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A-Garbawi & Aljuboori

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وحماية المستهلك

EFFECT OF ADDING PHOSPHORUS AND SPRAYING WITH ZINC IN THE VEGETATIVE GROWTH AND YIELD OF CABBAGE PLANTS

Rawaq Sattar Jebari A-Garbawi[1] *, Ayad Waleed Aljuboori[2]
[1]Department of Horticulture, College of Agricultural Engineering Sciences, University of Baghdad, Baghdad, Iraq. rewaq.jbari2105@coagri.uobaghdad.edu.iq
[2]Professor PhD. Department of Horticulture, College of Agricultural Engineering Sciences, University of Baghdad, Baghdad, Iraq. ayad.waleed@coagri.uobaghdad.edu.iq

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ABSTRACT

This study was conducted at the Experimental Research Station in the College of Agricultural Engineering/University of Baghdad in the Jadiriyah area during the fall season of 2022. The study aimed to find out the effect of adding phosphorus and spray with zinc in the vegetative growth and yield of cabbage plants. The experiment included two factors: the first factor was phosphorus (P) at four concentrations (P25%, P50%, P75%, and P100% of the recommended complete fertilizer dose of 135 kg P2O5 per hectare), and the second factor was spray with zinc sulfate (ZnSO4) at three concentrations (0, 30, and 60 mg/L). which symbolize it as (Z0, Z1, Z2) respectively the results showed that the treatment P75 Z2 significantly influenced most of the study's parameters, such as plant height, number of outer and inner leaves, leaf area, dry weight, and plant productivity, with values of 23 cm, 17.30 leaves, 71.67 leaves, 939.53 cm2, 12.84%, and 2.33 kg, respectively, compared to the control treatment.

Key words: Cabbage, Phosphorus fertilizer, Zinc element, foliar fertilization, Brassicaceae.

تأثير إضافة الفسفور والرش بالزنك في صفات النمو الخضري والحاصل لنبات اللهانة

رواق ستار جباري الغرباوي[1]، اياد وليد عبد الله الجبوري[2]
[1]قسم البستنة وهندسة الحدائق، كلية علوم الهندسة الزراعية، جامعة بغداد ، بغداد.العراق، rewaq.jbari2105@coagri.uobaghdad.edu.iq
[2]الاستاذ الدكتور، قسم البستنة وهندسة الحدائق، كلية علوم الهندسة الزراعية، جامعة بغداد ، بغداد.العراق، ayad.waleed@coagri.uobaghdad.edu.iq

الخلاصة

نفذت هذه الدراسة في محطة التجارب البحثية في كلية علوم الهندسة الزراعية/ جامعة بغداد في منطقة الجادرية للموسم الخريفي 2022 والتي هدفت الى معرفة تأثير اضافة الفسفور والرش بالزنك في صفات النمو الخضري والحاصل لنبات اللهانة، تضمنت التجربة عاملين العامل الأول اضافة الفسفور P وبأربع تراكيز P25 و P50 و P75 و P100 % من التوصية السمادية الكاملة (135 P_2O_5 كغم.هكتار$^{-1}$) والعامل الثاني هو الرش بكبريتات الزنك بصيغة $ZnSO_4$ وبثلاث تراكيز 0 و30 و60 ملغم لتر$^{-1}$ ورمز لها (Z0 و Z1 و Z2) بالتتابع، أظهرت النتائج ان المعاملة P75 Z2 قد اثرت معنويا في اغلب مؤشرات الدراسة مثل ارتفاع النبات وعدد الأوراق الخارجية والملفوفة والمساحة الورقية والوزن الجاف للاوراق والحاصل للنبات الواحد وبقيم بلغت 23 سم، 17.30 ورقة، 71.67 ورقة، 939.53 سم^2، 12.84 %، 2.33 كغم على التوالي مقارنة بمعاملة القياس.

الكلمات المفتاحية: اللهانة، السماد الفوسفاتي، عنصر الزنك، التسميد الورقي، العائلة الصليبية.

* **The article is taken from the master's thesis of the first researcher .**

INTORDUCTION

Cabbage (*Brassica oleracea* var.capitata) belongs to the Brassicaceae family. Its leaves can be green or red, and they are round or oval in shape. Cabbage plants typically consist of inner smooth light-colored leaves covered by outer tougher and darker leaves. The original habitat of cabbage is Western Europe and the northern coast of the Mediterranean Sea **(Moreb *et al*., 2020; Al-Tamimi, 2020).** Cabbage is known for its nutritional importance, as it contains high concentrations of minerals and vitamins. It has an appetite-stimulating effect and aids in the digestion process, thus helping to prevent constipation. Studies on healthy nutrition have confirmed that cabbage has intestinal and liver cleansing properties and reduces obesity by its ability to dissolve fats in the body **(AL-Tamimi & AL-Juboori, 2020; AL-Mharib *et al*, 2020; AL-Ethawi, 2022; Al-Mashhadany. & Al-Mharib, 2023).**

Phosphorus is considered one of the essential elements that significantly influence plant growth due to its critical role in metabolic pathways such as nutrient uptake, respiration, biological oxidation, photosynthesis, and cell division. Phosphorus is also a structural component of phosphorus-containing proteins, phospholipids, coenzymes, nucleic acids, and chromosomes. Zinc is another essential micronutrient necessary for plant growth and completing their life cycles. It plays an important role in regulating energy consumption and increasing the energy required for chlorophyll production. Zinc also contributes to the formation of the amino acid tryptophan, root growth, chloroplast synthesis, and enzymatic processes **(Alrawi, 2018; Makki, 2016; Umar,2021)**..found in a study investigating the effect of chemical fertilizer addition on the yield and growth of cabbage plants that adding phosphorus at a concentration of 60 kg/ha resulted in the highest plant yield at an average of 28.1 tons/ha. It also gave the highest average head circumference, diameter, head weight, and leaf number. This is consistent with the findings of **Al-Salmawi (2021)** who observed that phosphorus addition increased growth traits. **AL-juboori & Mohammed (2021)** observed that high levels of phosphorus led to an increase in pea production. **Taheri *et al*. (2020)** conducted a study on cabbage plants and noted that foliar application of zinc resulted in an increase in head weight, head diameter, head thickness, and yield compared to the control treatment, which yielded lower values. The study aims to know the effect of adding phosphate fertilizer and zinc spring on the vegetative traits and yield of the heads of cabbage.

MATERIALS AND METHODS

A field experiment was conducted to grow cabbage plant (Shorouq hybrid) in one of the research fields of the College of Agricultural Engineering Sciences at the University of Baghdad for the fall season of 2022, under open cultivation conditions. The experiment was carried out using a Complete Randomized Block Design (RCBD) with 4 × 3 and three replications, resulting in a total of 36 experimental units (4 × 3 × 3). The data analysis was performed using the statistical software Genstat

version 12, and the mean values were compared using the least significant difference (L.S.D) test at a significance level of 0.05 **(Al-Khafaji & Al-Khameesi, 2012).** The study included two factors, the first factor phosphorus fertilizer was added at four levels (25%, 50%, 75%, and 100%) of the recommended full fertilizer dosage of 135 kg/ha. And will symbolize it as P25, P50, P75, and P100. second factor: zinc sulfate spraying with three concentrations (0, 30, and 60 mg/L.) And will symbolize it as Z0, Z1, and Z2. The spraying will be done in three batches after 15 days, 45 days, and 60 days from planting. Phosphorus is added by making a groove beneath each plant.

The recommended chemical fertilizer dosage is 125 kg N/ha, 135 kg P_2O_5/ha, and 135 kg K2O/ha **(Ali: 2012)**. Nitrogen and potassium fertilizers will be added in two batches: the first two weeks after transplanting and the second one month after the first batch. fertilizers will be added by making a groove beneath each plant.

Study Indicators

Plant height (cm), number of outer leaves (leaf. plant^{-1}), number of collated leaves (leaf. plant^{-1}), leaf area (cm^2), plant dry weight (%), and yield per plant (kg)

RESULTS AND DISCUSSION

1- Plant height (cm):

The results in the table showed a significant difference in plant height with the treatment of phosphorus and zinc, as the interaction treatment of adding phosphorus and zinc P50Z2 had the highest growth rate of 24.33 cm compared to treatment P25Z0, which had the lowest growth rate of 20.00 cm.

Number of external leaves per plant (leaf. plant^{-1}): The table results indicated a significant effect of phosphorus and zinc treatment on increasing the number of external leaves in cabbage plants. The interaction treatment between phosphorus and zinc gave, P75Z2, had the highest leaf count with 17.30 leaves. plant, which was not significantly different from treatment P100Z2, which yielded 17.00 leaves. plant. However, treatment P25Z1 had the lowest count of 16.00 leaves. plant.

2- Number of cabbage leaves (leaf. plant):

The table results showed a significant difference in the treatment of phosphorus and zinc in increasing the number of cabbage leaves. The interaction treatment of phosphorus and zinc, P75Z2, had the highest leaf count with 71.67 leaves. plant, which was not significantly different from treatment P50Z2. On the other hand, treatment P25Z0 had the lowest count of 65.33 leaves. plant.

3-Leaf area per plant (cm^2. plant):

The table results indicate that the addition of phosphorus and zinc had a significant effect on increasing the leaf area per plant. The interaction treatment P75Z1 had the highest leaf area of 944.27 cm.plant, which was not significantly different from treatment P75Z2, which yielded a leaf area of 939.53 cm. However, treatment P25Z0 recorded the lowest leaf area of 677.11 cm.plant.

4- Percentage of dry matter in external leaves (%):

The results in the table showed a significant difference in the dry weight of the external leaves with the addition of phosphorus and zinc. The interaction treatment of phosphorus and zinc, P75Z2, had the highest percentage of 12.84%, which was not significantly different from treatment P75Z1 and P100Z2. However, treatment P25Z0 had the lowest percentage of 11.24%.

5- Yield per plant (kg):

The table results demonstrated that the addition of phosphorus and zinc had a significant effect on increasing the yield per plant. The interaction treatment of adding phosphorus and zinc, P75Z2, had the highest yield of 2.33 kg compared to treatment P25Z0, which recorded the lowest yield of 1.54 kg.

CONCLUSION

Highlights the role of phosphorus in stimulating cell division and expansion, as well as activating photosynthesis in plants, leading to increased leaf area and dry weight of the plant **(Al-Mohammadi & Yassin, 2017).** Phosphorus stimulates the metabolic processes in plants, due to the role of phosphorus in building phospholipids and DNA, which is important for plant development and general growth, and this leads to an increase in leaf area, number and plant height. Phosphorus helps in the manufacture of carbohydrates by photosynthesis and the accumulation of substances present in the plant **(Mauriya *et al*. 2018; Al-Slmawy & Abdul-Ratha,2023).** Zinc, on the other hand, is crucial for crop growth and formation. It is involved in DNA replication, protein synthesis, and energy transfer reactions, as well as chlorophyll formation **(Rivera, 2021; Al-Dulaimi & Al-Jumaili, 2017),** because zinc plays an important role in the formation of chlorophyll, cell division, meristematic activity, tissue expansion and elongation, and cell wall formation **(Souri & Hatamian, 2019).** The noticeable increase in vegetative growth attributes can be attributed to the use of foliar nutrients, specifically those containing zinc. Nutrient foliar application enhances nutrient absorption, achieving a nutritional balance that positively affects plant growth and hormonal regulation. This, in turn, increases photosynthesis activity, energy production, and protein synthesis effectively in plant tissues, resulting in increased dry weight of green plant parts **(Sadaqa & Bagash, 2018).**

Zinc's presence is essential as it promotes the synthesis of tryptophan, a fundamental compound contributing to the formation of plant hormones such as IAA (indole-3-acetic acid), which stimulates and encourages plant growth. Additionally, zinc enhances carbohydrate accumulation by promoting photosynthesis, leading to increased dry weight of green plant parts. Zinc is an important nutrient for plant growth due to its role in activating crucial enzymes, participating in starch formation, and enhancing the action of the auxin. As a result, the stems of the plant are increase in elongated, leading to increased plant height. The increase in leaf area can be attributed to zinc's role in stimulating photosynthesis, thereby promoting growth rates and achieving an increase in leaf surface area **(Al-Saadi, 2022).**

Table (1): the effect of adding phosphorus and spraying with zinc on the characteristics of the growth and yield per plant of cabbage plants.

Treatment	Plant height cm	Number of outer leaves	Number of collated leaves	Leaf area(cm2)	Dry Wight of plant %	Plant yield Kg
P25 Z0	20.00	16.00	65.33	677.11	11.24	1.54
P25 Z1	22.30	16.13	67.00	775.00	11.37	1.75
P25 Z2	22.36	16.76	68.00	813.33	11.50	1.76
P50 Z0	22.00	16.00	69.00	823.87	11.53	1.67
P50 Z1	22.16	16.66	69.67	861.26	11.63	1.84
P50 Z2	24.33	16.83	70.33	884.50	11.83	1.86
P75 Z0	22.00	16.76	69.00	854.93	12.09	1.93
P75 Z1	22.76	16.83	70.33	944.27	12.661	2.03
P75 Z2	23.00	17.30	71.67	939.53	12.84	2.33
P100 Z0	22.00	16.33	68.33	865.00	12.00	1.95
P100 Z1	22.33	16.66	69.00	891.98	12.25	2.00
P100 Z2	23.10	17.00	69.33	948.32	12.66	2.07
L.S.D. 5%	0.61	0.63	1.55	43.22	0.32	0.07

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