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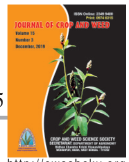

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Effect of several pre-sowing elicitor seed treatments on mustard (*Brassica juncea* L.) Vigour Index against Alternaria blight disease in India

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ABSTRACT

Alternaria leaf blight is a significant problem on mustard and the only way to control it is to use chemical pesticides. Due to environmental concerns and the likelihood of fungicide residues, this is not a brief solution. Because it increases the activity of various defense-related enzymes and non-enzymatic antioxidants, induced resistance is one of the most popular options. The effect of elicitors pre-sowing seed treatment on seed vigour and thus on induction of resistance to manage the disease was investigated in a net house with three different mustard types. On uninoculated plants, elicitor treatments had a higher vigour index of mustard seeds than the water sprayed control. These changes are linked to the role of elicitors, and it is well known that pre-sowing elicitor therapy, which is a viable and cost-effective strategy, improves plant defense systems and seedling character.

***Keywords*:** Alternaria brassicae, elicitors, Indian mustard, pre-sowing seed treatment, vigour index.

Oilseed crops are crucial to India's agriculture sector, since they represent the country's second largest agricultural commodity after food grains. Brassica genus is the world's second-largest oilseed crop, trailing only groundnut and sunflower). Global production and productivity were 72.42 t and 1974 kg ha^{-1} in 2017-2018, with India contributing for 19.8 per cent of acreage and 9.8 per cent of production, respectively (USDA, 2016-17). In 2016-2017, India's output and productivity were 7.98 t and 1324 kg ha^{-1}, respectively (India Stat, 16-17). Rajasthan (48.12 per cent) produces the most mustard rapeseed in India, followed by Haryana and Madhya Pradesh. West Bengal has an area of 4.578 lakh hectares (l ha) and a productivity of 1090 kg per hectare. India is the world's fifth largest vegetable oil economy, after the United States, China, Brazil, and Argentina, accounting for 7.4% of global oilseed output, 6.1 per cent of oil meal production, 3.9 per cent of global oil meal export, 5.8% vegetable oil production, 11.2 per cent of global oil import, and 9.3 per cent of global edible oil consumption. Mustard oil is also used to treat a variety of ailments. The remaining seeds are fed to livestock and used as fertiliser. India is the world's fifth-largest mustard producer and fourth-largest mustard user. The primary mustard-growing states in India are Rajasthan, Uttar Pradesh, Haryana, Madhya Pradesh, Gujarat, and West Bengal. Rajasthan produces over half of the county's total mustard, with the rest coming from Uttar Pradesh (11 %), Haryana (11 %), Madhya Pradesh (11%), Gujarat (6%), West Bengal (5%), and other areas (7 %). Mustard is grown for the oil-producing seeds. Seeds are used directly in almost all Indian curries, particularly in the "tadka" process, aside from oil extraction. In terms of both acreage and production, India is the world's biggest mustard producer. Despite a large area under cultivation and rising mustard production, productivity remains low when new varieties' potential yields are considered, and a big gap exists between expected yield and yield realised by farmers. As a result, it is vital to comprehend the biotic and abiotic factors that may cause the existing gap in mustard cultivation. The main constraints that limit productivity are various abiotic and biotic stresses that produce considerable yield losses in the crop. Disease is one of the most important biotic stress factors, as mustard is susceptible to a range of foliar diseases, the most frequent of which is *Alternaria brassicae* (Berk.) Sacc. It is the most debilitating and harmful sickness, as well as the greatest production constraint of this crop (Kolte, 1985). Yield losses of up to 47 per cent have been calculated in India and reported from all continents, depending on the severity of the disease (Meena *et al*., 2010). The disease has been documented in a variety of agro-climatic zones in West Bengal, including the undulating red and lateritic zones (Mamgain *et al*., 2014). Because of its global distribution, *A. brassicae* reproduces through seeds, plant debris, soil, and weed hosts plants, and it is difficult to control. Controlling the disease can be done in a number of ways, including breeding resistant cultivars, biological control and cultural methods. Chemicals, on the other hand, have become a critical component of the mustard disease management strategy. In recent decades,

Short Communication

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with the continued availability of highly effective and newer broad-spectrum fungicides, indiscriminate application of various pesticides has become a viable alternative that the majority of farmers in the field has utilised. The widespread use of fungal toxic substances, however, leads to environmental contamination and has led in the development of disease-resistant strains due to their broad-spectrum toxicity. The use of environmentally appropriate elicitors in plant disease management has gained importance and attention as a result of these situations. Elicitors are low-concentration molecules that activate chemical defence in plants. They work as signal compounds, providing information to the plant so that it can initiate defence in response to pathogen infection (Ebel and Cosio, 1994). Biochemical parameters such as chlorophyll, non-reducing sugars, total soluble, proline, total phenol, protein starch, reducing sugars, and total sugar content showed significant changes following the elicitation process when compared to the water treated seeds, which could be attributed to the plant's differential metabolomics responses.

The experiment was conducted in West Bengal at the BCKV's net house and Plant Pathology laboratory, using three local genotypes of Indian mustard (*Brassica juncea*): resistant, susceptible and moderately resistant namely TBM-204, B-9 and Bullet, respectively. The experiment was set up in a completely randomised design (CRD), which was replicated three times and sown after pre-sowing seed treatment with a variety of elicitors at different doses. BTH (0.25 mM, 0.75 mM, 1.5 Mm); JA (1 mM, 2.5 mM, 4 mM);H_2O_2 (1%, 2%, 3%); SA (0.5 mM, 1 mM, 2 mM) were sprayed and thereafter they were inoculated using an atomizer at 15 days after sowing (DAS) using single spore technique spore suspension with a concentration of 104 conidia/ ml of A. Plants in the control group were cultivated in a greenhouse and sprayed with distilled water. The treated and untreated seeds, as well as infected seeds, were sent to the laboratory for analysis in order to determine seed vigour and, as a result, to recommend and extend pre-sowing seed treatment with elicitors to farmers in order to improve seed quality, which is linked to future growth and disease resistance dimensions. The seedling vigour of collected mustard seeds was assessed using the Petriplate method. 35 seeds were given control media and placed in a germinator at 25°C for eight days, which is the final count period for mustard. Data was gathered after eight days, which is the last count period for mustard. However, from the time seeds with torn seed coats and extreme lengths of more than 2mm were judged to be germinated, continuous observation was done every 24 hours. To calculate seedling vigour, ten random seedlings were observed in each Petri dish and their root and shoot lengths were measured to quantity seedling vigour. The cumulative effect of emerging seeds under a wide range of biotic and abiotic conditions is seedling vigour. Seedling vigour is made up of numerous growth indices such as seedling length, fresh seedling weight, and seedling dry weight. While evaluating pre-sowing seed treatment on a variety of crops, a group of researchers saw many crops in various modes of observation (Neeraj *et al*., 2012).

From each variety, three replicates of 25 seeds were treated with different elicitors at varied doses, and germination % was evaluated using the blotting paper method indicated in the International Rules for Seed Testing. The seeds were incubated by placing them in a Petri plate with moistened blotting paper. After seven days, the percentage of germination was estimated using the formula:

$$Germination\ percentage = \frac{number\ of\ germinated\ seeds}{total\ no.of\ seeds} \times 100$$

Three replicates of 25 seeds from each variety were treated with various elicitors at different concentrations and stored in a Petri plate. After one week of incubation, germination percentage and seedling vigour were measured for seed samples maintained at room temperature in order to calculate the vigour index using the Abdulbaki and Anderson (1976) formula.

Vigour index = (mean of root length + mean of shoot length) × Germination percentage

The influence of elicitors on several seedling parameters was evaluated using the seedling vigour index in three mustard genotypes: TBM-204, Bullet, and B9 against Alternaria blight caused by *Alternaria brassicae*. Elicitors at varied concentrations reduced illness occurrence and demonstrated a substantial difference between various defense-related chemicals. Increases in the concentrations of the various elicitors were found to result in a considerable rise in defense-related chemicals in both pathogen and non-pathogen inoculation plants, with significant differences in all three genotypes. Table 1 and Figure 1 demonstrate this. In both healthy and diseased mustard seeds, treated mustard leaves showed a greater vigour index in all three kinds, where seedling vigour index was determined after knowing the germination % and seedling length. In the TBM-204 mustard genotype, the greatest seeding vigour index was

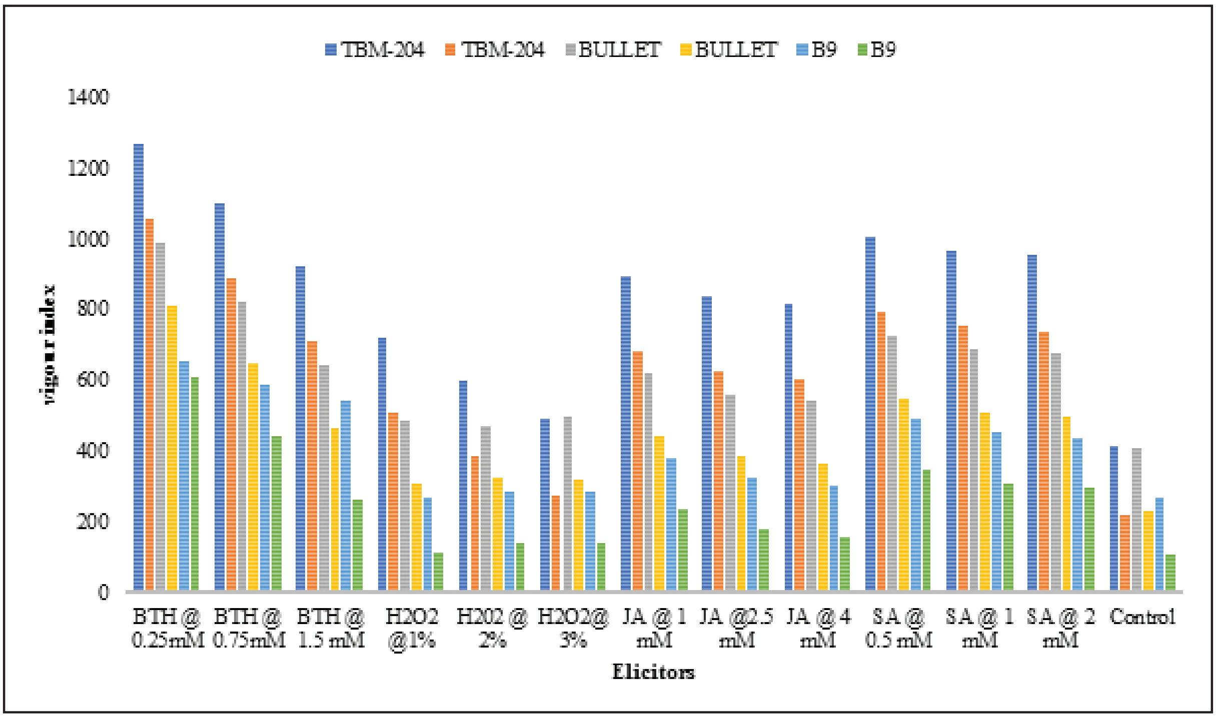

Fig. 1 : Graphical representation of impact of elicitors on seedling vigour in various mustard genotypes

Table 1: Varietal reaction to different elicitors on Vigour index of mustard

Treatments	TBM-204		BULLET		B9	
	Healthy seeds	Infected seeds	Healthy seeds	Infected seeds	Healthy seeds	Infected seeds
BTH @ 0.25mM	1263.80	1050.80	985.80	807.80	648.80	603.80
BTH @ 0.75mM	1098.79	885.79	820.79	642.79	583.79	438.79
BTH @ 1.5 mM	918.03	705.03	640.03	462.03	536.36	258.03
H_2O_2 @1%	720.17	507.17	482.17	304.17	265.17	110.17
H_20_2 @ 2%	595.19	382.19	463.86	319.19	280.19	135.19
H_2O_2@ 3%	485.99	272.99	493.66	315.66	283.32	138.32
JA @ 1 mM	889.11	676.11	617.78	439.78	374.11	229.11
JA @2.5 mM	835.74	622.74	557.74	379.74	320.74	175.74
JA @ 4 mM	811.48	598.48	540.15	362.15	296.48	151.48
SA @ 0.5 mM	1002.37	789.37	724.37	546.37	487.37	342.37
SA @ 1 mM	963.16	750.16	685.16	507.16	448.16	303.16
SA @ 2 mM	950.30	737.30	672.30	494.30	435.30	290.30
Control	410.61	212.28	404.06	226.06	267.06	102.06
SEm(±)	**1.82**	**3.42**	**10.93**	**9.80**	**12.42**	**4.39**
LSD (0.05)	**5.28**	**9.94**	**31.78**	**28.50**	**36.09**	**12.77**
CV	**0.37**	**0.94**	**3.04**	**3.80**	**5.35**	**3.02**

1263.80 when treated with BTH @ 0.25mM, followed by 1098.79 when treated with BTH @ 0.75mM. Similarly, BTH @ 0.25mM treated mustard leaves in Bullet genotype 985.80 showed a substantial increase in vigour index as compared to control plants, but had a greater vigour index than infected plants in the Bullet variety. The effectiveness of BTH@ 0.2 mM content, on the other hand, followed the same pattern as the other two genotypes. The graph indicated the efficiency of elicitors in all three genotypes, as well as between damaged and healthy seeds.

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