Journal Crop and Weed, 11(Special Issue):171-174(2015)

Isothiocyanate levels in relation to population of *Lipaphis erysimi* (Kaltenbach) in radish as affected by sowing dates and spacing

SUDHAVANI V., VIJI C. P., LAVANYA A. AND SYAMSUNDAR REDDY P.

Horticultural College and Research Institute,
Venkataramannagudem, Andhra Pradesh.

Received:15-09-2014; Revised:25-11-2014; Accepted:05-12-2015

ABSTRACT

Isothiocyanate is a crucifer specific volatile which plays an important role in plant defence as attractants and deterrents. Field Experiment was conducted at Horticultural College and Research Institute, Venkataramannagudem, West Godavari (Dist.) during the period from October, 2010 to January, 2011 to study the effect of sowing dates (1st October, 15th October, 1st November and 15th November) and spacings (45 x 10 cm, 45 x 20 cm and 45 x 30 cm) on the level of isothiocyanate content, its influence on the pest population and root yield of radish cv. Pusa Chetki. The study revealed that population of Lipaphis erysimi appeared in 3rd or 4th week after sowing (WAS) and increased with crop maturity. Highest aphid population was recorded in 8 WAS (16.2 aphids leaf^{-1}) in closely planted late sown crop. Isothiocyanate concentration increased with delay in sowing and decreased with increase in spacing. Highest isothiocyanate concentration was recorded in closely spaced late sown crop (20.00 mg^{-100}g). Highest yield was recorded in D_1S_1 (closely spaced crop and 1st October sowing) (13.88 t ha^{-1}) which had high isothiocyanate content (12.50 mg g^{-100}) and harboured more aphids. Even though aphid population is more in closer spacing, root yield of radish was high since more number of plants was recorded per unit area.

Keywords: Isothiocyanate, *Lipaphis erysimi*, radish, spacing, sowing dates.

Radish (*Rhapanus sativus* L.) is an important root vegetable crop grown in many parts of the world. It is relished for its pungent flavour and is considered as an appetizer. The characteristic flavour is due to the presence of thioglycosides known as glucosinolates. Glucosinolates are secondary plant substances found in several plant families mainly in Brassicaceae species (Gruber *et al*., 2009). They are amino acid-derived natural products that upon hydrolysis release numerous products (mixtures of isothiocyanates, thiocyanate, nitriles and many others) with a wide range of biological activities (Fahey *et al.*, 2001). They determine the quality and overall flavour of this vegetable. Isothiocyanates play a role in plant defence as attractants and deterrents. They act as repellents or attractants depending on insect pest specificity. They act as attractant and arrestant to cruciferous pests but act as deterrent to other herbivores (Mikkelsen and Halkier, 2003). Differences in the concentration of these compounds in radish are due to many factors among them the most important being the genetic potentials, agronomic factors and environmental conditions. Agronomic factors like proper time of sowing and optimum plant density influence the isothiocyanate content which ultimately decide the pest population. But there is no satisfactory information available on these aspects. Therefore, present investigation was carried out to study the effect of sowing dates and plant spacing on the isothiocyanate content in relation to pest density and root yield of radish.

Email: viji_iari@rediffmail.com

MATERIALS AND METHODS

Field experiment was conducted at Horticultural College and Research Institute, Venkataramannagudem, West Godavari (Dist.), Andhra Pradesh, India during the period from October, 2010 to January, 2011. The experimental site had red sandy loam with pH 6.9, EC 0.01 dS^{-1}m, 0.34 % organic carbon and 712, 32.5, 217.5 kg of N, P_2O_5 and K_2O ha^{-1}, respectively. The experiment was laid out in a factorial randomized block design with three replications having twelve treatments. The treatments comprised of the combination of four dates of sowing (1st Oct., 15th Oct., 1st Nov., and 15th Nov) and three plant spacings (45 x 10 cm, 45 x 20 cm and 45 x 30 cm). Seeds of popular radish cultivar Pusa Chetki was sown on ridges at a depth of 1.5 cm. Thinning was done at 25-30 DAS by retaining one seedling per hill. The crop was nourished with 80 kg ha^{-1} of nitrogen and 50 kg ha^{-1} each of P_2O_5 and K_2O.

Observations on pest incidence and population fluctuation were made at weekly intervals throughout the cropping season. Three leaves from top, middle and bottom per plant were considered for counting aphids and converted to mean number of aphids per leaf.

Biochemical analysis for the estimation of isothiocyanate content was determined according to the method of Ezaki and Onozaki (1980). The analysis of data was done by the method of variance outlined by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

The crop was infested with aphid, *Lipaphis erysimi* and leaf webber, *Crocidolomia binotalis*. Infestation by *L. erysimi* started at 3rd or 4th WAS (Weeks after sowing) and there was a gradual increase in aphid population which reached peak near harvest (8 WAS). The population of *C. binotalis* was negligible. The population of aphids increased with the increase in crop duration and maximum population was recorded near maturity. Highest aphid population was observed in late planted crop (D_4) with closer spacing (S_1) at 8 WAS (16.2 aphids leaf^{-1}) (Table 1).Isothiocyanates levels increased significantly with the delay *in dates of sowing and decreased with* increase in spacing, maximum and minimum were recorded in D_4S_1 (20 mg 100g^{-1}) and minimum in D_1S_3 (10 mg 100g^{-1}) respected (Table 2). Similar results of enhanced levels of isothiocyanates was observed in June sowing than in August sowing reported in China (Shen Qi and Wang Long Zhi, 1997).

It was also observed that isothiocyanate content was more in late planted crop which indicates that with the increase in isothiocyanate concentration, the population of the pest increased. Increase in concentration of isothiocyanates lead to the increased population of flea beetle, *Phyllotreta cruciferae* (Burgess and Wiens, 1980; Palaniswamy and Lamb, 1992; Soroka *et al*., 2005), feeding stimulant and attractant for cruciferous pest *Hellula undalis* (Mewis *et al*., 2001), feeding attractant and oviposition stimulant on diamond back moth, *Plutella xylostella* and cabbage white, *Pieris brassicae* (Gupta and Thorsteinson, 1960). Different alkyl thiocyanates are used for trapping various cruciferous pests (Peng *et al*., 1992; Liblikas *et al*.,;

Table 1 : Population of aphid (No. of leaf^{-1}) in radish cv. Pusa Chetki as influenced by sowing dates and spacing

Treatments	Plant spacing																	
Planting time	S_1 (45 x 10 cm)						S_2 (45 x 20 cm)						S_3 (45 x 30 cm)					
Sowing date	Weeks after sowing																	
	3	4	5	6	7	8	3	4	5	6	7	8	3	4	5	6	7	8
D_1(1st October)	0.0	2.4	5.9	8.2	10.3	12.5	0.0	2.0	4.8	7.8	9.5	11.2	0.0	1.8	3.5	6.9	8.7	9.1
D_2(15th October)	1.5	3.6	6.7	9.1	11.5	14.2	0.8	2.8	5.5	8.2	10.0	10.8	0.6	2.0	4.9	6.2	9.4	11.0
D_3(1st November)	2.0	4.6	8.5	10.3	12.1	14.8	1.7	3.5	6.9	9.0	10.2	13.3	1.5	2.8	5.7	7.4	10.3	11.5
D_4(15th November)	3.6	6.1	10.3	13.2	15.9	16.2	2.9	5.2	8.5	10.7	13.7	14.5	2.2	4.8	8.0	9.8	12.0	13.7

Data is the average of 25 observations in each case

Table 2: Effect of sowing dates and spacings on isothiocyanate content (mg 100g^{-1}) in radish cv. Pusa Chetki

Treatments	Plant spacing			
Sowing date	S_1 (45 x 10 cm)	S_2 (45 x 20 cm)	S_3 (45 x 30 cm)	Mean
D_1 (1st October)	12.50	12.00	10.00	11.50
D_2 (15th October)	15.00	15.50	16.00	15.50
D_3 (1st November)	18.00	17.00	16.50	17.15
D_4 (15th November)	20.00	19.00	18.50	19.16
Mean	**16.37**	**15.80**	**15.25**	

	Sowing Date (D)	Spacing (S)	D x S
SEm (±)	**0.41**	**0.36**	**0.72**
LSD (0.05)	**0.86**	**0.76**	**1.49**

D-Planting time S- Plant spacing

Table 3: Effect of sowing dates and spacings on yield (ha^{-1}) in radish cv. Pusa Chetki

Treatments	Plant spacing			
Planting time	**S_1(45 x 10 cm)**	**S_2(45 x 20 cm)**	**S_3(45 x 30 cm)**	**Mean**
D_1 (1^{st} October)	13.88	10.41	9.64	
D_2 (15^{th} October)	12.34	8.48	7.13	9.31
D_3 (1^{st} November)	10.60	7.89	3.46	7.32
D_4 (15^{th} November)	5.13	3.47	2.42	3.67
Mean	**10.49**	**7.56**	**5.66**	
	D	**S**	**D x S**	
Sem(±)	**0.39**	**0.34**	**0.68**	
LSD (0.05)	**1.15**	**0.99**	**1.99**	

2003, Smart *et al*., 1997) since it acts as an attractant to cruciferous pests.

Data recorded in the present studies showed that yield was high in closer spacing (10.49 t ha^{-1}) since more number of plants were accommodated per unit area. Highest root yield was recorded in closely spaced early sown crop D_1S_1 (13.88 t ha^{-1}) and lowest root yield (9.64 t ha^{-1}) was observed in late sown crop with wider spacing (D_1S_3). Aziz-Ur-Rehman and Nawab Ali (2000) also reported that yield was high in closely spaced crop. Ray *et al.* (2011) also reported higher yield in early planted chick pea. Late sown crop (D_4) had higher concentration of isothiocyanates which acted as an attractant and arrestant for *L. erysimi* population which may also have an impact on reduction in yield. The results were similar to the findings of Picket *et al*. (1992) who reported that isothiocyanates are powerful stimulants for Brassicacae specialist aphids.

The aphid population increased with the age of the crop and maximum population of the aphids are observed near maturity. It was also observed that isothiocyanate concentration increased with the delay in sowing and decreased with the increase in spacing which showed that isothiocyanate acts as an attractant for the aphid, *L. erysimi.* Nayak et al. (2014) also reported on the role of cibiotic factors of insects population dynamics.

The yield was recorded maximum in D_1S_1 (13.88 t ha^{-1}) due to the accommodation of more number of plants per unit area. Yield attributing characters like high root girth, root weight and low pungency levels were recorded with early sowing and wider spacing D_1S_3. It was concluded that the reduction in yield due to the lower plant density can be compensated by the high prices of high quality roots.

REFERENCES:

Aziz-Ur-Rehman and Nawab Ali. 2000. Effect of plant spacing and sowing time on yield in turnip (*Brassica campestris* cv. Purple Top) crop. *Sarhad J. Agri*., **16**: 575-79.

Burgess, L. and Wiens, J.E. 1980. Dispensing allyl isothiocyanate as an attractant for trapping crucifer-feeding flea beetles. *Canadian Ent.*, **112**:93-97.

Ezaki, H. and Onozaki, H. 1980. Calorimetric determination of pungent principles in radish root. *J. Home Eco.,***33**: 161–67.

Fahey, J.W., Zalcmann, A.T. and Talalay, P. 2001. The chemical diversity and distribution of glucosinolates and isothiocyanates among plants. *Phytochem.*, **56**: 5-51.

Gruber , M. Y., Xu, N., Grenkow , L., Li,X., Onyilagha, J., Soroka, J. J., Westcott, N. D. and Hegedus, D. D. 2009. Responses of the Crucifer Flea Beetle to *Brassica* Volatiles in an Olfactometer. *Env. Ento.*, **38**:1467-79.

Gupta, P. D. and Thorsteinson, A. J. 1960. Food plant relationships of the diamondback moth (*Plutella maculipennis* (Curt.)). *Ento. Exp. App*., **3**: 305-14.

Liblikas, I., Mottus, E., Borg-Karlson, A.K., Kuusik, S., Ojarand, A., Kannaste, A. and Tanilsoo 2003. Flea beetle (Coleoptera, Chrysomelidae) response to alkyl thiocyanates and alkyl isothiocyanates. *J. Agron. Res*., **1**: 175-84.

Mewis, I., Ulrichs, C. and Schnitzler, W.H. 2001. Feeding behaviour and host plant finding of the cabbage webworm, *Hellula undalis* (F.) (Lep.: Pyralidae) in the context of secondary host plant compounds. *Mitteilungen der Deutschen*

Gesellschaff fur allgemeine und angewandte Entomologie. **13**: 273-79.

Mikkelsen, M.D. and Halkier, B.A., 2003. Metabolic engineering of valine and isoleucine derived glucosinolates in Arabidiopsis expressing CYP79D2 from cassava. *Pl. Phys.*, **131**: 773-79.

Nayak, U.S. ; Baral, K,; Khuntia, A. and Rath, L.K. 2014. Monitoring of brinjal shoot and fruit borer (*Leucinodes orbonalis*, Gunee) through Phenomone traps and impact of abiotic factors on trap catch. *J. Crop Weed*, **10** : 143-46.

Palaniswamy, P. and Lamb. R.J. 1992. Host preferences of the flea beetles *Phyllotreta cruciferae* and *P. striolata* (Coleoptera: Chrysomelidae) for crucifer seedlings. *J. Eco. Ento.* **85**: 743–52.

Panse, V.G. and Sukhatame, P.V., 1985. *Statistical Methods for Agricultural Workers.* ICAR, New Delhi.

Peng, C.W., Weiss, W.J. and Anderson, M.D. 1992. Flea beetle (Chrysomelidae, Coleoptera) response, feeding, longevityon oilseed rape and crambe. *Env. Ento*., **21**:604-09.

Picket, J.A., Wadhams, L.J. and Woodcock. 1992. The chemical ecology of aphids. *Ann. Rev. Ento.*, **37**: 67-90.

Ray, M., Nanda, M.K.,and Khan, D.K. 2011. Effect of date of sowing and irrigation on yield, yield attributes and water use of chick pea (*Cicer arientium* L) at lower Gangetic plains of West Bengal. *J. Crop Weed*, **7** : 30-32.

Shen Qi and Wang Long Zhi. 1997. Changes of MTB-ITC content and the pungency in radish. *Acta Horti. Sinica*, **23**: 251-54.

Smart, L.E., Blight, M.M. and Hick, A.J. 1997. Effect of visual cues and a mixture of isothiocyanates on trap caputure of cabbage seed weevil, *Ceuhtorhynchus assimilis. J. Chem. Eco.*, **23**: 889 - 902.

Soroka, J. J., Bartelt, R.J., Zilkowski, B. W. and Cosse, A.A., 2005. Responses of flea beetle *Phyllotreta cruciferae* in the field to synthetic aggregation pheromone components and host plant volatiles in field trials. *J. Chem. Eco.,* **31**: 1829–43.