Some biochemical plant characters in relation to suseptibility of mustard to aphid

Morzia Begum, M.W. Zaman[1] and M.L.R. Mollah
Entomology Division, Bangladesh Institute of Nuclear Agriculture (BINA), [1]Department of Agricultural Chemistry, Bangladesh Agricultural University, Mymensingh-2202

Abstract: The relation of biochemical characters in ten varieties of mustard to aphid susceptibility to, *Lipaphis erysimi* were studied. The higher amount of phenol, sugar and oil content was recorded on varieties of moderately resistant group followed by varieties of less susceptible group and low on varieties of susceptible to highly susceptible group. A negative correlation between aphid population and phenol, sugar and oil content respectively. Higher protein content was observed in varieties of highly susceptible to susceptible group and low in varieties of moderately resistant to less susceptible group. A significant positive correlation was found between aphid population and protein content of mustard seed..
Key words: Biochemical, plant characters, suseptibility, mustard, aphid.

Introduction

Mustard is the main oilseed crop of Bangladesh and its performance in total oil seed production is approximately 70 percent. It covers an area of 3,07583 hactres with production 2,18,725 metric tons of mustard and rapeseed (Anonymous, 1997). This amount is very low. One of the factors responsible for such low yield in the average caused by insect pests attacking various stages of the crop. Among them mustard aphid, *Lipaphis erysimi* (Kaltenbach) is the most destructive pest, causing enormous loss with mean loss of 78% and sometimes it loss goes up to 100%. The use of insecticides is being restricted because of the various demerits and emphasis is being given particularly the use of resistant varieties which fit well in pest management programme. Therefore, the present investigation was undertaken to study the biochemical (Protein, Phenol, sugar and oil) basis of resistance in mustard crop against *L. erysimi*.

Materials and Methods

The experiment was conducted under field condition of Bangladesh Agricultural University (BAU) farm, Mymensingh. Ten varieties of mustard were selected as test plants. Among these eight varieties of *Brassica campestris* (Safal, Agrani, YS - 52, Sampad, SS-75, Sangam, BS-5 and Tori-7), one variety of *Brassica napus* (Nap-3) were included.

These varieties were belonging to moderately resistant, moderately susceptible and highly susceptible.

These varieties were grown in Randomized Block Design (RBD) with three replications and plot size of 5m X 4m. All the recommended cultural operations were adopted in raising the crop. The experimental fields were exposed to natural infestation and no insecticide was sprayed. For chemical analysis, fresh plant samples of the apical twig (30 cm) with leaves and stalk were collected from 45 and 75 days after sowing while immature seed pods were collected when pod formations just started. These samples were washed with distilled water to remove the adhering dust particles and dried in air followed by sun drying. Then the samples were oven dried in petridishes at 70^0c for 48 hours. These were ground to a fine powders and protein, total phenol, total sugar and oil content were estimated. A modified Microkjheldal method was used for total nitrogen estimation and protein computation (Jakson,1973). The procedure given by AOAC(1976) were employed for colorimetric estimation of total phenol which is based on the measurement of blue colour formed due to the reduction of phosphotungustomolybdic acid by tannin like compounds in alkaline solution. The total sugar were extracted and quantitative estimation of the extracted sugar was done using another one reagent as described by Morris (1948). The oil content of mustard seeds were determined by the NMR (Nuclear Magnetic Resonance) technique in Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh. All the data were analyzed statistically by computers.

Results and Discussion

The results of the study have been described and discussed in the light of available relevant references as and where applicable.

Phenol content: Phenol content of leaf at 45 days of plant age was low where as it was higher at 75 days plant age. Significant differences were observed on all the varieties of mustard in leaf at 45 and 75 days after sowing and ranged from 1.97 to 2.62 and 2.04 to 3.18 mg/g respectively (Table 1). Significantly highest phenol content of stalk was observed in the variety Nap-3(15.31mg/g) of moderately resistant followed by moderately susceptible, susceptible group where as significantly lowest phenol content was observed in Tori-7 (3.14). Similar trend was also recorded in seed pod which higher phenol was recorded on variety of resistant group followed varieties of highly susceptible group. In seed pod phenol content varied from 3.14 to 15.31mg/g being highest in Nap-3 and lowest in Tori-7. A significant negative correlation was found between aphid population and phenol content indicating that higher amount of phenol was responsible for low aphid Population these findings are in conformity with the findings of earlier reports that the higher amount of phenol imparts resistance in host plant reduces the survived of insects (Khurana and Verma, 1983; Gill and Bakhetia, 1985 and Sachan and Sachan, 1991). On the other hand Malik (1978) reported the phagostimalatory effect of phenols on mustard aphid attack was higher in susceptible group in comparison to resistant or susceptible group.

Sugar content: Data of Table 2 shows significant difference in total sugar in leaf, stem and seed pod of difference varieties of mustard. In leaf, sugar content varied from 5.05 to 8.45mg/g in 45 and 75 days after sowing, respectively. Higher amount of sugar was observed on stalk in 75 days after sowing as compared to 45 days after sowing and it varied from 8.23 to 20.95 and 14.00 to 41.10 mg/g at 45 and 75 days after sowing

respectively. Sugar content in seed pod ranged from 17.42 to 43.20mg/g being highest in Nap-3 and lowest in Tori-7.Aphid population showed negative correlation with sugar content indicating that higher amount of sugar had lower aphid infestation. The above findings are in agreement with Gill and Bakhetia (1985). They reported that the strains of *B. napus* containing higher amount of total sugar and reducing sugar were resistant to mustard aphid as compared to *B.campestris* having low amount of sugar. On the contrary, Sachen and Sacher (1991) reported that higher amount of sugar was found in varieties of susceptible group followed by varieties of moderately resistant group where as lowest amount of total sugar in varieties of resistant group.

Table 1. Phenol content of leaf stalk and pod of different mustard varieties.

Varieties	Aphid population	Phenol content (mg/g) of leaf at		Phenol content (mg/g) of stalk at		Phenol content (mg/g) of seed pod
		45 DAS	75 DAS	45 DAS	75 DAS	
Nap-3	11.75h	2.62a	3.18a	3.21a	13.72a	15.31a
Shambol	12.95g	2.19b	2.88b	2.93b	11.58b	10.24b
Safal	14.35f	2.16bc	2.77c	2.81c	10.18c	9.45c
Agrani	15.31f	2.15c	2.30f	2.32g	8.25e	8.85d
YS-52	16.88e	2.14cd	2.36e	2.45f	7.16f	8.94d
Sampad	17.84d	2.12d	2.50d	2.52e	9.36d	9.06d
SS-75	18.48d	2.13d	2.38e	2.60d	6.17g	8.56e
Sangam	20.89e	2.08e	2.13g	2.43f	5.16h	5.40f
BS-5	25.17bs	2.00f	2.10g	2.30g	5.41h	4.28g
Tori	28.37a	1.97g	2.04h	2.25h	2.87i	3.14h
LSD (0.01)		0.027	0.050	0.049	0.410	0.22
r (Aphid population)		-0.77**	-0.92**	-0.82**	-0.96**	-0.90*

Within column, means followed by same letter (S) do not differ significantly at P<0.01% by DMRT , DAS = Days after sowing, r=simple correlation coefficient, **significant at 1% lavel

Table 2. Total soluble sugar content of leaf stalk and seed pod of different mustard varieties.

Varieties	Aphid population	Total soluble sugar content (mg/g) of leaf at		Total soluble sugar content (mg/g) of stalk at		Total soluble sugar content (mg/g) of seed pod
		45 DAS	75 DAS	45 DAS	75 DAS	
Nap-3	11.75h	8.45a	7.35a	20.95a	41.10	43.20
Shambol	12.95g	7.63b	6.72b	17.15b	36.30b	37.60b
Safal	14.35f	7.30c	6.65c	16.05c	24.45c	30.50c
Agrani	15.31f	7.20c	5.15e	15.65c	23.25d	28.95d
YS-52	16.88e	6.25d	6.05c	13.50d	18.48f	27.80e
Sampad	17.84d	7.20c	6.20c	15.85c	20.55e	28.85d
SS-75	18.48d	6.05d	5.95c	11.62e	18.10f	26.30f
Sangam	20.89e	5.40e	5.60d	9.05f	15.95g	21.15g
BS-5	25.17bs	5.05f	4.65f	8.65fg	15.90h	20.20h
Tori-7	28.37a	5.20ef	5.10e	8.23g	14.00i	17.42i
LSD(0.01)		0.25	0.26	0.65	0.87	0.64
r (Aphid population)		-0.98**	-0.82**	-0.97**	-0.90**	-0.94**

Within column, means followed by same letter (S) do not differ significantly at P<0.01% by DMRT , DAS = Days after sowing, r =simple correlation coefficient, **significant at 1% level

Protein and oil content of mustard seed

Protein content of mustard seed: Significant differences were observed in protein content of all the varieties of mustard. Highest protein content was observed in Tori-7 (26.14 percent) where as it was lowest in Nap-3 (20.21 percent). Varieties having higher protein content had higher aphid infestation (Table 3). A positively significant correlation between protein content of seeds of different varieties and aphid population. Comparatively higher protein content were recorded in the varieties of mustard infected with aphid. Susceptible strain than the resistant strain in case of mustard aphid contained higher protein acted as most suitable host for growth and development of insects as compared to varieties containing lower amount of protein (Wigoreck and Krzymanska, 1975; (Malik, 1978; Moral, 1975; Singh and Bakheta, 1983).

Oil content of mustard seed: Significantly highest oil content was observed in the variety Nap-3(39.84%). No difference were observed between Agrani (38.10%) and Safal (38.01%) with respect to oil content of mustard seed. The lowest oil content was found in the variety Tori-7(28.72%) (Table 3).

Varieties having higher oil content (%) of seeds had lower infestation of aphids. A negatively significant correlation was found between oil content (%) and aphid population. Gill and Bakhetia (1983) observed a negative correlation between aphid population and oil content in *Brassica* spp. and contrary to this, Mehrotra and Rao (1972) showed that mustard oil stimulates the feeding of *Schistscerca gregaria*. Henna *et al.* (1983) reported that *Spodoplera exigua* developed better on castor oil due to higher oil content. Sachan and Sachan (1991) observed a positive correlation between oil content and aphid population.

It was observed that from the results that higher protein and lower oil content of seeds were estimated in highly susceptible varieties than less susceptible (Table 3). A negative significant correlation between protein (%) and oil (%) of mustard seed.

Table 3. Oil and protein content of seed of different mustard varieties.

Varieties	Aphid population	Oil content (%)	Protein content (%)
Nap-3	11.75h MR	39.84a	20.21i
Shambol	12.95g MR	38.82b	21.72h
Safal	14.35f MS	38.01c	22.41g
Agrani	15.31f MS	38.10c	23.56f
YS-52	16.88e MS	36.26d	23.91e
Sampad	17.84d MS	34.24e	24.95c
SS-75	18.48d MS	34.55e	24.41d
Sangam	20.89c S	30.01g	25.44b
BS-5	25.17b S	30.82f	44.99c
Tori-7	28.37a HS	28.72h	26.14a
LSD(0.01)	-	0.61	0.20
r (Aphid population)	-	- 0.93**	0.85**

Within column, means followed by same letter (S) do not differ significantly at P<0.01% by DMRT, DAS = Days after sowing , r =simple correlation coefficient, **significant at 1% level

References

A.O.A.C. 1976. American Association of Cereal Chemist, Cereal Laboratory method. St. Paul Minn., U.S.A.

Anonymous, 1997. Acreage and production of oil seeds. Statistical year- book, Bangladesh. 18th Edition. Bangladesh Bureau of statistics. 309pp.

Chenchaiah, K.C. 1983. Varietial resistance to mustard aphid *Lipaphis erysimi* (Kaltenbach), in some cruciferous oil-seeds. M. Sc. Ag. Theses, GB. Pant Univ. Agr. and Tech, Pantnagar, Nainital p.110.

Gill, R. S. and Bakhetia, D.R.C. 1985. Resistance of some *Brassica napus* and *B. campestris* strains to the mustard aphid. J. oilseed Res. 2(2): 227-39.

Henna, H. M.; Hemad N.E.F and Azad, S.G. 1983. Effect of larval food on weight and components of the lesser cotton leaf worm *Spodoptera exigua*. Bull. Dela Soc. Entomol., Egypte, 62: 71-82.

Jakson, M.L. 1973. Soil Chemical Analysis, Asia Publlishing, House, New Delhi. 183-93.

Khurana, A.D. and Verma, A.N. 1983.Some biochemical plant characters in relation to susceptibility of sorghum to stem borer and shootfly. Indian J. Ent. 45(1): 29-37.

Malik, R.S. 1978. Breeding for aphid resistance in *Brassica*. Ph. D. Thesis, Agra Univ, Agra and Division of Genetics, I.A.R.I., New Delhi, p.140.

Mehrotra, K.N. and Rao, P.J. 1972. Phagostimulants for locusts. Studies with edible oils. Ent. Exp. Appl. 15(2): 208-12.

Morals, A.C. 1975. Nutritive value and susceptibility of Opague 2 composite K and different types of corn to the longer rice weevil, *Sitophilous zeamais* Most. Philip. Agric. 58(7/8): 280-86.

Morris, D.L. 1984. Quantitative determination of carbohydrates with Dreywood`s Anthrons reagent. Science, 107.

Morzia, B. 2000. Differential response of ten mustard varieties to aphid. *Lipaphis erysimi* (Kalt.) under natural and artificial conditions. Ph.D. Thesis, Ent. Div. Bangladesh Agril. Univ. Mymensingh, p.193.

Sachan, S.K. and Sachan, G.C. 1991. Relation of some biochemical characters of *Brassica juncea* (Cossan) to susceptibility to *Lipaphis erysimi* (Kaltenvach). Indian J. Ent. 53(2): 218-225.

Singh, P. and Bakhctia, D.R.C. 1983. Comparative development and host selections mechanisms of the pea leaf miner, *Phytomyza horticola* (Goureau) on rapseed and mustard. In: Proceedings of VITH International Rapseed Conference held at Paris from 17-19 May 1983, 1135-1141.

Sumati, 1985. Biology of *Lipaphis erysimi* (Kaltenvach) and field incidence of *Athalia proxima* klug on oleiferous *Brassica* with reference to effects of insecticides on germination. M.Sc.Ag.Thesis, G.B. Pant. Univ. Agri. and Tech. Pantnagar, Nainitial. p.107.

Wigorek, W. and Krzymanska, J. 1974. Preliminary investigations on the biochemical differences between the varieties of Lucerne susceptible and resistant to the pea aphid (*Acyrthosiphon pisum*). Prace Naukawe Inst. Ochroni Boslin, 15(1): 5-10.