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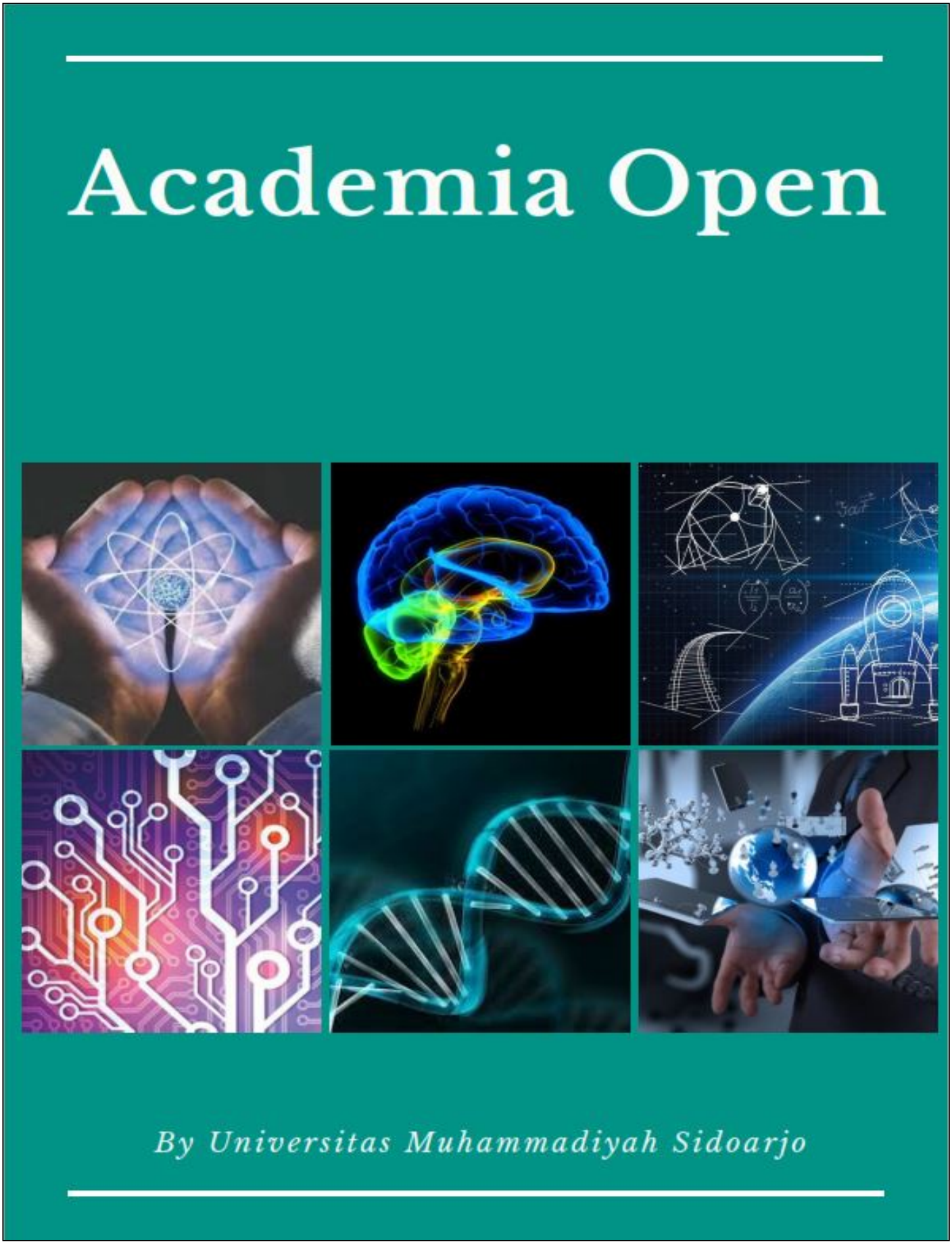

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Effect of Spraying the Vigna Radiata L.Plant, with Salicylic Acid and Boron on Yield and Protein Percentage

Pengaruh Penyemprotan Tanaman Vigna Radiata L. dengan Asam Salisilat dan Boron terhadap Hasil dan Persentase Protein

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Abstract

This study was conducted for the period from 1 Nomber 1to 15 April for the 2023 season to determine the effect of Salicylic acid and Boron on Vigna radiata plant yield and protein percentage. Concentrations of (0, 50,75 and 100,).and boron with (0, 25 and 50) mg L-1distile water were used sprayed on plants grown in plastic pots using the CRD design. The results showed: The treatment spraying with salicylic acid by 100 and boron by 50mg L-1 concentration mg.L-1 distilled water gaved The highest values for yield triats (number of pods.plant-1, number of seeds.pod-1, weight of 100 seeds.g, seed yield Plant -1 gm , harvest index and protein percentage) reached (9.0, 7.44, 10.99, 29.40 , 62.99 and), while the lowest values were in the Control treatment (without spraying with salysic acid boron) and were (3.99, 4.99, 10.0, 23.99 , 51and 32) respectively.

Highlights:

1. Study salicylic acid and boron effects on Vigna radiata yield.
2. 100mg salicylic acid + 50mg boron maximized yield traits.
3. Treatment improved pods, seeds, protein, and harvest index significantly.

Keywords: Vigna radiate; salysilic acid; boron

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Introduction

A leguminous (Fabaceae family) crop of economic importance with edible seeds is mung bean (*Vigna radiata* L). The mung bean is considered to be widely adaptable and to have agricultural advantages that include relative tolerance to salinity, very low nutritional requirements (protein fixer) and a short life cycle of about 70–80 days, after which it can be cultivated again, producing up to 4–5 seeds per plant. These traits justify its position as a crop of significant importance in several Asian countries, notably China, Bangladesh, Pakistan, India and to some extent, East Asia. They are also grown in arid regions of Southern Europe and warmer climates of Canada and United States (Dahiya et al., 2015).

The foliar feeding technique is a commonly used method, especially with the development of sprinkler irrigation techniques, which facilitated the addition of nutrients with irrigation water (Heyland & Werner, 2000).

Salicylic acid is one of the natural phenolic hormones extracted from the willow tree (Pirsata, 2005). It is produced from the amino acid phenyl alanine and has an important role in regulating several physiological processes in plants, such as biotic and abiotic stress (Koo *et al.*, 2020). The plant's response to salicylic acid depends on the concentration used,and time to add as well as the growth stage in which acid is added (Abdi and Al-Hbeti., 2022).

The element boron is important in increasing the rate of pollination and fertilization of leguminous crops and thus increasing production through its stimulation of physiological processes during the flowering stage (Shorrock, 1991). Boron increases the resistance of plants to drought by controlling the speed of the plant's absorption of water through its participation in the process of maintaining the water balance of the cells (Sujatha, 2005) by increasing the growth of root cells.

Methods

The experiment was carried out at agricultural nursery in Salah al-Din Governorate, Iraq during November 1st to April 15, during 2023 growing season. Plastic pots of dimensions, 30 cm diameter, 40 cm height, and carrying capacity of 20 kg were put to use in the study. A mixed soil substrate was used to fill these pots. Plants were grown from local mung bean (Vigna radiata) seeds, obtained from agricultural offices. During the experiment all necessary agricultural practices were carried out.

The factors were arranged in a two factor factorial experiment using a completely randomized design (CRD). The first factor was the salicylic acid treatment at four concentrations (0, 50, 75 and 100 mg L−1 distilled water) and foliar application of boro at three concentrations (0, 25 and 50 mg L−1 distilled water) were the second factor. The sprays were done at two stages with one month interval between the first and second sprays. Salicylic acid and boron were applied with a three day gap in between. In each pot was a single plant.

In the experiment, there were 3 replications, each comprising 12 treatment combinations derived from the two factor interactions. The following characteristics were evaluated:

Number of pods per plant: The average number of pods per harvested plant was determined.

Number of seeds per pod: Average number of seeds per plant divided by the average number of pods per plant.

Weight of 100 seeds (g): Harvested seeds were mixed and 100 seeds were taken at random, weighed, mixed together and weighed again.

Seed yield (g per plant): The seed yield from the harvested plant was also measured by weighing the wet weight of the seed yield in each experimental unit.

Harvest index (%): Calculated using the formula:

Harvest Index (%)

=(Seed Yield Biological Yield)×100

Harvest Index (%)=(Biological Yield Seed Yield)×100

Protein percentage (%): But they are determined for the harvested seeds.

Statistical Analysis

Duncan's multiple range test was used to determine differences between treatments at significance level of 0.05.

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Results and Discussion

From Table (1) we note that the interaction treatment of spraying with Salysilic acid and Boron on the number of pods plant^{-1} produced a significant positive effect on the number of pods plant^{-1} as the highest number reached (10.10) an increase of 102% compared to untreated plants, which had a number of pods of 5.0.

Saly.	0	50	75	100	Boron.Mean
Boron					
0	5.00f	6.00e	8.00c	9.00b	7.00
25	6.50de	7.00d	8.00c	9.33b	7.70
50	6.66de	9.00b	9.33b	10.10a	8.77
Salysilic Mean	6.05	8.00	8.44	9.47	

Table 1. ***Effect Spraying Salysilic acid and Boron on the number of pods.plant^{-1} .***

The results of Table (2) indicate that the interaction treatment of spraying with Salysilic acid and Boron had a positive significant effect on the number of seeds per pod, as the highest number reached 7.44 seeds as a result of the interaction treatment of spraying with Salysilic acid 100mg and Boron 50mg on the number of pods.plant^{-}, an increase of 86.0% compared to untreated plants, which had of 4.00 seeds.pod^{-1}.

Saly.	0	50	75	100	Boron.Mean
Boron					
0	4.00e	5.00d	6.00c	6.66c	5.41c
25	4.66d	6.00c	6.33c	6.66c	5.90ab
50	4.60d	7.00ab	6.33bc	7.44a	6.34a
Salysilic Mean	4.44	6.00	6.22	5.92	

Table 2. *Effect Spraying Salysilic acid and Boron on the number of seeds.plant-1.*

It is clear from the results of Table (3) that the intervention treatment, spraying withSalysilic acid and Boron a positive significant effect on the weight of 100 seeds, as the highest weight reached 10.99 grams as a result of the interaction treatment of spraying with Salysilic acid 100mg and Boron 50mg an increase rate of 12.14% compared to the untreated plants, which weight of 100 seeds was 9.80 gm.

Saly.	0	50	75	100	Boron.Mean
Boron					
0	9.80e	10.25f	10.0d	10.90c	12.23
25	10.09d	10.59e	10.70d	11.00b	10.59
50	10.91c	10.00d	10.86c	10.99a	10.69
Salysilic Mean	10.26c	10.28c	10.52b	10.35	

Table 3. *Effect Spraying Salysilic acid and Boron on the weigt of 100 seeds.gm.*

From Table (4) it is clear that the intervention treatment, spraying with Salysilic acid and Boron on the number of seed yields plant^{-1}, had a positive, significant effect on trait the seed yield plant-1, as it gave the highest value amounting to (29.40). gm.plant^{-1}, an increase of 102.29% compared to the control treatment plants, which had the lowest seed yield (14.85) gm plant^{-1}.

Saly.	0	50	75	100	Boron.Mean
Boron					
0	14.80h	24.66e	27.13c	27.66b	23.58b
25	18.72g	26.00cd	27.03c	28.00ab	24.94ab
50	21.89f	27.13c	27.00c	29.40a	23.85a
Salysilic Mean	18.49c	25.93b	27.05ab	28.35a	

Table 4. *Effect Spraying Salysilic acid and Boron on the Yeild.plant-1 gm.*

From Table (5) it is clear that the interaction treatment, spraying with Salysilic acid and Boron on the number of pods.plant^{-1}, had a positive, significant effect on the harvest index characteristic of mung plants, as it gave the

highest value amounting to 62.99%, with a percentage increase. It amounted to 20.39% compared to the control treatment plants, which had the lowest harvest index of 52.32%.

Saly.	0	50	75	100	Boron.Mean
Boron					
0	52.32f	55.17e	57.40d	58.00d	55.72b
25	58.33cd	58.50	59.48bc	59.47b	85.94a
50	58.89c	58.39c	6.07ab	62.99a	60.00a
Salysilic Mean	58.89c	57.39c	58.98ab	58.98b	60.15a

Table 5. *Effect Spraying Salysilic acid and Boron on on the harvest index%.*

From Table (6) it is clear that the interaction treatment, spraying with Salysilic acid and Boron on the protein percentage % on the seeds, had a positive, significant effect on the protein percentage characteristic of mung plants, as it gave the highest value amounting to 12.60%, with a percentage increase. It amounted to 42.93% compared to the control treatment plants, which had the lowest protein percentage reached of 7.57%.

Saly.	0	50	75	100	Boron.Mean
Boron					
0	7.57f	8.04e	1.00d	12.00b	9.40b
25	8.05e	9.60de	11.65c	12.22ab	10.28ab
50	8.00e	11.00d	12.01b	12.60a	10.82a
Salysilic Mean	7.87d	9.21c	11.22b	12.27a	

Table 6. *Effect Spraying Salysilic acid and Boron on protein percentage%.*

Discussion:

The reason for so many pods was the function of salicylic acid as an activator of physiological processes and accelerator of the flowering process by stimulating of photosynthesis (Prakash et al., 2019). Additionally, Boron is important in the promotion of Photosynthesis that eventually leads to the eruption of more flowers to the culmination of correlative increase in number of the pods (Fadhil and Jader, 2020). In addition, boron increases the rate of pollination and fertilisation in leguminous crops causing the increase in production stimulated by its accelerative effects on certain critical processes at flowering stage (Shorrocks, 1991).

Salicylic acid played a probable part in increasing seed weight since it enhanced the strength of root system, reduced ion leakage, increased water retention and decreased transpiration rates. These factors forming new membranes and tissues in the plant (Al-Dabbagh and Al-Dulaimi, 2019). Boron also makes the translocation of photosynthetic products from leaves to the rest of the plant like seeds to grow more seed weight (Vern, 2010).

Physiological effect of salicylic acid improves harvest index, increasing cell division and elongation, increasing absorption of the nutrients by the roots and increasing the activity of antioxidant enzyme. Together, these processes enhance vegetative growth, and hence biological yield (Al-Water and Hamadany, 2021). Salicylic acid's role in affecting cell division, improving meristematic cells activity, promoting nutrient translocation to branches and hormones regulation (auxins and cytokinins) can also contribute to overall yield increase(s). In addition, salicylic acid helps transmit signals to gene expression and speeds up photosynthesis (Jahan et al., 2019). This is in addition to boron's positive impacts on pollen germination and the number and yield of seeds (Bidwell, 1979).

It is possible to link the increase in seed protein content resulting from application of salicylic acid and boron to their roles in increasing growth parameters and total yield. Next, protein content is increased by promoting these processes (Al-Jubory and Obaid, 2020). However, boron contributes to nitrogen fixation and RNA synthesis which eventually adds to seed protein content (Jasim and Obaid, 2014).

Conclusion

The study concluded that the application of salicylic acid and boron significantly improved the yield and protein content of Vigna radiata. Salicylic acid enhanced physiological processes, including photosynthesis, root strength, water retention, and antioxidant enzyme activity, which contributed to increased pod and seed production, seed weight, and harvest index. Boron played a vital role in promoting photosynthesis, pollination, fertilization, and nutrient translocation, resulting in higher seed yields and improved protein content. The synergistic effects of salicylic acid and boron enhanced vegetative growth, flowering, and nitrogen fixation, ultimately leading to better crop performance and quality.

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