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The Efficacy of Seed Pre-treatments with Exogenous Jasmonic Acid and Salicyclic Acid-T Tpathogen induced Stress in Mungbean Selected Genotypes in India

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ABSTRACT

Our agriculture is threatened by resource depletion, biodiversity loss, and climate change. To increase crop productivity and sustainably to ensure food quality and safety, a new agricultural revolution is necessary. SA and JA were used to prime seeds can assist assure the long-term viability of agriculture. Seed elicitor priming is a potent method for altering the metabolic and signalling pathways in seeds, which has an impact on the whole plant life cycle, not only germination and seedling establishment. A few advantages include higher food nutritional quality, greater output, and improved plant growth and development. The effects of elicitor priming on metabolic pathways, the balance of reactive oxygen species, and plant growth hormones increase stress and disease tolerance while lowering the need for pesticides and fertilisers. To evaluate seed vigour, shoot weight, shoot height, and germination % were employed. Indicating that pre-sowing treatments can have either positive or negative effects on seed vigour depending on the treatment dose, the use of SA and JA in combination as an elicitor had a marginally advantageous effect on seed vigour. To determine their effects and the ideal seed priming dosage, more study is required.

Key words : *M. phaseolina, SA, JA, Mungbean, Pre-sowing seed treatment, Seedling vigour.*

Introduction

The widely farmed mung bean (*Vigna radiata* L.) is a seed legume crop used largely as a source of digestible protein for people and animals (24–27 percent). Due to their high protein content, mungbean seeds are a great addition to most cereal-based diets that lack lysine (Saini *et al*., 2010; Widjajaseputr *et al*., 2019) (Baskaran and others, 2009). It has the ability to boost soil fertility and bio-stabilize atmospheric nitrogen, among other things. Mung beans (*Vigna radiata* L.), a widely cultivated seed legume, are principally utilised as a source of digestible protein for people and animals (24-27 percent). Due to their high lysine content, mungbean seeds are a fantastic addition to most cereal-based diets (Saini *et al*., 2010; Widjajaseputr *et al*., 2019); (Baskaran *et al*., 2009). It can boost soil fertility and bio-stabilize atmospheric nitrogen, among other things.

It belongs to the Leguminoseae plant family's Papilinoidae subfamily. Even though Asia is where it is mostly cultivated, it has lately begun to expand to Africa and the Americas. Mungbean is a beneficial crop that is typically grown in dry and semiarid regions due to its early maturity, ability to restore soil nutrients. This important crop is being destroyed by

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the soil-borne plant disease *M. phaseolina*, which is also producing charcoal rot. This widespread fungal disease affects 500 plant species in the tropics and subtropics, including angiosperms and conifers (Dhingra and Sinclair, 1978).

When compared to unprimed seed, seed priming procedures like hydro priming, hormo priming, or nutrient priming have been demonstrated to increase seed germination rate, speed, uniformity, and percentage as well as seedling vigour (Ahmet *et al*., 2013; Sori, 2014; Ozdemir and Sade, 2015; Soliman *et al*., 2016). This technique allows the seed to retain as much of its stored saved nutrients as possible while preventing damage to the seed cell membrane during the imbibition phase, the most important stage of germination. In the field, seed priming techniques improve seed resistance to abiotic stress (Ozdemir and Sade, 2015).

In contrast to previous treatments, Umair *et al*. (2010) found that priming mung bean seeds with phosphorus at a concentration of 0.6% for five hours boosted germination speed, radicle length, seedling vigour index, and seedling dry weight (distilled water, salicylic acid and dry seeds). By radicle and branch length, seedling dry weight, and seedling vigour index measurements, Umair *et al*. (2013) discovered that soaking mung bean seeds in 10 and 20 mg l^{-1} salicylic acid for 4 and 5 hours increased seedling vigour. Furthermore, Laghari *et al*. (2016) found that, compared to dry seeds treatment, soaking mung bean seeds in distilled water for 4 hours significantly increased germination ratio, radicle and stalk length, seedling dry weight, and seedling vigour index. The purpose of this study is to investigate how successful elicitor pre-treated procedures are in terms of seedling vigour in mung bean seeds.

Plant roots, stems, branches, petioles, leaves, pods, and seeds are all consumed by *Macrophomina phaseolina*. Additionally, *Macrophomina phaseolina* seed infection lowers urdbean protein content by 12.3% and diminishes grain yield by 10.8%. (Kaushik *et al*., 1987). Mature plants experience the development of reddish to brown lesions on their roots and stems from *Macrophomina phaseolina*. Black microscelerotia and dark mycelia made plants wilt and lose their leaves (Abawl and Pastor- Corrales, 1990).

Salicylic acid was discovered in 1979 by White, who asserts that SA contributes to the disease resistance of tobacco plants (White, 1979). Since then, a tonne of research has been conducted to show how important SA is for plant defence against biotic and abiotic stresses. SA levels are known to increase in a number of pathosystems following infection with viruses, fungi, insects, or bacteria (Hao *et al*., 2018; Zhao *et al*., 2019), and exogenous SA treatment boosts the host's defence mechanism. (Tripathi *et al*., 2019). In plants that overexpress NahG, a salicylate hydroxylase that breaks down SA, the inability to manufacture SA in response to pathogen infection weakens systemic acquired resistance (SAR), a broad-spectrum systemic resistance acquired after a primary infection (Lawton *et al*., 1995). Despite the fact that SA is necessary for SAR, it is unlikely that a mobile signal will be needed. Pipecolic acid and SA collaborate to synchronise SAR (Hartmann and Zeier, 2019; Huang *et al*., 2010). Resistance genes are mostly expressed in plants through JAs and SA-mediated signalling pathways in response to pathogen infection, environmental damage (mechanical, herbivore, and insect damage), and both. Plant hormones play a significant role in the formation of signalling networks that regulate plant growth and stress responses.

The endogenous growth-regulating compound jasmonic acid (3-oxo-22-cis-pentenyl-cyclopentane-1-acetic acid, also known as JA) is present in higher plants. Jasmonates, a family of fatty acid derivatives, include JA, its methyl ester (MeJA), and the conjugate of isoleucine (JA-Ile) (JAs). Vital growth and developmental processes are regulated by JAs (Wasternack *et al*., 2007 and Campos *et al*., 2014).

Materials and Methods

In the experiment, two gentoypes of mungbean—Bireshwar and Samrat—that are resistant and sensitive, respectively, were employed. According to Biswas *et al*., these gentoypes were treated post-seed with various elicitors at variable doses after being surface sterilised. Grown plants were sprayed with distilled water as a control. The lab tested treated and untreated seeds, infected seeds, and seeds that had not been treated to evaluate the vigour of the seeds. Thee 35 seeds passed through the final count phase of the mungbean, which lasted eight days at 25°C, after receiving control media and observed every 24 hours. Fifteen seedlings were observed and their roots and shoots measured in each Petri dish to determine the vigour of the seedlings. Seedling vigour is the end consequence of seeds growing in a variety of biotic and abiotic environments.

Details of Treatment

Treatment 1. Salicyclic acid along with infected seedlings
Treatment 2. Salicyclic acid without infected seedlings
Treatment 3. Jasmonic acid with infected seedlings
Treatment 4. Jasmonic acid without infected seedlings
Treatment 5. Water priming

Seed Germination Test

Calculating seedling vigour involves combining a variety of growth indices, such as seedling length, fresh seedling weight, and seedling dry weight.

1. *Germination percentage = total number of seeds multiplied by the number of seeds germinated*

Seedling Vigour Index

Three identical Petri dishes containing 25 seeds of each kind were subjected to different elicitors at different dosages. In order to construct the vigour index.

2. *Vigour index = (mean root + mean shoot length) × Germination percentage*

Results and Discussion

Utilizing the seedling vigour index, the efficacy of elicitors in Bireshwar (resistant genotype) and Samrat (sensitive genotype) against *M. phaseolina* Charcoal rot—was evaluated. Elictors reduced disease occurrence and demonstrated a substantial difference between several defense-related molecules at various dosages. This was also the goal of my experiment, which is not included in this study, which showed that increases in the concentrations in defense-related chemicals in both pathogen and non-pathogen inoculation plants. The highest seeding vigour index was recorded by the Bireshwar mungbean genotype at 0.02 percent chitosan elicitor concentration (24.513), which was followed by 0.05 percent yeast-treated mungbean seeds (24.366). Its vigour index increased significantly compared to control plants and was higher than that of infected plants of the samrat type. The effectiveness of the

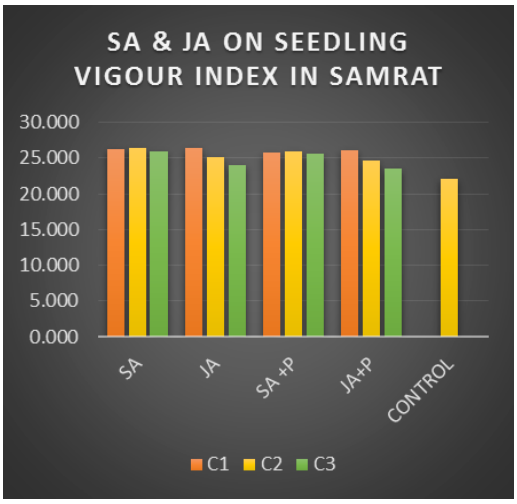

Fig. 1. Graph depicting the effect of elicitors on seedling vigour in the Bireshwar mungbean genotype

Table 1. Vigour index of mungbean to SA and JA on (Bireshwar)

Elicitors	C1	C2	C3
SA	31.065	31.172	30.882
JA	31.287	30.136	29.267
SA+P	30.680	30.788	30.680
JA+P	30.904	29.739	28.857
CONTROL		27.617	

- SA (C1,C2 and C3)= 0.5 mM, 1 mM, 2 mM
- JA (C1,C2 and C3)= 1mM, 2.5 mM, 4 mM

Table 3. Vigour index of mungbean to SA and JA on (Samrat)

Inducers	C1	C2	C3
SA	26.23	26.35	26.01
JA	26.49	25.12	24.07
SA +P	25.77	25.90	25.55
JA+P	26.04	24.64	23.57
Control		22.03	

- SA (C1,C2 and C3)= 0.5 mM, 1 mM, 2 mM
- JA (C1,C2 and C3)= 1mM, 2.5 mM, 4 mM

Table 2. Various Elicitorsand their interaction with different concentrations (Bireshwar)

	Elicitors	Concentrations	I x C	Check vs Others	
SEm±	34.52	34.51	34.51549	37.57277	34.51549
CD (Pd"0.05)	99.36	99.36677	99.36677	108.1684	99.36677
CV %	121.7298				

Table 4. Various Elicitors and their interaction with different concentrations (Samrat)

	Inducers	Concentrations	I x C	Check vs Others
SEm±	34.51	34.51	34.51	37.57
CD (Pd″0.05)	99.36	99.36	99.36	108.16
CV %	314.39			

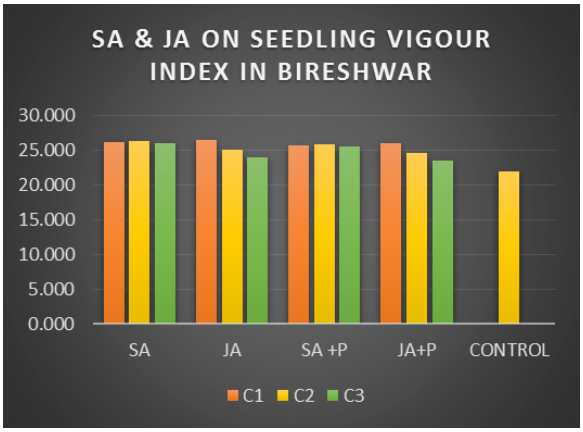

Fig. 2. Graph depicting the effect of elicitors on seedling vigour in the Samrat mungbean genotype

0.02 percent chitosan elicitor content, however, exhibited the similar pattern as the other two genotypes. Elicitor effectiveness was displayed on the graph for both genotypes, damaged seeds, and healthy seeds.

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Conflict of interest

There are no conflict of interests to declare to publish this article

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