Relationship between glucosinolates and the population of *Lipaphis erysimi* on *Brassica* spp.

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ABSTRACT

Mustard aphid, *Lipaphis erysimi* (Kaltenbach), one of the most destructive biotic stresses of mustard, is responsible for qualitative and quantitative losses in the production of the mustard in the *Tarai* region of Uttaranchal, newly formed state of India. As the resistant varieties, having biochemical defense mechanism, control the insect-pests without additional cost, for this biochemical resistance, a study was made to establish the relationship between the population of *L. erysimi* and glucosinolates of different *Brassica* spp, *Brassica carinata*, *B. alba*, *B. napus*, *B. nigra B. campestris*, *Eruca sativa* and *B. juncea*.

The varying quantity of glucosinolates could be detected from leaves and seeds of different *Brassica*, spp. The highest glucosinolate content was found in seeds (158.241 m moles/g) and leaves (47.525 m moles/g) of *B. carinata* whereas lowest in seeds of *B. napus* (76.666 m moles/g) and leaves of *B. campestris* cv. YST-151 (20.117 m moles/g). A negative correlation existed between the total glucosinolates content and mustard aphid population.

Key Words: *Lipaphis erysimi*, *Brassica* spp., *glucosinolates*

INTRODUCTION

India, a sub-continent, holds a premier position in the global oilseeds scenario accounting for 19 per cent of the total area and 9 per cent production. Out of the total oilseeds production, more than one-fifth was contributed by rapeseed-mustard in India. The production and productivity of rapeseed-mustard is very erratic in the country due to a number of abiotic and biotic stresses. Among the biotic constraints the insect-pests have the most detrimental effect on the yield. Forty-three insect pests are known to be associated with different growth stages of rapeseed-mustard. Among them, the mustard aphid, *Lipaphis erysimi* (Kaltenbach) is the key pest throughout the mustard growing belts (Bakhetia and Sekhon, 1989). Although the use of chemical insecticides has been found effective in controlling mustard aphid but their indiscriminate use becomes Pandora’s box causing much harm to agro-

ecosystem, pest resurgence and outbreak of secondary pests. The scientists are striving hard to devise the ways for alternative eco-friendly management tools of the aphid.

In due course of co-evolution, plants have evolved certain secondary metabolites and biochemicals that are known to impart resistance to insect-pests. Understanding of the biochemical basis of resistance may help in development of insect resistant cultivars with the aid of modern biotechnology. Keeping these points in view the present study was undertaken to establish the relation between the pest population, *L. erysimi*, and biochemicals, glucosinoltes, present in the *Brassica*spp.

MATERIALS AND METHODS

The field experiment was conducted during rabi season, 1999-2000, at Crop Research Centre, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttaranchal, India. It is situated in the foothill of shivalik range of Himalayas. This region is characterized by hot dry summer and cold winter. The soil type of experimental plot is sandy loam. The experiment was laid down in Randomized Block Design with three replications. The eight treatments were composed of *Brassica carinata, B. alba, B. napus, B. nigra B. campestris* c.v. YST-151 and BSH-1. *Eruca sativa* and *B. juncea* cv. *Varuna*.

Quantitative glucosinolate determination from seeds

The quantitative estimation of total glucosinolate content was carried out by following the standard procedure (Thies, 1982) in the Oilseeds Laboratory of the Department of Genetics and Plant Breeding, College of Agriculture. 200 mg oven dried seeds were taken and crushed in a mortar and pestle and transferred it to a test-tube (10 ml) with cap. Then 300 m l of 70 per cent methanol was added into it to inactivate myrosinase and decompose the tissues. Blank was also taken without sample. The tube was put immediately into water bath at 80^0C for 5 minutes and 2 ml of double distilled boiling water was added to it and vortexed and afterwards the samples were put into water bath for 15 to 20 minutes at 80^0C. Now, the samples were kept at room temperature for 15 minutes for cooling, again vortexed and centrifugation was done at 5000 rpm for 30 minutes at room temperature.

For sample analysis, 5 m l of supernatant was taken into the well of a microtiter tray with flat bottom in which standard, blank and unknown samples are kept together. Now 300 m l of colour reagent (Sodium tetra chloro palladate, $Na_2(PdCl_4)$ was added into each well of the tray. The microtiter tray having blank, standard and unknown samples was kept into the oven at 70^0C for 30 minutes for the formation of the colour complex. The microtiter tray was placed in the chamber of ELISA Reader. Photometry against blanks at 405 nm by ELISA Reader was done along with standard and unknown samples. The absorption reading was taken.

$$\text{Amount of glucosinolate} = \frac{\text{Absorption value of unknown}}{\text{Absorptionvalue of known standard}} \times \text{Concentration of known standard}$$

Quantitative glucosinolate determination from leaves

Leaves were collected from the experimental plots when the plants were in reproductive stage. The collected leaves were oven dried at 50^0C for overnight. The procedure followed for determination of glucosinolate content in seeds was followed for leaves also, except that 50 mg of leaves were taken and crushed in liquid nitrogen for sample preparation.

RESULTS

Total glucosinolate content in seeds

Among all the samples analysed for total glucosinolate content, highest quantity was found in *B. Carinata* (158.241 m mole/g of defatted meal) which does not differ significantly with that of *B. nigra* (156.065 m mole/g of defatted meal). The critical study of Table 1 revealed that there was no significant difference in total glucosinolate content among *B. campetris* cv. BSH-1, *B. campestris* cv. YST-151, *B. juncea* cv. Varuna and *B. napus*. The difference in glucosinolate content of*B. carinata* and *B. napus* was highly significant. There was no significant difference in the glucosinolate content of *B. alba* and *E. sativa*. The lowest amount of total glucosinolate was observed in *B. napus* (76.66 m mole/g of defatted meal).

Total glucosinolate content in leaves

Significantly a high amount of glucosinolate was obtained in leaves of *B. carinata* (47.525 m mole/g defatted meal) while the lowest amount in *B. campestris* cv. YST-151 (20.117 m mole/g defatted meal). There was no significant difference in total glucosinolate content of leaves of *E. sativa, B. campestris* cv. BSH-1, *B. alba* and *B. juncea* cv. Varuna which were 28.251, 27.314, 26.250 and 26.102, respectively. However, there was only a slight or marginal difference in amount of glucosinolate (1.4232 m mole/g defatted meal) between *B. napus* and *B. campestris* cv. YST-151 which had lowest amount among all the analysed samples. Next to *B. carinata* the total glucosinolate content in leaves was found to be highest in *B. nigra* (31.52 m mole/g of defatted meal) (Table 1). The results suggested that *B. carinata* had the highest amount of total glucosinolate in both seeds and leaves whereas the lowest amount of total glucosinolate in seeds was observed in *B. napus* and in leaves in *B. campestris* cv. YST-151.

Relationship between total glucosinolate and *Lipaphis erysimi* (Kalt.)

The aphid population was observed to be lowest on *B. carinata* which contained the highest amount of total glucosinolate both in seeds and leaves. The aphid

population on *B. campestris* cvs. BSH-1, YST-151 and *B. nigra* were at par but the total glucosinolate content of *B. campestris* cultivars different significantly with that of *B. nigra* both in seeds and leaves. Field observation revealed that the aphid population on E. sativa and *B. juncea* cv. Varuna were at par whose total glucosinolate content varied significantly in seeds while there was no significant different in leaves *B. alba* which harboured highest aphid population among test species contained 108.34 and 26.25 m mole/g of defatted meal of total glucosinolate in seeds and leaves, respectively.

Table 1: Amount of total glucosinolates in leaf and seeds of *Brassica* species (m mole/g of defatted meal)

S.No.	*Brassica* species	Glucosinolate (m mole/g)		Mean aphid population (aphids/10 cm TSL*)
		Seed	Leaf	
1.	*B. carinata*	158.241	47.525	1.4
2.	*B. alba*	108.345	26.250	61.5
3.	*B. napus*	76.666	21.540	12.5
4.	*B. nigra*	156.965	31.521	21.9
5.	YST-151	92.048	20.117	21.8
6.	BSH-1	86.046	27.314	20.9
7.	*E. sativa*	123.121	28.251	9.5
8.	Varuna	99.840	26.102	9.6
CD at 5%		24.700	4.300	-

*TSL = Terminal Shoot Length

DISCUSSION

A negative correlation has been observed between the total glucosinolate content and mean aphid population. This result suggested that glucosinolate imparted resistance in the plants against the mustard aphid. The degree of resistance in the plants varied with the species of *Brassica* suggesting the quantity, number and nature of glucosinolate components in the total glucosinolate. The results of the present investigation are in conformity with the report of Malik (1981) who observed a negative correlation between the total glucosinolate content and aphid population. But he observed a significant difference in total glucosinolate among resistant, tolerant and susceptible groups of *Brassica* species, which is in contradiction to the present investigation findings. *B. alba* which fall under

resistant group differed significantly in total glucosinolate content of seed with that of *B. nigra* and *B. carinata* which also fall under resistant group, *B. napus* which falls under tolerant group had no significant difference in total glucosinolate content of seeds with that of *B. campestris* cv. YST-151 and *B. campestris* cv. BSH-1 and *B. juncea* cv. Varuna. Similarly the results of present findings agree with the report of Gill & Bakhetia (1985) who reported that there exist a negative correlation between aphid population and glucosinolate content however, they observed a significant difference in glucosinolate content of *B. napus* and *B. campestris* which is not evident from the present finding results.

CONCLUSION

A negative correlation was observed between the total glucosinolate in the seeds and leaves of all *Brassica* spp. and corresponding mean aphid population.

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