results of the table indicate that the hybrids have significantly affected the number of flowers, as the Darina hybrid plants significantly outperformed the Ballistic and Super Faris hybrid plants with an increase rate of (4.34 and 5.63)%. As for the effect of the fish protein hydrolysate, the superiority of the plants treated with a concentration of 4 ml L-1 appears compared to the concentrations (0, 4 and 6) m L-1 with an increase rate of (12.35, 12.39 and 14.3)%, while the concentrations did not differ significantly among them. In the interaction, it was clear from the same table that the Darina hybrid plants treated with a concentration of 4 ml L-1 were significantly superior with the highest value reaching 33.27%, while the Super Faris hybrid in the comparison treatment recorded the lowest value reaching 24.99%. It is noted from the results of the table that the hybrids have an effect on the percentage of fruit set, as the Ballistic hybrid plants outperformed significantly compared to the Super Faris and Darina hybrids with an increase rate of (4.26 and 4.38)%, while the two hybrids did not differ significantly from each other. As for the effect of the fish protein hydrolysate solution, the plants treated with a concentration of 6 ml L-1 outperformed significantly compared to the control treatment with an increase rate of (6.96)%, while the concentrations did not differ significantly from each other. As for the interaction, it is clear from the same table that the Ballistic hybrid plants treated with a concentration of 4 ml L-1 were significantly superior with the highest value of 90.30%, while the Super Faris hybrid plants treated with a concentration of 2 ml L-1 recorded the lowest value of 79.23%.

The effect of fish protein hydrolysate on cucumber hybrids Super Faris, Ballistic and Darina and the interaction on floral growth indicators.

Table (6): Effect of variety, fish protein decomposer and interference on some floral growth indicators of cucumber plants grown in a plastic house.

hybrid		Transactions	Total number of flowers (flower/plant-1)	Contract (%) percentage
Hybrid and concentration overlap	Super Faris	control	28.02	83.07
		ml-1 liter 2	26.70	79.23
		ml-1 liter 4	28.88	85.18
		ml-1 liter 6	26.51	89.79
	Ballistic	control	27.88	82.66
		ml-1 liter 2	26.70	89.56
		ml-1 liter 4	30.38	90.30
		ml-1 liter 6	26.51	89.17
	Darina	control	24.99	80.95
		ml-1 liter 2	28.84	88.54
		ml-1 liter 4	33.21	82.50
		ml-1 liter 6	29.77	84.92
L. S. D. 0.05			**1.88**	**6.54**
Average effect of protein degradant concentrations		control	26.96	82.23
		ml-1 liter 2	27.42	85.78
		ml-1 liter 4	30.82	85.99
		ml-1 liter 6	27.43	87.96
L. S. D. 0.05			**1.09**	**3.77**

Average effect of hybrids	Super Faris	27.53	84.32
	Ballistic	27.87	87.92
	Darina	29.08	84.23
L. S. D. 0.05		**0.94**	**3.27**

Table (6) shows that the hybrids had a significant effect on the number of flowers, as the Darina hybrid plants outperformed Ballistic and Super Faris hybrid plants significantly, with an increase rate of (4.34 and 5.63)%. As for the effect of the fish protein hydrolysate, the plants treated with a concentration of 4 ml L-1 were superior compared to the concentrations (0, 2 and 6) ml L-1, with an increase rate of (12.35, 12.39 and 14.31)%, while the concentrations did not differ significantly between them. In the interaction, it was clear from the same table that the Darina hybrid plants treated with a concentration of 4 ml L-1 were superior significantly, with an increase rate of 33.27%, while the Super Faris hybrid plants in the comparison treatment gave the lowest increase rate, reaching 24.99%. The results in the same table indicate that hybrids have an effect on the percentage of fruit set, as the Ballistic hybrid plants outperformed significantly compared to the Super Faris and Darina hybrids, with an increase rate of (4.26 and 4.38)%, while the hybrids did not differ significantly between them. As for the effect of the fish protein hydrolysate, it is noted that the plants treated with the fish protein hydrolysate at a concentration of 6 ml L-1 were significantly superior compared to the control treatment, with an increase rate of (6.96)%, while the concentrations did not differ significantly between them. As for the interaction, it is clear from the same table that the Ballistic hybrid plants treated with a concentration of 4 ml L-1 were significantly superior with the highest increase rate of (90.30)%, while the Super Faris hybrid plants treated with a concentration of 2 ml L-1 gave the lowest increase rate of 79.23. The results of the table indicate that there are significant differences between hybrids in floral growth indicators, and these differences can be attributed to the genetic composition of each hybrid as well as to the interaction between genetic and environmental factors [41]. These results are consistent with the findings of other studies, such as [42], [43] and [44]. Thus, this leads to an increase in the number of flower buds on the plant [45]. In addition, the increase in leaf area plays an important role in improving the efficiency of photosynthesis, which increases the carbohydrate content, which is associated with an increase in the formation of female flowers and the fixation of nodes due to the good availability of carbohydrates [46]. This effect may be related to a hormonal effect similar to the action of auxin, which counteracts the effect of abscisic acid, which leads to an increase in fruit fixation [47]. Also, the organic nutrient containing potassium at a rate of (2)% plays a

role in activating the enzymes responsible for carbohydrate metabolism and transporting them from their formation sites to other parts of the plant, which enhances the formation of a greater number of flower buds [48]. In addition, potassium contributes to the activation of the compound (ATP) Adenosine Triphosphate, the compound responsible for energy transfer and which affects the process of photosynthesis [49], which provides sufficient amounts of photosynthesis products, which reduces competition between different parts of the plant and encourages the formation of flower buds and increases the number of flowers and the percentage of nodes [50]. These results are consistent with what was reached by [51] and [52] and [53]

The effect of fish protein decomposer on cucumber hybrids Seminis, Super Faris and Ballistic and the interference in yield components.

Table (7): The effect of fish protein decomposer on cucumber hybrids Super Faris, Ballistic and Darina and the interference in yield components.

hybrid		Transactions	Number of fruits (fruit per plant-1)	Fruit weight (g) (	Fruit length (cm)	Fruit diameter (cm)	Yield per plant (kg plant-1)	Early yield per plant (kg plant-1)	Total yield (tons per acre-1)
Hybrid and concentration overlap	Super Faris	control	20.00	76.8	15.87	2.693	0.786	2.767	1.536
		ml-1 2 liter	21.10	119.3	18.48	2.490	1.141	3.273	2.230
		ml-1 4 liter	23.27	132.1	19.12	3.137	1.042	2.760	2.036
		ml-1 6 liter	23.27	120.7	19.12	2.907	1.347	3.000	2.631
	Ballistic	control	21.17	85.9	17.10	3.163	0.930	2.800	1.818
		ml-1 2 liter	23.90	108.1	17.45	3.040	1.322	2.977	2.583
		ml-1 4 liter	25.17	97.0	20.11	3.187	1.249	3.747	2.441

		ml-1 6 liter	23.63	113.7	19.28	3.147	1.375	3.057	2.686
	Darina	control	20.47	94.0	19.67	2.780	0.985	2.997	1.924
		ml-1 2 liter	25.53	119.3	19.22	3.130	1.559	3.027	3.045
		ml-1 4 liter	20.23	132.1	19.05	3.010	1.368	3.640	2.672
		ml-1 6 liter	22.50	120.7	17.31	3.080	1.390	3.203	2.715
L. S. D. 0.05			**2.26**	**27.32**	**2.798**	**0.423**	**0.016**	**0.964**	**0.010**
Average effect of protein degradant concentrations		control	20.54	85.6	17.66	2.879	0.900	2.854	1.759
		ml-1 2 liter	23.51	111.0	19.27	2.887	1.340	3.092	2.619
		ml-1 4 liter	22.89	105.5	19.15	3.111	1.219	3.382	2.383
		ml-1 6 liter	23.30	115.0	18.05	3.044	1.371	3.087	2.677
L. S. D. 0.05			**1.30**	**15.77**	**1.615**	**0.244**	**0.009**	**0.556**	**0.005**
Average effect of hybrids		Super Faris	22.03	95.2	17.64	2.807	1.079	2.950	2.108
		Ballistic	23.47	101.2	19.15	3.134	1.219	3.145	2.382
		Darina	22.18	116.5	18.81	3.000	1.325	3.217	2.589
L. S. D. 0.05			**1.13**	**13.66**	**1.399**	**0.211**	**0.016**	**0.482**	**0.005**

The results of Table (7) show that hybrids have an effect on the number of fruits, as the Ballistic hybrid plants significantly outperformed the Darina and Super Faris hybrid plants with an increase rate of (5.81 and 6.53)%, and the hybrids did not differ significantly among themselves. As for the concentrations of fish protein decomposer, the plants treated with the concentrations [2 and 6] ml L-1 significantly outperformed the

plants treated with the concentrations (0 and 4) ml L-1 with an increase rate of (2.70 and 14.45)%, and the plants treated with the concentration 6 ml L-1 significantly outperformed compared to the concentrations (0 and 4) ml L-1 with an increase rate of (1.79 and 13.54)%, while the rest of the concentrations did not differ significantly among themselves, and the interaction had a significant effect, as the Darina hybrid plants treated with a concentration of 2 ml L-1 gave the highest value and reached 25.53 fruits plant-1, while the Super Faris hybrid plants in the comparison treatment gave The lowest value was 20.00 fruits per plant-1.

The table indicates that hybrids have a significant effect on fruit weight, as the hybrid Darina significantly outperformed the hybrids Ballistic and Super Faris with an increase rate of (15.11 and 22.37)% respectively, and the hybrids did not differ significantly among themselves. As for the effect of the fish protein hydrolysate, the plants treated with a concentration of 6 ml L-1 significantly outperformed compared to the comparison treatment with an increase rate of (34.34)%. Likewise, the plants treated with a concentration of 2 ml L-1 significantly outperformed compared to the comparison treatment with an increase rate of (29.67)%, and the plants treated with a concentration of 4 ml L-1 significantly outperformed compared to the comparison treatment with an increase rate of (23.24)%. The results of the same table indicate that hybrids have an effect on the fruit length trait, as Ballistic hybrid plants significantly outperformed Super Faris hybrid plants by an increase of (8.56)%, while the rest of the hybrids did not differ significantly among themselves. As for the effect of fish protein hydrolysate, the results did not show significant differences between the plants that were treated with different concentrations of it, but the interaction between these two factors had a significant effect, as Ballistic hybrid plants treated with a concentration of 2 ml/l-1 achieved the highest value, reaching 20.11 cm, while the lowest value was for Super Faris hybrid, which reached 15.87 when treated as a comparison. The table shows that the hybrids differed significantly in the fruit diameter trait, as the Ballistic hybrid plants outperformed the Super Faris hybrid plants significantly by an increase of (11.64)%, while the rest of the hybrids did not differ significantly and the concentrations of the fish protein hydrolysate did not show a significant difference in this trait. As for the interaction, it showed a significant effect, as the Ballistic hybrid plants treated with a concentration of 4 ml L-1 achieved the highest value of 3.187 cm, while the lowest value was for the Super Faris hybrid and reached 2.490 cm when treated with concentrations (2 and 4) ml L-1. The results of the same table indicate that hybrids have a significant effect on the trait of the single plant yield, as Darina hybrid plants outperformed significantly compared to Ballistic and Super Faris hybrids with an increase rate of (8.69 and 22.79)%, and Ballistic hybrid plants also outperformed significantly compared to Super Faris hybrid plants with an increase rate of (12.97)%. As for the effect of fish protein hydrolysate, the results show significant differences between plants treated with different concentrations of it, as plants treated with a concentration of 6 ml L-1 outperformed significantly compared to concentrations [0, 2 and 4] ml L-1 with an increase rate of (2.31, 12.46 and 52.33)%, and

plants treated with a concentration of 2 ml L-1 outperformed significantly over plants treated with concentrations (0 and 4) ml L-1 with an increase rate of (9.92 and 48.88)%, respectively, and plants treated with a concentration of 4 1 ml L-1 significantly on the control treatment plants and an increase rate of (35.44)%.

The interaction showed a significant effect as Darina hybrid plants treated with a concentration of 2 ml L-1 gave the highest value and reached 1.559 kg plant-1 while Super Faris hybrid plants in the control treatment gave the lowest value and reached 0.786 kg plant-1.

It is clear from the same table that the hybrids did not show any significant differences in the yield of one plant, and no significant effect was observed for using different concentrations of fish protein hydrolysate. As for the interaction, it showed a significant effect as Ballistic hybrid plants treated with a concentration of 4 ml L-1 gave the highest value and reached 3.747 kg plant-1 while Super Faris hybrid plants treated with a concentration of 4 ml L-1 gave the lowest value and reached 2.760 kg plant-1.

It is noted that hybrids have an effect on the total yield, as Darina hybrid plants outperformed significantly compared to Ballistic and Super Faris hybrid plants with an increase rate of (8.69 and 12.99)%, and Ballistic hybrid plants also outperformed significantly compared to Super Faris hybrid plants with an increase rate of (12.99)%. As for the effect of fish protein hydrolysate, the results showed significant differences between plants treated with different concentrations of it, as plants treated with a concentration of 6 ml L-1 outperformed compared to concentrations (0, 2 and 4) ml L-1 with an increase rate of (2.21 and 12.33 and 25.18)%, and plants treated with a concentration of 2 ml L-1 outperformed significantly compared to concentrations (0 and 4) ml L-1 with an increase rate of (9.90 and 48.89)%, and plants treated with a concentration of 4 ml L-1 also outperformed the control treatment plants with an increase rate of It reached (35.47)%.

The interaction showed a significant effect, as the hybrid Darina plants treated with a concentration of 2 ml L-1 gave the highest value of 3.045 tons dunum-1, while the hybrid Super Faris plants in the comparison treatment gave the lowest value of 1.536 tons dunum-1.

It is evident from the results of the table that there are significant differences between the hybrids in some characteristics of the yield and its components, which is attributed to genetic variations between them.

Table (8): Effect of variety and protein hydrolysate on some qualitative yield indicators of cucumber hybrids grown in the plastic house.

hybrid	**Transactions**			**Vitamin C (IU)**	**(%)Protein**

			Dry matter content of (%) fruits	**Total dissolved (%) solid**		
Hybrid and concentration overlap	Super Faris	control	4.61	3.973	8.47	13.23
		ml-1 2 liter	5.67	4.420	9.22	14.46
		ml-1 4 liter	5.66	5.137	10.58	12.15
		ml-1 6 liter	6.17	3.623	9.29	14.19
	Ballistic	control	5.53	3.233	7.42	14.40
		ml-1 2 liter	5.40	4.560	9.22	15.96
		ml-1 4 liter	5.46	4.363	10.66	11.56
		ml-1 6 liter	6.33	4.433	10.29	13.46
	Darina	control	4.68	3.383	7.78	11.75
		ml-1 2 liter	5.46	3.653	7.69	10.42
		ml-1 4 liter	5.59	4.243	11.78	16.33
		ml-1 6 liter	5.70	4.307	8.53	11.75
L. S. D. 0.05			**1.21**	**0.914**	**1.714**	**6.614**
Average effect of protein degradant concentrations		control	4.94	3.530	7.89	13.12
		ml-1 2 liter	5.51	4.211	8.71	13.61

	ml-1 4 liter	5.57	4.581	11.01	13.35
	ml-1 6 liter	6.07	4.121	9.37	14.40
L. S. D. 0.05		**0.70**	**0.528**	**0.990**	**3.819**
Average effect of hybrids	Super Faris	5.53	4.288	9.39	13.51
	Ballistic	5.68	4.147	9.40	13.84
	Darina	5.36	3.897	8.95	13.52
L. S. D. 0.05		**0.60**	**0.457**	**0.857**	**3.307**

Table (8) shows that the hybrids did not show any significant differences in the percentage of dry matter. As for the effect of the fish protein hydrolysate solution, significant differences were observed from the results between the plants treated with different concentrations of it, as the plants treated with a concentration of 6 ml L-1 outperformed compared to the control treatment with an increase rate of (22.87)%, while the rest of the concentrations did not differ significantly among themselves. As for the interaction, the results showed a significant effect, as the Ballistic hybrid plants treated with a concentration of 6 ml L-1 gave the highest value, reaching (6.33)%, while the Super Faris hybrid plants in the control treatment gave the lowest value, reaching (4.61)%. From the same table, it is noted that the hybrids did not show any significant differences in the total dissolved solid matter, as for the effect of the fish protein hydrolysate solution, the results show significant differences between the plants treated with different concentrations of it, as the plants treated with a concentration of 4 ml L-1 outperformed compared to the control treatment with an increase rate of (29.77)%, and the plants treated with a concentration of 2 ml L-1 outperformed significantly compared to the control treatment with an increase rate of [19.29]%, and the plants treated with a concentration of 6 ml L-1 also outperformed significantly compared to the control treatment with an increase rate of (16.74)%. As for the interaction, the treatment with different concentrations of the fish protein hydrolysate solution showed a significant effect, as the Super Faris hybrid plants and the treatment with a concentration of 4 ml L-1 gave the highest value, reaching (5.17)%, while the Ballistic hybrid plants in the control treatment gave the lowest value, reaching (3.233)%. It is noted from the same table that the hybrids did not significantly affect the vitamin C trait, and as for the effect of the fish

protein hydrolysate solution, the results showed significant differences between the plants that were treated with different concentrations of it, as the plants treated with a concentration of 4 ml L-1 significantly outperformed compared to the plants treated with concentrations (0, 2 and 6) and with an increase rate of (17.50, 26.40 and 39.54)% respectively, and the plants treated with a concentration of 6 ml L-1 significantly outperformed compared to the treatment of the control plants and with an increase rate of (18.75)%, while the rest of the concentrations did not differ significantly among themselves. The same table shows the significant effect of the interaction between these two factors, as the Darina hybrid plants achieved the highest value, reaching (11.78) mg 100 g-1 when treated with a concentration of 4 ml L-1, while the lowest value was for the Ballistic hybrid, which reached (7.42) mg 100 g-1 when treated with the comparison. It is clear from the table that the hybrids did not significantly affect the protein percentage, as well as the treatment with the fish protein hydrolysate solution and the interaction. The results did not show any significant differences between the plants that were treated with different concentrations of it. The same table shows that the hybrids differ significantly in the vitamin C trait as a result of genetic differences and environmental influence, and that the increase in vitamin C indicates the high ability of the hybrid to accept the surrounding environmental factors and exploit them in the photosynthesis process in order to convert them into good practical products in the economic yield [66]. These results are consistent with what was reached by [67] and [68]. As for the significant effect of the fish protein hydrolysate solution on some components of the qualitative yield, as shown in the table, the concentration exceeded 4 ml L-1, and the reason for this is due to the role of organic fertilizers in improving the readiness of nutrients in the soil, which facilitates their absorption by the plant, which enhances the strength of vegetative growth and increases the production of carbon representation, which leads to a better accumulation of complex compounds such as carbohydrates, soluble amino acids and organic acids. These compounds are transferred to the fruits, which contributes to improving their quality characteristics. In addition, increasing the concentration of nitrogen in the plant enhances the production of amino acids [69]. The organic nutrient works to prepare the appropriate conditions in the soil (lowering the pH) by increasing the readiness to absorb elements, and this is reflected in the course of physiological processes inside the plant as well as the process of photosynthesis, which affects the increase of vitamin C in the fruits. The reason for this is the role of the organic extract, which gives positive results in vital activities, and this leads to productivity in carbohydrate compounds that work to synthesize ascorbic acid [70]

CONCLUSION

In conclusion, this study demonstrates that the application of fish protein hydrolysate significantly enhances the growth and yield of cucumber hybrids, particularly highlighting the superior performance of the "Darina" hybrid across various agronomic

traits. The positive effects observed with concentrations of 2 and 4 ml L-1 on key growth indicators underscore the potential of biostimulants to optimize cucumber production in unheated plastic houses. These findings imply that incorporating fish protein hydrolysate into agricultural practices could serve as an effective strategy for improving both yield and quality of cucumber crops, promoting sustainable farming methods. Further research is warranted to explore the long-term impacts of fish protein hydrolysate on additional crop varieties, optimal application timings, and potential synergistic effects with other agronomic practices to fully elucidate its role in modern agriculture.

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