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Influence of sunflower genotypes on parasitization efficiency of *Trichogramma chilonis* Ishii (Hymenoptera: Trichogrammatidae) on *Helicoverpa armigera* (Hübner)(Lepidoptera: Noctuidae)

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ABSTRACT: **Two experiments were conducted on the effect of sunflower genotypes (21 nos.) on the parasitization efficiency of *Trichogramma chilonis* Ishii on *Helicoverpa armigera* (Hübner) under screen house conditions at Project Directorate of Biological Control (ICAR), Bangalore, Karnataka during 1999-2000. Pooled analysis of the data generated under these experiments revealed significant difference in per cent parasitism of *H. armigera* eggs by *T. chilonis* on these genotypes. Highest parasitism was observed on sunflower hybrid MSFH 17 (53.50%) among all the genotypes evaluated. Second best performance was on variety Morden (42.50%), followed by RHA-274 (41.00%) and hybrid KBSH 1 (38.00%). However, statistically all these were on par. Least parasitism was recorded on hybrid BSH-1 (8.00%), followed by variety 6D-1 (9.50%) and accession no. 109 (12.50%). Strangely, both parent lines of this hybrid, namely, CMS 234A and RHA 274, recorded much higher parasitism. All other genotypes recorded low to moderate parasitism ranging from 16.00 to 34.50 per cent. The sunflower genotypes (hybrids, cultivars, inbred lines), which are found *T. chilonis* friendly, are also agronomically acceptable. Among them, two are important national high yielding (seed and oil) hybrids (MSFH 17 and KBSH 1).**

KEYWORDS: Genotypes, *Helicoverpa armigera*, parasitization efficiency, sunflower, *Trichogramma chilonis*

INTRODUCTION

Sunflower (*Helianthus annuus* Linnaeus) is one of the important oilseed crops grown commercially all over India and ranks fourth in area and production. More than 90 species of arthropod pests have been reported damaging sunflower at different crop growth stages in India (Virupakshappa, 1996; Bilapate and Chakravarthy, 1999). Among them, capitulum borer, *Helicoverpa armigera* (Hübner) is one of the most widespread and serious (Panchabhavi *et al.*, 1977; Rohilla *et al.*, 1980; Men and Kandalkar, 1990; Singh *et al.*, 1992; Arya *et al.*, 1995). It causes damage to developing seeds and thereby affects the crop yield directly. Panchabhavi and Krishnamoorthy (1978) reported reduction in sunflower yield by *H. armigera* to the extent of 120kg/ha from Karnataka.

According to Rogers (1992), *H. armigera* and *Heliothis peltigera* may destroy more than 50 per cent of the seed.

For the management of *H. armigera*, biological control is considered as the best option in many crops including sunflower. Altogether, 77 species of parasitoids have been recorded on *H. armigera* from India (Manjunath *et al.*, 1985). Among them, *Trichogramma chilonis* Ishii has been reported as the most effective egg parasitoid on sunflower under screen house as well as field conditions (Singh and Ballal, 1999; Ballal and Singh, 2003). Inundative releases of *T. chilonis* synchronizing with egg laying of *H. armigera* form an appropriate strategy. Inter-specific, intra-specific and intra-population variability in host plants due to morphological, physiological and allelochemical characters play key role in the success or failure of *T. chilonis* (Tandon, 2001). However, no information is available in this regard pertaining to sunflower genotypes. The present experiments were conducted to know the effect of different genotypes of sunflower on the parasitization efficiency of *T. chilonis* on *H. armigera* with a view to identify *Trichogramma* friendly varieties/ hybrids.

MATERIALS AND METHODS

Two experiments on parasitization efficiency of *T. chilonis* on *H. armigera* on different genotypes of sunflower were conducted under screen house conditions at Project Directorate of Biological Control (PDBC), Bangalore during 1999-2000.

Host and parasitoid cultures

The cultures of *H. armigera* and *T. chilonis* were initially obtained from Mass Production Laboratory and thereafter multiplied in the Entomophagous Insect Behaviour Laboratory of PDBC.

Sunflower genotypes

Twenty-one genotypes, which included accessions, open-pollinated lines, varieties and hybrids were grown in 30cm diameter earthen pots in a screen house. The genotypes evaluated were: accession nos.109, 194, 344, 367, 450, 1039, 1143, 1172 and 1175; CMS-234A, 6D-1, EC 68414 (Peredovick), EC68415 (Armavirskii), RHA-274, BSH-1, GAU-SUF-15, KBSH-1, MSFH-17, PAC1091, TNAU-SUF-7 and Morden. These genotypes were obtained from the All India Coordinated Sunflower Project located at UAS, Bangalore. Two plants of each genotype (each pot) constituted a single replication. Each genotype was replicated ten times.

Parasitization efficiency of *T. chilonis*

Potted sunflower plants at flower initiation stage were artificially infested with one-day old *H. armigera* eggs at the rate of 5 eggs per plant on five topmost leaves (one egg/ leaf). The number of *T. chilonis* adults to be released was estimated based on total host eggs placed on all plants, male: female ratio of *T. chilonis* (1:1) and parasitoid-host ratio of 1:30. Two-day-old *T. chilonis* adults were released after 2 hours of infestation of sunflower plants with *H. armigera* eggs. After 48 hours, all the eggs were collected in Petri-plates for recording observation on parasitization. Per cent parasitism was recorded initially based on blackening of eggs and later confirmed by adult emergence. Both the years' data on per cent parasitism were pooled and transformed to angular values before subjecting to analysis of variance.

RESULTS AND DISCUSSION

In a multi-trophic system, the role of the autotroph (host plants) in mediating ecological interactions between host insects and their parasitoids has been well recognized (Andow and Prokrym, 1990; De Moraes and Mescher, 1999; Gingras *et al.*, 2003). In the present study, significant variability in terms of per cent parasitism of *H. armigera* eggs on 21 different genotypes was observed from the pooled data (Table 1). Highest parasitism was recorded on sunflower hybrid MSFH-17 (53.50%), which was significantly different from all other genotypes evaluated. Second highest parasitism (42.50%) was recoded on the variety Morden. However, this was on par with RHA-274

(41.00) and KBSH-1 (38.00%). Ballal and Singh (2003) also reported 50.1 per cent parasitism of *H. armigera* eggs on the same variety under screen house condition, however, the comparison was made with pigeonpea.

Moderate per cent parasitism was observed on sunflower accession no.194 (34.50), EC 68414 (34.00), GAU-SUF-15 (33.50), TNAU-SUF-7 (32.50) and CMS-234A (28.00). Low per cent parasitism was recorded on another group of eight genotypes which includes, PAC 1091 (22.50), accession nos. 1039 (22.00), 1143 (21.00), 344 (20.50), 450 (19.50), 1172 (16.50), 367 (16.50) and 1175 (16.00). Statistically, all these were on par (P=0.05). The least parasitism was observed on hybrid BSH 1(8.00%), followed by variety 6 D-1 (9.50%) and accession no.109 (12.50%). However, both the parent lines of hybrid BSH 1, namely, CMS 234A and RHA 274 recorded much higher parasitism.

Table 1. Influence of sunflower genotypes on parasitization efficiency of *T. chilonis* on *H. armigera*

Sl. no.	Variety/hybrid	Mean parasitization of *H. armigera* eggs (%)*
1	BSH-1 (CMS 234Ax RHA 274)	8.00 (15.62)
2	6D-1	9.50 (16.59)
3	Accession no. 109	12.50 (19.95)
4.	EC 68415 (Armavirskii)	13.50 (20.220
5.	Accession no. 1175	16.00 (21.77)
6.	Accession no. 367	16.50 (22.83)
7.	Accession no.1172	16.50 (23.67)
8.	Accession no. 450	19.50 (25.43)
9.	Accession no. 344	20.50 (25.75)
10	Accession no.1143	21.00 (27.14)
11.	Accession no. 1039	22.00 (27.27)
12.	PAC-1091	22.50 (27.72)
13.	CMS-234A	28.00 (31.95)
14.	TNAU-SUF-7 (Dwarf x Surya)	32.50 (34.79)
15.	GAU-SUF-15 (Mutant of Sun-Sel-10-84)	33.50 (35.36)
16.	EC 68414 (Peredovick)	34.00 (35.27)
17.	Accession no.194	34.50 (35.65)
18.	KBSH-1 (CMS-234 x 6D-1)	38.00 (38.18)
19.	RHA-274	41.00 (40.03)
20.	Morden	42.50 (40.92)
21.	MSFH-17	53.50 (41.46)
	SEM±	2.43
	CD (P=0.05)	6.74
	CV (%)	26.59

*Mean of ten replications

The host plants of insect pests are known to affect parasitoids directly or through tritrophic interactions (Gross and Price, 1980; Bottrell *et al.*, 1998). Several researchers have reported the influence of different crop species on the relative dominance of parasitoids of *Heliothis* spp. in field conditions (Bhatnagar *et al.*, 1982; Murray and Rynne, 1994; Murray *et al.*, 1995; Ballal and Singh, 2003). Mohite and Uthamasamy (1998) studied the parasitization of *H. armigera* eggs by *T. chilonis* on two species of *Gossypium* and reported that it was lowest on *G. raimondii* (25.3%) and highest on *G. harknessii*. Extent of parasitism was negatively correlated with trichome density. However, not much study has been conducted on the influence of plant genotypes on parasitization efficiency except laboratory evaluation of *T. chilonis* against *Corcyra cephalonica* (Stainton) eggs on rice varieties. Great variation in per cent parasitism due to varietal differences has been reported in earlier studies (Basit *et al.*, 2001).

Earlier, influence of genotypes on the parasitization efficiency of *T. chilonis* on *H. armigera* eggs in chickpea (Tandon and Bakthavatsalam, 2001) and pigeonpea (Tandon and Bakthavatsalam, 2003) has been reported. The authors related it to the presence of morphological characters like glandular trichomes. Bakthavatsalam *et al.* (2001) reported the highest EAG response of *Chrysoperla carnea* (Stephens) to KBSH1 hybrid of sunflower and least to the cultivar, 6D-1. The authors also reported the presence of caryophyllene in the hybrid KBSH 1 and related it to the attraction of *C. carnea*.

The sunflower genotypes (hybrids, cultivars, inbred lines), which are found *T. chilonis* friendly, are also agronomically acceptable. Among them, two are important national high yielding (seed and oil) hybrids (MSFH 17 and KBSH 1). Morden is an introduced national dwarf variety, which was released in 1979 as short duration crop. RHA-274 is high oil yielding inbred line, which is also moderately resistant to the whitefly, *Bemisia tabaci* (Gennadius). Similarly, EC68414 (Peredovick) is high oil yielding early dwarf variety grown as late crop. We may be able to derive greater benefit from augmentation and conservation strategies of biological control in sunflower giving preference to these *Trichogramma* friendly genotypes.

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REFERENCES

Andow, D. A. and Prokrym, D. R. 1990. Plant structure complexity and host finding by a parasitoid. *Oecologia*, **82**: 162-165.

Arya, D. R., Yadav, P. R. and Singh, H. V. 1995. Insect pests of sunflower in relation to crop phenology. *Indian Journal of Entomology*, **57**(2): 141-145.

Bakthavatsalam, N., Singh, S. P., Tandon, P. L., Hanumantharaya, L. and Vellaikumar, S. 2001. Influence of different cultivars of sunflower on the Electroantennogram response and behaviour of *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae), pp.52-53. *Proceedings of the Symposium on Biocontrol Based Pest Management for Quality Crop Protection in the Current Millennium*. July18-19, 2001, PAU, Ludhiana.

Ballal, C. R. and Singh, S. P. 2003. The effectiveness of *Trichogramma chilonis*, *Trichogramma pretiosum* and *Trichogramma brasiliense* (Hymenoptera: Trichogrammatidae) as parasitoids of *Helicoverpa armigera* (Lepidoptera: Noctuidae) on sunflower (*Helianthus annuus*) and redgram (*Cajanus cajan*). *Biocontrol Science and Technology*, **13**: 231-240.

Basit, A., Saikia, K. and Bhattacharya, B. 2001. Varietal preference of *Trichogramma chilonis* Ishii in laboratory. *Insect Environment*, **7**(1): 22-23.

Bhatnagar, V. S., Lateef, S. S., Sithanantham, S., Pawar, C. S. and Reed, W. 1982. Research on *Heliothis* at ICRISAT, pp.385-396. In: *Proceedings, International Workshop on* Heliothis *Management*, 15-19 November, 1981, ICRISAT, Patancheru, A. P., India.

Bilapate, G. G. and Chakravarthy, A. K. 1999. Biology of sunflower pests and their management, pp. 319-347. In: R. K. Upadhyay, K. G. Mukerji and R. L. Razak (Eds.), *IPM Systems in Agriculture, Vol.5 Oilseeds*. Aditya Books Pvt. Ltd., New Delhi.

Bottrell, D. G., Barbosa, P. and Gould, F. 1998. Manipulating Natural Enemies by Plant Variety Selection and Modification: A Realistic Strategy? *Annual Review of Entomology*, **43**: 347-367.

De Moraes, C. M. and Mescher, M. C. 1999. Interactions in entomology, plant parasitoid interaction in tritrophic systems. *Journal of Entomological Science*, **34**: 31-39.

Gingras, D., Dutilleul, P. and Boiven, G. 2003. Effect of plant structure on host finding of lepidopterous pests of crucifers by two *Trichogramma* parasitoids. *Biological Control*, **27**: 25-31.

Gross, P. and Price, P. W. 1980. Plant influences on parasitism of two leafminers, a test of enemy free space. *Ecology*, **69**: 1506-1516.

Manjunath, T. M., Bhatnagar, V. S., Pawar, C. S. and Sithananthan, S. 1985. Economic Importance of *Heliothis* spp. in India and an Assessment of their Natural Enemies and Host Plants, pp. 197-228. In: I. G. King and R. D. Jackson (Eds.), *Proceedings of the Workshop on Biological Control of* Heliothis*: increasing the effectiveness of natural enemies*. November11-15, 1985, New Delhi, India.

Men, U. B. and Kandalkar, H. G. 1990. Pest complex of sunflower, *Helianthus annuus* Linn. in Maharashtra. *PKV-Research Journal*, **21**(1): 61-63.

Mohite, P. B. and Uthamasamy, S. 1998. Host plant resistance and natural enemies interaction in the management of *Helicoverpa armigera* (Hübner) on cotton. *Indian Journal of Agricultural Research*, **32**: 28-30.

Murray, D. A. H. and Rynne, K. P. 1994. Effect of Host Plants on parasitism of *Helicoverpa armigera* (Lep.: Noctuidae) by *Microplitis demolitor* (Hymenoptera: Braconidae). *Entomophaga*, **39**(3/4): 251-255.

Murray, D. A. H., Rynne, K. P., Winterton, S. L., Bean, J. A. and Lloyd, R. J. 1995. Effect of host plant on parasitism of *Helicoverpa armigera* (Hübner) (Lepidoptera: Noctuidae) by *Hyposoter didymator* Thunberg (Hymenoptera: Ichneumonidae) and *Cotesia kazak* (Telenga) (Hymenoptera: Braconidae). *Journal of the Australian Entomological Society*, **34**(1): 71-73.

Panchabhavi, K. S., Devaiah, M. A., Seetharam, A. and Patil, N. M. 1977. Incidence of *Heliothis armigera* (Hübner) on different varieties of sunflower at Bangalore. *Indian Journal of Agricultural Sciences*, **47**(10): 519-520.

Panchabhavi, K. S. and Krishnamoorthy, P. N. 1978. Estimation of avoidable loss by insect pests of sunflower at Bangalore. *Indian Journal of Agricultural Sciences*, **48**(5): 264-265.

Rogers, C. E. 1992. Insect pests and strategies for their management in cultivated sunflower. *Field Crops Research*, **30**: 301-332.

Rohilla, H. R., Singh, H. V., Gupta, D. S. and Singh, K. 1980. Pest complex other than diseases of sunflower, *Helianthus annuus* in Haryana. *Indian Journal of Plant Protection*, **8**:177-182.

Singh, J., Brar, D. S., Bakhetia, D. R. C., Sandhu, G. S., Natarajan, N. and Subbarao, P. V. 1992. Field incidence and chemical control of *Helicoverpa (Heliothis) armigera* (Hübner) on sunflower in Punjab. *Journal of Research-PAU*, **29**(4): 473-479.

Singh, S. P. and Ballal, C. R. 1999. Role of Biocontrol agents in IPM, pp.57-65. In: H. Bassappa, Harvir Singh and C. Chattopadhyay (Eds.), *Integrated Pest Management in Sunflower*. Directorate of Oilseeds Research, Hyderabad, India.

Tandon, P. L. 2001. Negative aspects of interaction between Host Plant Resistance and Biological Control and its Implications in Integrated Pest Management of Crops, pp.13-21. In: R. K. Upadhyay, K. G. Mukerji and B. P. Chamola (Eds.), *Biocontrol Potential and Its Exploitation in Sustainable Agriculture*. Kluwer Academic/ Plenum Publisher, USA.

Tandon, P. L. and Bakthavatsalam, N. 2001. Influence of chickpea genotypes on the parasitization efficiency of *Trichogramma chilonis* Ishii on *Helicoverpa armigera* (Hübner) eggs, pp.36-37. *Proceedings of the Symposium on Biocontrol Based*

Pest Management for Quality Crop Protection in the Current Millennium. July 18-19, 2001,PAU, Ludhiana, Punjab.

Tandon, P. L. and Bakthavatsalam, N. 2003. Parasitization Efficiency of *Trichogramma chilonis* Ishii on *Helicoverpa armigera* (Hübner) eggs - influence of pigeonpea genotypes, pp. 75-78. In: P. L. Tandon, C. R. Ballal, S. K. Jalali and R. J. Rabindra (Eds.), *Biological Control of Lepidopteran Pests*. Proceedings of the Symposium on Biological Control of Lepidopteran Pests held during July 17-18,2002 at Bangalore.

Virupakshappa, K. 1996. Sunflower, pp.352-365. In: R. S. Paroda and K. L.Chadha (Eds.), *50 years of Crop Science Research in India*. ICAR, New Delhi.