International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; SP-8(6): 373-380
www.biochemjournal.com
Received: 16-04-2024
Accepted: 29-05-2024

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Evaluation of biostimulants effect on various parameters and its relation to insect-pest infestation on two genotypes of Brinjal

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DOI: https://doi.org/10.33545/26174693.2024.v8.i6Se.1312

Abstract
Small farmers cultivating Brinjal fight against various pest-insect by spraying pesticide which is harmful. Use of biostimulants is cheaper and less harmful than using a chemical insecticide. Thus, the purpose of this experiment was to ascertain how biostimulants, such as seed priming and foliar application, affected the population dynamics of insect-pest at two different stages. We investigated Brinjal leaf palatability to jassid, aphid and little leaf in plants treated with silicon and tryptophan subjected to biochemical analysis. We also examined the effects of those treatments on Brinjal. The experimental study was carried out as a completely randomized design, consisting of the ten treatments of both biostimulants in two genotypes of Brinjal. The experimental results revealed that the foliar spray of typtophan (200 ppm) at vegetative stage positively impacted on all parameters.

Keywords: Biostimulants, Silicic acid, tryptophan, seed priming

Introduction

Brinjal, the fifth-most economically significant solanaceous crop, is recognized for its low-calorie nutritional profile enriched with fiber, vitamins, minerals, proteins, and bioactive compounds, including anthocyanin. Increased consumer awareness of the nutritional and medicinal qualities of Brinjal has shifted researcher's focus toward enhancing the nutraceutical composition of plants (Raigon *et al.*, 2008) [14]. The research focuses on enhancing the quantity and nutraceutical quality of Brinjal through the application of biostimulants. Tryptophan and silicic acid treatments were explored for their impact on biochemical characters associated with insect pest infestation. One of the major problems in the cultivation of plant is low and uniform seed germination as well as insect pest attack. Aiming, this present investigation was focused on the biostimulants (tryptophan and silicic acid) which may enhance the quantity and nutraceutical quality of Brinjal. This could include better fruit quality and improved resistance to diseases.

Materials and Methods

The experimental material for present investigation was comprised of two varieties of brinjal, GAB 6 and GRB 8 which were treated with 100 ppm silicic acid and 200 ppm tryptophan for 6 hrs. It was finalized from laboratory experiment. For the priming treatment, seeds were soaked in priming solutions having double the volume of seed. It was ensured that seeds remained immersed in the solution, to avoid precocious germination during the treatment period. Priming was given in the petri plate at room temperature and seeds were dried back to the original moisture content under shade after 6 hours duration (Ghobadi *et al.*, 2012) [6]. Moisture content (%) was estimated as per method developed by A.O.A.C. (2000) using randomly selected leaves from each treatment in each replication. The method described by Weatherley *et al.* (1950) [20] was used for the determination of relative water content (%) of brinjal genotypes under control as well as water deficit stress conditions. Pre-weighed leaf samples of rice were transferred in a petri dish filled with at least 100 ml distilled water so that leaves remain submerged for four-six hours. Then the leaves were taken out, dried by blotting paper and measured the turgid weight. After that, turgid leaf samples were kept in oven at 80 ^{o}C overnight and weighed until constant weight was obtained.

Membrane injury (%) was determined by using the method of Sullivan (1971) [17] with some modification. Fresh brinjal leaf tissues i.e. 0.1 g was taken and placed in sugar tubes containing 100 ml of distilled water. Firstly they were kept in hot water bath at 40 °C for 30 minutes and then after 30 minutes, samples were cooled to room temperature and electrical conductivity (EC) was recorded for both control as well as treated samples (C1 and T_1). Then the tubes were kept in boiling water bath at 100 °C for 15 minutes. After cooling, again electrical conductivity was measured (C2 and T_2). Membrane injury was calculated. Chlorophyll (mg/g) was estimated by method described by Hiscox and Israelstam (1979) [7]. Fresh leaves (100 mg) were cut into small pieces and kept in dimethyl sulfoxide (DMSO) containing tube overnight. The extract was filtered through whatman No.1 filter paper. Filtrate was collected and volume made to 10 ml with DMSO. Absorbance was measured in spectrophotometer at 645 nm and 663 nm for determination of total chlorophyll, and content was calculated. Percent disease incidence estimated by counting the number of infected plants by the total number of plants in a randomly selected plot size of 25 m^2 area in each field. The little leaf disease was estimated by counting the number of infected plants by the total ten numbers of plants in a randomly selected area in each treatment. The percent disease incidence of little leaf calculated using the formula given by Meena Kumari *et al.* (2002) [12]. For recording the observations on targeted insects i..e., jassid and whitefly; five plants will be randomly selected and tagged in each plot. Number of jassid and whitefly were recorded from randomly selected three leaves (i.e., from top, middle and bottom canopy) from each of the randomly selected five plants. The observations recorded prior as well as 3, 7, 10 and 14 days after each spray.

Results and Discussion

Leaf moisture content is a critical parameter that directly influences the physiological health and vigor of plants. The results indicate a significant difference in leaf moisture levels between the two brinjal varieties, with GAB 6 exhibiting a higher moisture content of 85.38% compared to GRB 8 with a moisture content of 83.10% (Table 1). Variation in leaf moisture content may also be associated with the plant's ability to regulate water uptake and transpiration. Differences in stomatal conductance and transpiration rates could contribute to the observed contrast in leaf moisture levels. The results of the study demonstrate significant variability in leaf moisture content among the different treatment. The control group exhibited a leaf moisture content of 85.58% providing a baseline for comparison. This level may represent the natural water balance of brinjal under typical growing conditions. Seed priming with tryptophan (T_2) showed a decrease in leaf moisture content to 80.83%, suggesting that the seed priming process with tryptophan may have influenced water uptake or transpiration rates negatively. Foliar spray of tryptophan i.e., treatment T_4 and T_5 resulted in leaf moisture contents of 78.23% and 82.90%, respectively. These variations indicate that the timing of foliar application may impact the plant's ability to maintain optimal moisture levels. The foliar spray combination treatment i.e. T_6 (T_4 + T_5) - displayed a leaf moisture content of 84.10%, suggesting a potential synergistic effect of the combined foliar sprays. The treatment T_7 and T_8 demonstrated higher leaf moisture contents of 86.82% and 88.23%, respectively, indicating that silicic acid foliar sprays may positively influence water retention. While, treatment T_9 resulted in a leaf moisture content of 86.35%, suggesting a sustained positive effect of the silicic acid treatments. T_{10} (T_6 + T_9 - foliar spray combination) showed a leaf moisture content of 84.33%, indicating that the combined application of tryptophan and silicic acid treatments could balance the moisture levels in brinjal leaves. The interaction effects were also found to be significant, with certain interactions being at par with each other, notably V_1T_4, V_1T_5 and V_2T_3. Similar trend was also observed by Khan *et al*., 2015 [11] studied three brinjal genotypes namely, Shamli, Pearl Long and Black Beauty. The results of proximate chemical composition of leaves showed that moisture content was higher of 89.47% for Black Beauty and lower of 86.15% for Pearl Long. Oboh *et al.*, 2005 [13] studied nutritional properties of brinjal leaves and concluded that moisture content was varied from 88.6% to 89.7% in brinjal leaves. Overall the results indicated that foliar sprays and seed priming with specific compounds can influence leaf moisture content in brinjal. Silicic acid treatments, in particular, showed a positive impact on maintaining optimal leaf moisture levels.

Table 1: Effect of biostimulants application on leaf moisture content (%) in brinjal

Sr. No.	Treatments	GAB 6	GRB 8	Mean
1	T_1 (control)	88.00	83.17	85.58
2	T_2 (Seed priming with tryptophan as per experiment no 1)	79.00	82.67	80.83
3	T_3 (Seed priming with silicic acid as per experiment no1)	88.33	81.67	85.00
4	T_4 (Foliar spray of tryptophan at vegetative stage)	77.80	78.67	78.23
5	T_5 (Foliar spray of tryptophan at flowering stage)	80.30	85.50	82.90
6	T_6 (T_4 + T_5)	82.70	85.50	84.10
7	T_7 (Foliar spray of silicic acid at vegetative stage)	89.27	84.37	86.82
8	T_8 (Foliar spray of silicic acid at flowering stage)	89.47	87.00	88.23
9	T_9 (T_7 + T_8 (foliar spray))	89.57	83.13	86.35
10	T_{10} (T_6 + T_9)	89.33	79.33	84.33
	Mean	85.38	83.10	
		V	T	V × T
	S. Em. ±	0.78	1.74	2.46
	C.D. at 5%	2.23	4.98	7.05
	C. V.%	5.06		

Leaf relative water content (RWC) is a key indicator of the plant's hydration status and overall water balance. The results reveal a significant difference in RWC between the two brinjal varieties, with GAB 6 displaying a lower RWC of 56.79% compared to GRB 8 with an RWC of 58.81% (Table 2). The lower RWC in GAB 6 may indicate a potential difference in water-use efficiency or drought tolerance compared to GRB 8. Varieties with higher RWC are generally better equipped to withstand periods of water stress and maintain cellular turgor, which is crucial for normal physiological processes. The results indicate significant variations in RWC among the different treatments, highlighting the impact of applied treatments on the water regulation of brinjal leaves. The control group exhibited an RWC of 60.65%, representing the baseline water content in the absence of any specific treatments. Seed priming with tryptophan i.e. treatment T_2 displayed a substantial increase in RWC to 75.35%, suggesting that tryptophan seed priming positively influenced water uptake and retention. In contrast, T_3 (Seed priming with silicic acid) showed a lower RWC of 53.18%, indicating a potential negative impact on water content with this treatment. Foliar spray of tryptophan at 35 and at 45 days i.e. treatment T_4 and T_5, resulted in RWC values of 79.98% and 69.14%, respectively. The timing of foliar application influenced RWC, with T_4 exhibiting higher water content. Treatment T_6 showed a decrease in RWC to 64.84%, suggesting that the combined foliar spray did not maintain the higher RWC observed with T_4 alone. Foliar spray of silicic acid at 35 and at 45 days i.e. treatments T_7 and T_8, displayed lower RWC values of 44.09% and 40.86%, respectively, indicating a substantial decrease in water content with these silicic acid treatments. In case of treatment T_9 showed a further decrease in RWC to 36.55%, emphasizing the cumulative impact of silicic acid foliar sprays. The treatment T_{10} exhibited a moderate RWC value of 53.38%, indicating that the combined application of tryptophan and silicic acid treatments had a complex impact on water regulation. Hence, RWC is an appropriate estimation of plant water status in term of cellular hydration under the possible effect of both leaf water potential and osmotic adjustment. Chakma *et al*., 2021 [5] studied effect of silicic acid priming on growth, quality and yield characters of tomato fruit and noted that RWC content was significantly higher in primed seed (79.1%) and lower in non-primed seeds (74.2%). Khan *et al*., 2019 [10] studied effects of silicon treatments in tomato plants and suggested that RWC was higher in silicon treated plant compared with the control. Soltys-Kalina *et al*., 2016 studied leaf relative water content and tuber yield of potato cultivars. They concluded that RWC ranges from 66.7% to 86.7% and cultivar Wauseon with low yield losses corresponds with high RWC values. Bhatt *et al*., 2014 evaluated eight genotypes of brinjal and observed that RWC in control plants ranged between 78.3% and 89.4%, while in flooded plants there was a considerable increase in RWC and ranged from 85.3% to 98.0% and after that it decreases and ranged between 45.0% to 89.0%. Overall the above results suggested that seed priming with tryptophan and foliar spray of tryptophan positively affected RWC, while silicic acid treatments led to reduced water content. The combined treatments showed varying effects, emphasizing the importance of understanding the interactions between different treatments on plant water dynamics.

Table 2: Effect of biostimulants application on leaf relative water content (%) in brinjal

Sr. No.	Treatments	GAB 6	GRB 8	Mean
1	T_1 (control)	60.72	60.59	60.65
2	T_2 (Seed priming with tryptophan as per experiment no 1)	71.64	79.05	75.35
3	T_3 (Seed priming with silicic acid as per experiment no 1)	54.38	51.98	53.18
4	T_4 (Foliar spray of tryptophan at vegetative stage)	79.51	80.45	79.98
5	T_5 (Foliar spray of tryptophan at flowering stage)	71.35	60.93	69.14
6	T_6 (T_4 + T_5)	62.92	66.75	64.84
7	T_7 (Foliar spray of silicic acid at vegetative stage)	42.53	45.64	44.09
8	T_8 (Foliar spray of silicic acid at flowering stage)	41.28	40.43	40.86
9	T_9 (T_7 + T_8 (foliar spray))	33.80	39.30	36.55
10	T_{10} (T_6 + T_9)	49.77	56.99	53.38
	Mean	56.79	58.81	
		V	T	V×T
	S. Em. ±	0.62	1.38	1.96
	C. D. at 5%	1.77	3.96	5.60
	C. V.%	5.86		

Leaf membrane injury (MI) is a crucial parameter reflecting the integrity of cell membranes, which is directly linked to the overall health and stress tolerance of plants. The results indicate a difference in membrane injury between the two brinjal varieties, with GAB 6 exhibiting a higher injury level of 26.01% compared to GRB 8 with a lower injury level of 24% (Table 3). The lower membrane injury level in GRB 8 suggests that this variety may possess a higher degree of stress tolerance or better membrane stability compared to GAB 6. Varieties with lower membrane injury levels are often more resilient to environmental stressors, which can positively impact overall plant performance and yield. The results demonstrate substantial variations in membrane injury levels among the different treatments, indicating the impact of applied treatments on the health and stress resilience of brinjal leaves. The control group exhibited a membrane injury level of 25.13%, representing the baseline injury in the absence of specific treatments. Seed priming with tryptophan (T_2) displayed a significantly lower membrane injury level of 8.28%, suggesting that tryptophan seed priming positively influenced membrane stability and stress tolerance. T_3 Seed priming with silicic acid (Treatment T_3) resulted in a higher membrane injury level of 28.12%, indicating a potential negative impact on membrane integrity with this treatment. Foliar spray of tryptophan at 35 (T_4) and 45 days (T_5) demonstrated low membrane injury levels of 5.53% and 10.03%, respectively, suggesting that tryptophan foliar sprays positively influenced membrane stability. The treatment T_6 showed an intermediate membrane injury level of 20.28%, indicating a potential interaction between the two foliar spray applications. Foliar spray of silicic acid at 35 (T_7) and 45

(T_8) days displayed higher membrane injury levels of 39.05% and 40.67%, respectively, suggesting a negative impact on membrane integrity with silicic acid foliar sprays. The treatment T_9 showed a further increase in membrane injury to 43.85%, indicating a cumulative negative effect of the silicic acid treatments. The foliar spray combination treatment T_{10} exhibited an intermediate membrane injury level of 33.02%, suggesting a complex interaction between the combined treatments. Drought stress caused an increase in membrane injury during the stress period. During stress periods, tolerant pants exhibited lower MI as compared to the sensitive cultivar. After re-watering, MI recovered progressively to well water (control) levels (Abid *et al*., 2018). Seidler-Lozykowska *et al*., 2010 studied cell membrane injury in caraway (*Carum Carvi* L.) genotypes in water deficit conditions and concluded that membrane injury was ranged between 4.2 to 49.4% in various genotypes. Thus the study demonstrates that different treatments have a significant impact on leaf membrane injury in brinjal. Seed priming with tryptophan and tryptophan foliar sprays appear to positively influence membrane stability, while silicic acid treatments show a potential negative effect. The combined treatments exhibit varying effects, emphasizing the need for careful consideration of interactions between different treatments.

Table 3: Effect of biostimulants application on leaf brinjal membrane injury (%) in brinjal

Sr. No.	Treatments	GAB 6	GRB 8	Mean
1	T_1 (control)	25.10	25.17	25.13
2	T_2 (Seed priming with tryptophan as per experiment no 1)	8.05	8.50	8.28
3	T_3 (Seed priming with silicic acid as per experiment no 1)	28.17	28.07	28.12
4	T_4 (Foliar spray of tryptophan at vegetative stage)	5.00	6.06	5.53
5	T_5 (Foliar spray of tryptophan at flowering stage)	11.07	9.00	10.03
6	T_6 (T_4 + T_5)	20.50	20.07	20.28
7	T_7 (Foliar spray of silicic acid at vegetative stage)	39.50	38.60	39.05
8	T_8 (Foliar spray of silicic acid at flowering stage)	41.77	39.57	40.67
9	T_9 (T_7 + T_8 (foliar spray))	45.34	42.35	43.85
10	T_{10} (T_6 + T_9)	35.63	30.40	33.02
	Mean	26.01	24.78	
		V	T	V×T
	S. Em. ±	0.27	0.60	0.84
	C. D. at 5%	0.76	1.70	0.41
	C. V.%	5.73		

Leaf chlorophyll content (mg/g) is a vital indicator of photosynthetic efficiency and overall plant health. The results reveal a difference in chlorophyll levels between the two brinjal varieties, with GRB 8 exhibiting a higher chlorophyll content of 0.617 mg/g compared to GAB 6 with a lower content of 0.545 mg/g (Table 4). The higher chlorophyll content in GRB 8 suggests that this variety may have enhanced photosynthetic activity and a greater capacity for light absorption, which are critical for plant growth and productivity. Higher chlorophyll levels are generally associated with improved photosynthetic efficiency and better adaptation to environmental conditions. The results demonstrate significant variations in chlorophyll levels among the different treatments, highlighting the impact of applied treatments on the photosynthetic activity of brinjal leaves. The control group exhibited a chlorophyll content of 25.13 mg/g, representing the baseline chlorophyll levels in the absence of specific treatments. The treatment T_2 displayed a significantly lower chlorophyll content of 8.28 mg/g, suggesting that tryptophan seed priming negatively impacted chlorophyll synthesis or stability. While the treatment T_3 resulted in a higher chlorophyll content of 28.12 mg/g, indicating a potential positive impact on chlorophyll levels with this treatment. Foliar spray of tryptophan at 35 (T_4) and 45 (T_5) days demonstrated low chlorophyll contents of 5.53 mg/g and 10.03 mg/g, respectively, suggesting that tryptophan foliar sprays negatively influenced chlorophyll levels. Treatment T6 showed intermediate chlorophyll content of 20.28 mg/g, indicating a potential interaction between the two foliar spray applications. Foliar spray of silicic acid at 35 (T_7) and 45 (T_8) days displayed higher chlorophyll contents of 39.05 mg/g and 40.67 mg/g, respectively, suggesting a positive impact on chlorophyll levels with silicic acid foliar sprays. Foliar spray combination treatment T_9 showed a further increase in chlorophyll content to 43.85 mg/g, indicating a cumulative positive effect of the silicic acid treatments. The treatment T_{10} (T_6 + T_9 - foliar spray combination) exhibited an intermediate chlorophyll content of 33.02 mg/g, suggesting a complex interaction between the combined treatments. Hozayn *et al*., 2020 studied physiological effect of pre-soaking with tryptophan on sugar beet and observed that tryptophan treated seed had significantly higher chlorophyll content (2.45 mg/100g FW) than control seed (2.26 mg/100g FW). Khan *et al*., 2019 [10] studied effects of silicon treatments in tomato plants and suggested that chlorophyll content was significantly increased in silicon treated plant as compared to the control. Sundareswari and Sudarmani 2019 [18] studied biochemical changes in the leaves of brinjal, in this study they observed that total chlorophyll content was ranged from 0.025 mg/g in control leaf were 0.536 mg/g to 0.025 mg/g. The results observed here are in agreement with the result obtained by various scientists (Ashrafi and Pandit 2014) [2]. Thus the above results indicated that different treatments have a significant impact on leaf chlorophyll content in brinjal. Seed priming with tryptophan and tryptophan foliar sprays appear to negatively influence chlorophyll levels, while silicic acid treatments show a potential positive effect. The combined treatments exhibit varying effects, emphasizing the need for careful consideration of interactions between different treatments.

Table 4: Effect of biostimulants application on leaf total chlorophyll content (mg/g) in brinjal

Sr. No.	Treatments	GAB 6	GRB 8	Mean
1	T_1 (control)	0.597	0.657	0.627
2	T_2 (Seed priming with tryptophan as per experiment no 1)	0.913	1.117	1.050
3	T_3 (Seed priming with silicic acid as per experiment no 1)	0.520	0.543	0.532
4	T_4 (Foliar spray of tryptophan at vegetative stage)	1.070	1.347	1.208
5	T_5 (Foliar spray of tryptophan at flowering stage)	0.817	0.860	0.838
6	T_6 (T_4 + T_5)	0.707	0.747	0.727
7	T_7 (Foliar spray of silicic acid at vegetative stage)	0.217	0.250	0.233
8	T_8 (Foliar spray of silicic acid at flowering stage)	0.120	0.140	0.130
9	T_9 (T_7 + T_8 (foliar spray))	0.067	0.060	0.063
10	T_{10} (T_6 + T_9)	0.427	0.437	0.432
	Mean	0.545	0.617	
		V	T	V×T
	S. Em. ±	0.010	0.021	0.030
	C. D. at 5%	0.027	0.061	0.086
	C. V.%	8.99		

Little leaf disease, often caused by various pathogens, can negatively impact the overall health and yield of brinjal plants. The observed variations highlight the importance of selecting varieties with inherent resistance to little leaf disease (%) for sustainable and productive brinjal cultivation. The incidence of little leaf disease was assessed in two brinjal varieties, GAB 6 and GRB 8. Variety GAB 6 exhibited a little leaf disease incidence of 3.70%. This indicates that GAB 6 is susceptible to some extent to little leaf disease. Variety GRB 8 showed a slightly lower little leaf disease incidence of 2.86%. The variance in disease incidence between the two varieties suggests potential genetic differences in resistance or susceptibility to little leaf disease. The impact of different treatments on little leaf disease incidence in brinjal plants was evaluated, and the results are summarized in Table 5. Tryptophan seed priming (T_2) resulted in a significant reduction in little leaf disease incidence to 1.50%, indicating a potential protective effect against the disease during the early stages of plant development. Silicic acid seed priming (T_3) also showed a reduction in little leaf disease incidence to 2.50%, suggesting a positive influence on disease resistance. Foliar spray of tryptophan at different stages (T_4 and T_5) and the combined treatment (T_6) resulted in varying little leaf disease incidences. T_6 exhibited a disease incidence of 2.00%, indicating a potential cumulative effect. Foliar spray of silicic acid at different stages (T_7 and T_8) and the combined treatment (T_9) led to varying little leaf disease incidences, ranging from 3.00% to 5.50%. The combined foliar spray of tryptophan and silicic acid (T_{10}) demonstrated a little leaf disease incidence of 4.16%, suggesting a potential interaction between the two treatments. These results indicate that certain treatments, particularly seed priming with tryptophan, show promise in reducing little leaf disease incidence. Little leaf disease can adversely affect plant growth and yield. The observed variations in disease severity under different treatments suggest that specific treatments, especially seed priming with tryptophan and combined foliar spray, may have protective effects against little leaf disease in brinjal plants. Kedarnath *et al*., (2023) [9] studied severity of powdery mildew in tomato with various concentration of silicic acid. The data showed that, foliar silicic acid plant recorded lowest disease severity (35.24% disease index-PDI) with 55.95% reduction over untreated control (80.00 PDI).

Table 5: Effect of biostimulants application on little leaf disease (%) in brinjal

Sr. No.	Treatments	GAB 6	GRB 8	Mean
1	T_1 (control)	5.00	5.33	5.16
2	T_2 (Seed priming with tryptophan as per experiment No. 1)	2.00	1.00	1.50
3	T_3 (Seed priming with silicic acid as per experiment No. 1)	3.33	1.66	2.50
4	T_4 (Foliar spray of tryptophan at vegetative stage)	3.00	1.00	2.00
5	T_5 (Foliar spray of tryptophan at flowering stage)	3.66	2.00	2.83
6	T_6 (T_4 + T_5)	1.66	2.33	2.00
7	T_7 (Foliar spray of silicic acid at vegetative stage)	4.00	2.00	3.00
8	T_8 (Foliar spray of silicic acid at flowering stage)	4.33	4.00	4.16
9	T_9 (T_7 + T_8 (foliar spray))	5.66	5.33	5.50
10	T_{10} (T_6 + T_9)	4.33	4.00	4.16
	Mean	3.70	2.86	
		V	T	V×T
	S. Em. ±	0.06	0.14	0.20
	C. D. at 5%	0.18	0.41	0.58
	C. V.%	10.64		

Leaf jassids are known pests that can adversely affect brinjal plants, leading to reduced yield and quality. The observed variations highlight the importance of selecting varieties with inherent resistance to jassid infestation for effective pest management in brinjal cultivation. The incidence of leaf jassid infection was assessed in two brinjal varieties, GAB 6 and GRB 8. Variety GAB 6 exhibited a leaf jassid infection rate of 1.39%. This indicates a relatively low incidence of jassid infestation in GAB 6. Variety GRB 8 showed a slightly higher leaf jassid infection rate of 1.92%.

The variance in infection rates between the two varieties suggests potential differences in susceptibility or resistance to jassid infestation. The impact of different treatments on leaf jassid infection in brinjal plants was assessed, and the results are summarized in Table 6. The control group (T_1) exhibited a jassid infection rate of 1.74%, providing a baseline for comparison with treated groups. Tryptophan seed priming (T_2) resulted in a slight increase in jassid infection to 2.05%, suggesting a potential influence on pest susceptibility during the early stages of plant development. Silicic acid seed priming (T_3) showed a jassid infection rate of 2.00%, indicating a moderate impact on jassid infestation compared to the control (Table 6). Foliar spray of tryptophan at different stages (T_4 and T_5) and the combined treatment (T_6) resulted in varying jassid infection rates. T_6 exhibited the lowest infection rate at 1.23%, suggesting a potential synergistic effect. Foliar spray of silicic acid at different stages (T_7 and T_8) and the combined treatment (T_9) led to varying jassid infection rates, ranging from 1.32% to 1.96%. The combined foliar spray of tryptophan and silicic acid (T_{10}) demonstrated a low jassid infection rate of 1.29%, indicating a potential complementary effect. These results suggest that certain treatments, especially foliar spray of tryptophan and the combined foliar spray, show promise in reducing jassid infection. However, the effectiveness of treatments may vary, and further investigations into the underlying mechanisms and long-term effects on pest resistance are warranted. Integrating these findings into pest management strategies can contribute to sustainable and healthy brinjal cultivation practices. Regular monitoring and early detection of pest infestations remain crucial for effective pest control. Bakhat *et al*., (2023) [3] studied effect of silicon fertilization on brinjal growth and insect population dynamics and concluded that compared to control, silicon treated plants were less infested with insects. Jassid population was reduced in the range of 33.68% to 60.62% in brinjal leaves.

Table 6: Effect of biostimulants application on leaf jassid infection (%) in brinjal

Sr. No.	Treatments	GAB 6	GRB 8	Mean
1	T_1 (control)	1.54	1.93	1.74
2	T_2 (Seed priming with tryptophan as per experiment No. 1)	1.90	2.20	2.05
3	T_3 (Seed priming with silicic acid as per experiment No. 1)	1.85	2.15	2.00
4	T_4 (Foliar spray of tryptophan at vegetative stage)	1.39	1.85	1.62
5	T_5 (Foliar spray of tryptophan at flowering stage)	1.25	1.73	1.49
6	T_6 (T_4 + T_5)	0.87	1.58	1.23
7	T_7 (Foliar spray of silicic acid at vegetative stage)	1.75	2.18	1.96
8	T_8 (Foliar spray of silicic acid at flowering stage)	1.57	2.12	1.84
9	T_9 (T_7 + T_8 (foliar spray))	0.97	1.68	1.32
10	T_{10} (T_6 + T_9)	0.82	1.75	1.29
	Mean	1.39	1.92	
		V	T	V×T
	S. Em. ±	0.02	0.04	0.06
	C. D. at 5%	0.05	0.12	0.16
	C. V.%	5.97		

Whitefly infection in brinjal leaves was assessed for different varieties, and the results are presented in Table 7. Brinjal variety GAB 6 exhibited a whitefly infection rate of 1.66%. This suggests a relatively lower susceptibility to whitefly infestation in comparison to variety GRB 8. Brinjal variety GRB 8 showed a higher whitefly infection rate of 2.15%. This indicates a comparatively higher susceptibility to whitefly infestation when compared to variety GAB 6. The observed differences in whitefly infection rates between the two brinjal varieties highlight the importance of varietal selection in pest management strategies. Variety GAB 6 demonstrated a lower susceptibility to whitefly infestation, making it potentially more resilient to this pest. Whitefly infection in brinjal leaves was evaluated under different treatments, and the results showed that control group (T_1) exhibited a whitefly infection rate of 1.97% (Table 7), representing the baseline infection level in brinjal leaves. Tryptophan seed priming (T_2) resulted in a slight increase in whitefly infection, with a rate of 2.17%. This suggests that tryptophan application during seed priming may have a limited impact on whitefly resistance. Silicic acid seed priming (T_3) showed a similar whitefly infection rate of 2.15%, indicating a comparable level of resistance as observed in the tryptophan seed priming treatment. Foliar spray of tryptophan at different stages (T_4 and T_5) and the combined treatment (T_6) resulted in varying whitefly infection rates. T_6 exhibited a similar infection rate as the control (1.97%), suggesting that the combined treatment did not significantly impact whitefly resistance. Foliar spray of silicic acid at different stages (T_7 and T_8) and the combined treatment (T_9) led to varying whitefly infection rates, with T_9 and T_{10} showing a slightly lower rate of 1.75% (Table 7). This suggests a potential interaction between silicic acid and other treatments. The combined foliar spray of tryptophan and silicic acid (T_{10}) demonstrated a whitefly infection rate of 1.75%, indicating a potential interaction between the two treatments. Whiteflies are known pests that can negatively impact plant health and yield. The observed variations in infection rates under different treatments suggest that specific treatments, especially foliar spray of silicic acid and combined foliar spray, may influence whitefly resistance in brinjal plants. Bakhat *et al*., (2023) [3] studied effect of silicon fertilization on brinjal growth and insect population dynamics and concluded that compared to control, silicon treated plants were less infested with insects. Whitefly population was reduced in the range of 19.23% to 50.92% in brinjal leaves.

Table 7: Effect of biostimulants application on leaf whitefly infection (%) in brinjal

Sr. No.	Treatments	GAB 6	GRB 8	Mean
1	T_1 (control)	1.66	2.27	1.97
2	T_2 (Seed priming with tryptophan as per experiment No. 1)	1.81	2.53	2.17
3	T_3 (Seed priming with silicic acid as per experiment No. 1)	1.85	2.46	2.15
4	T_4 (Foliar spray of tryptophan at vegetative stage)	1.57	2.25	1.91
5	T_5 (Foliar spray of tryptophan at flowering stage)	1.58	2.03	1.81
6	T_6 ($T_4 + T_5$)	1.46	2.48	1.97
7	T_7 (Foliar spray of silicic acid at vegetative stage)	1.79	1.30	1.54
8	T_8 (Foliar spray of silicic acid at flowering stage)	1.70	2.32	2.01
9	T_9 ($T_7 + T_8$ (foliar spray))	1.54	1.96	1.75
10	T_{10} ($T_6 + T_9$)	1.60	1.89	1.75
	Mean	1.66	2.15	
		V	T	V×T
	S. Em. ±	0.02	0.06	0.06
	C. D. at 5%	0.06	0.13	0.18
	C. V.%	5.83		

The data presented in table 8 indicates the correlation coefficient of seven different variables in the present study in understanding the underling dynamics of investigation of work. Mostly strongly positive corrected with membrane injury and little leaf. Highly significantly negative correlation of moisture was found for chlorophyll, relative water content, jassid and aphid. The strong positive correlation of relative water content was recorded with chlorophyll. In case of membrane injury two variables moisture and little leaf observed significant. The chlorophyll content was highly positively significantly correlated with three variables (relative water content, jassid and aphid). Chlorophyll content was highly negatively correlated with variables like moisture, membrane injury and little leaf.

Table 8: Correlation study of biochemical parameters of brinjal leaf

	Moisture	Chlorophyll	Membrane injury	RWC	Jassid	Aphid	Little leaf
Moisture	1	-.463(**)	.519(**)	-.509(**)	-0.146	-0.117	.372(**)
Chlorophyll	-.463(**)	1	-.958(**)	.951(**)	0.081	.300(*)	-.649(**)
Membrane injury	.519(**)	-.958(**)	1	-.957(**)	-0.06	-0.226	.627(**)
RWC	-.509(**)	.951(**)	-.957(**)	1	0.054	0.248	-.607(**)
Jassid	-0.146	0.081	-0.06	0.054	1	.555(**)	-.358(**)
Aphid	-0.117	.300(*)	-0.226	0.248	.555(**)	1	-.311(*)
Little leaf	.372(**)	-.649(**)	.627(**)	-.607(**)	-.358(**)	-.311(*)	1

Conclusion

Overall it can be concluded that the foliar spray of tryptophan at flowering stage can enhance the relative water content and chlorophyll in brinjal leaves. This treatment can also reduce the membrane injury as well as seed priming with tryptophan can reduce the little leaf disease in brinjal leaves.

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