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Do Microbial Fertilizers Increase Immunity in Indian Mustard (*Brassica juncea*) Against Insects?

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Introduction

Plants induce various morphological and chemical changes due to insect herbivory. These induced responses may divert a substantial share of resources from plant growth towards increasing plant immunity. Microbial fertilizers are rapidly gaining popularity among farmers all over the world to increase plant growth and yield in a sustainable manner (Adesemoye and Kloepper, 2009). However, whether these biofertilizers boost immunity of plants as efficiently as their growth and development or whether bio fertilizer-facilitated development is a result of immunity tradeoff is still unknown. We therefore determine the effect of microbial fertilizers on immunity of Indian mustard (*Brassica juncea*) after damage by the generalist insect *Spodoptera litura* (Fabricius, 1775).

Materials and Methods

B. juncea was grown in soil supplemented with phosphate solubilizing bacteria (PSB) and vesicular-arbuscular mycorrhiza (VAM), separately and in combination. 4- week old plants were damaged by *S. litura* and plant's morphological and chemical changes were analyzed. Changes in antioxidants were taken as quick responses (3 to 72 hours of damage) and changes in leaf thickness and trichome density were measured as delayed responses (4th and 9th day of damage). Larval behavioral changes in terms of first choice, orientation and leaf area eaten were determined using leaf from undamaged and damaged plants from different treatments.

Results and Discussion

Trichome density increased significantly on both adaxial and abaxial surfaces of the leaves adjacent to the damaged leaves as well as in newly emerged leaves of induced plants supplemented with VAM as compared to the other treatments. Activities of antioxidants, namely, peroxidase (POD) and superoxide dismutase (SOD), remained highest at 3 hours (hrs) and were subsequently decreased by 72hrs. Plants showed an overall increase in POD activity after 3hrs of damage, irrespective of the treatment. However, after 72hrs, only plants without any microbial fertilizer treatment continued to show an increase in POD activity. SOD activity remained high at 3h and decreased at subsequent hours. However with VAM supplementation, the SOD activity remained high even at 9hrs after damage. PSB-VAM supplemented plants showed reduced SOD activity at all the hours.Insect behavioral bioassays revealed that the larvae moved to both PSB and VAM supplemented plants as their first choice. However, larval orientation was highest in PSB-VAM combination supplemented plants. Highest leaf area consumption by the larvae was from PSB-VAM supplemented plants when the plants were intact. However, following damage, this feeding preference was decreased to similar amount of leaf area consumed as that of other treatment plants. Our study suggests that bio fertilizers definitely boost plant induced responses along with plant growth but this doesn't necessarily translate to increase in induced resistance.

Table 1: Induced responses of *Brassica juncea* to damage by *Spodoptera litura* treated by phosphate solubilizing bacteria (PSB), vesicular-arbuscular mycorrhiza (VAM) or their combination. + and ++ indicate elevation of the response at different intensities; - indicates no change after damage by *S. litura*.

Parameters		Phosphate solubilizing bacteria (PSB)		Vesicular-arbuscular mycorrhiza (VAM)		PSB-VAM	
		Undamaged	Damaged	Undamaged	Damaged	Undamaged	Damaged
POD	3hrs	-	+	-	++	-	-
	9hrs	+	+	+	-	+	-
	72hrs	+	+	+	-	+	-
SOD	3hrs	-	-	-	+	-	-
	9hrs	+	-	+	++	+	+
	72hrs	+	-	+	-	+	-
Trichomes	Day 4	+	-	-	++	+	-
	Day 9	+	+	+	++	-	+
Leaf thickness	Day 9	-	-	-	-	+	+
Larval first choice		15%	21%	19%	15%	21%	9%
Larval orientation		9%	19%	15%	14%	23%	19%
Leaf area eaten		+	-	+	-	++	-

POD= Peroxidase, SOD= Superoxide dismutase

Reference

Adesemoye AO and Kloepper JW 2009. Plant-microbes interactions in enhanced fertilizer-use efficiency. *Applied microbiology and biotechnology* **85**: 1-12.