Table 1. Mean pod damage (%) caused by *Helicoverpa armigera*, wilting (%), and grain yield in early-maturing chickpea cultivars.

Cultivar	Time to 50% flowering (days)	Pod damage (%) 1985/86	Pod damage (%) 1986/87	Pod damage (%) Pooled mean	Wilting (%)	Mean seed yield (t ha^{-1}) 1985/86 and 1986/87
ICCX 730008-8-1-1P-BP	58	14.7(22.5)[1]	4.2(11.6)	9.5(18.4)	11.1	1.32
ICC 506	62	15.1(22.8)	3.6(10.8)	9.4(18.3)	6.8	1.36
ICCX 790197-25PLB-12PLB-3PLB-BPLB	58	-	3.3(10.5)	3.3(10.5)	7.2	1.61
ICCX 790197-5PLB-2PLB-BPLB	59	-	3.2(10.3)	3.2(10.3)	6.5	0.76
ICCX 780286-5PLB-2PLB-2EB	62	-	3.2(10.3)	3.2(10.3)	9.0	1.82
ICCX 790197-23PLB-11PLB-2EB	58	-	4.3(11.9)	4.3(10.3)	16.9	1.29
Controls						
Annigeri	57	27.1(31.1)	10.9(19.2)	19.0(26.6)	12.5	1.05
Keonjhar Local	60	16.5(23.7)	4.5(12.3)	10.5(19.4)	10.7	0.86
SE		(±1.99)	(±0.92)	(±4.41)	-	±0.26
CD (P=0.05)		(6.13)	(2.79)	(12.66)	-	0.77
CV (%)		16.4	13.1	33.5	-	0.03

1. Figures in parentheses are angular transformations.

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Vegetation Management and the Biological Control of *Helicoverpa armigera* in Chickpea

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The enhancement of the natural enemy complex of *Helicoverpa armigera* may be possible by planned diversification of chickpea agroecosystems. The type of diversity introduced should help enhance parasite and

Table 1. Pod damage by *Helicoverpa armigera*, percent parasitism by *Campoletis chlorideae*, and yield of two chickpea cultivars grown with and without coriander border crop, ICRISAT Center, 1988/89 postrainy season.

Plot	Pod-borer damage in chickpea (%)		Parasitism in chickpea (%)		Seed mass (g)	
	With coriander	Without coriander	With coriander	Without coriander	With coriander	Without coriander
			ICCX 79012			
1	5.8 (1175)[1]	6.8 (1464)	5.7	0.0	172.5	202.0
2	6.5 (1592)	4.5 (823)	1.9	0.0	249.5	113.2
3	4.6 (1932)	2.7 (934)	3.4	0.0	290.0	135.4
4	5.5 (1714)	5.7 (1587)	5.3	0.0	261.8	229.9
Mean	5.6	4.9	4.1	0.0	243.4	170.1
t value	0.89		4.62*		1.68	
			Annigeri			
1	8.4 (2388)	7.9 (1334)	3.2	0.0	465.2	250.0
2	9.3 (1134)	5.1 (917)	2.0	0.0	225.8	179.1
3	9.5 (1470)	7.6 (1864)	4.9	0.0	274.6	352.4
4	7.6 (2076)	7.6 (1542)	3.8	0.0	420.4	278.6
Mean	8.7	7.1	3.5	0.0	346.5	265.0
t value	1.75		5.75*		1.29	

1. Values in parentheses indicate the total number of pods observed on 40 plants sampled in a systematic sampling design.

predator attraction to the agroecosystem, as well as their efficiency within it. This can be done by providing alternative hosts on noncrop vegetation, nectar-rich plants for adult parasitoid wasps, and suitable ground cover. Among the few natural enemies able to feed on *H. armigera* in chickpea, the ichneumon parasitoid, *Campoletis chlorideae*, is a particularly suitable candidate to improve the biological control of the pod borer through the addition of selective plant diversity. This is an important parasite because it can kill the caterpillars before they have a chance to cause much damage.

Nectar-rich umbellifers (coriander, indian dill, fennel) were laid out as border plants around chickpea plots in the 1988/89 postrainy season at ICRISAT Center. All these companion plants are valuable cash crops, and are non- or less-preferred host plants of the pod borer, which can provide food for adult parasitoid wasps.

Due to poor seed quality, coriander was the only

Table 2. Distribution of the incidence of parsitism by *Campoletis chlorideae* in terms of the proximity of coriander to the sampled chickpea (ICCX 79012 and Annigeri) plants.

Plot	Pod borer damage in rows (No. of pods observed) (%)		Parasitism in rows (%)	
	Close to coriander	Away from coriander	Close to coriander	Away from coriander
		ICCX 79012		
1	8(702)[1]	2.5(473)	10.7	0.0
2	9.4(994)	1.8(598)	4.2	0.0
3	5.1(1007)	4.1(925)	6.8	0.0
4	5.7(1071)	5.3(643)	5.3	4.2
Mean	7.1(3774)	3.4(2639)	6.8	1.05
t value	2.08		2.80*	
		Annigeri		
1	8.7(1105)	8.2(1283)	3.3	3.0
2	10.4(700)	7.6(434)	4.8	0.0
3	10.4(848)	8.2(622)	7.8	0.0
4	8.5(1311)	6.1(765)	5.3	0.0
Mean	9.5(3964)	7.5(3104)	5.3	0.75
t value	3.89*		2.91*	

1. Values in parentheses indicate the total number of pods observed on 40 plants sampled in a systematic sampling design.

umbellifer which became established. Damage inflicted by the pod borer on chickpea was low this postrainy season. No significant differences in pod damage could therefore be detected between chickpea grown with or without coriander. However, although relatively low, the numbers of pod borer larvae parasitized by *C. chlorideae* were about four times greater in chickpea plots with coriander border crops than in those with only chickpea (Table 1). The systematic sampling design used showed that the incidence of pod-borer parasitism by *C. chlorideae* was significantly higher in rows of chickpea closest to the coriander crop (Table 2). The presence of umbellifer borders therefore attracts and/or increases the prey-hunting efficiency of the parasitoid wasp within the chickpea agroecosystem. Further on-farm trials will be made to examine the contribution which various chickpea/coriander cropping patterns can make to *Helicoverpa* control.

Pathology

Toxicity of Some of the Crop Residues to Soilborne Pathogens of in vitro Chickpea

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Immature (1-month old) and mature (gathered from the field after harvest) wheat, oats, pea, chickpea, and lentil plants, completely dried at 60°C for 2-4 days, were finely ground in a mill. A 20 g sample of each

Table 1. Inhibition or stimulation in radial growth in extracts of soils amended with different crop residues.

Extracts of soil amended with residues of	Types of residue used	Percentage of inhibition (-) or stimulation (+) over control		
		R. bataticola	*F. oxysporum* f. sp *ciceri*	*S. rolfsii*
Wheat	Immature	-31.71 (21.00)1	- 7.47 (24.75)	+ 2.86 (18.00)
	Mature	-37.40 (19.25)	- 8.41 (24.50)	+24.28 (21.75)
Oats	Immature	+4.78 (32.22)	-22.43 (20.75)	+60.00 (28.00)
	Mature	-11.38 (27.25)	-10.28 (24.00)	+55.7 (27.25)
Chickpea	Immature	- 6.5 (28.75)	- 5.61 (25.25)	-48.57 (9.00)
	Mature	-16.26 (25.75)	- 6.54 (25.00)	+32.86 (23.25)
Pea	Immature	-47.25 (16.22)	- 9.35 (24.25)	-15.71 (14.75)
	Mature	- 6.5 (28.75)	- 5.61 (25.25)	- 8.57 (16.00)
Lentil	Immature	-16.5 (25.75)	- 2.80 (26.00)	-30.00 (12.25)
	Mature	-17.89 (25.25)	-11.21 (23.75)	+41.43 (24.75)
Control (No amendment)		0.0 (30.75)	0.0 (26.75)	0.0 (17.50)
CD (P=0.05)		0.08	0.68	1.58

1. Figures in parentheses are actual mean values in mm.