Bioefficacy of three promising predators on *Myzus nicotianae* Blackman (Homoptera : Aphididae)

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ABSTRACT

Coccinella transversalis Fab., *Cheilomenes sexmaculata* (Fab.) and *Chrysoperla carnea* Stephens were evaluated for their bio-efficacy against the tobacco aphid, *Myzus nicotianae* Blackman under field conditions. Based on the results of a feeler trial under greenhouse conditions, the predators were tested at two dosages of release (i.e., 8 and 16 larvae/plant) and three schedules of release (i.e one release @5th weeks after planting (WAP), two releases @ at 5th & 7th WAP and three releases @ 5th, 7th & 9th WAP. The efficacy of the predators was measured in terms of the density of the aphid, both before and after the release of the predators, besides estimating the reduction in the density of the aphid at 6th, 8th and 10th WAP. Among the three predators evaluated, *C. transversalis* gave the significantly highest reduction in aphid density at 6th WAP (54.38%), 8th WAP (60.42%) and 10th WAP (59.96%), thus indicating that *C.transversalis* was relatively more superior then the other two predators in the suppression of the aphid population under field conditions.

INTRODUCTION

The current total global production of tobacco is 6 billion kg. Nearly one-third of India's total tobacco production comprises of Virginia flue-cured (VFC) tobacco which is utilized in the manufacture of cigarettes. It is the principal export-oriented variety of tobacco and as much as 50 per cent of India's total production of VFC tobacco is exported to foreign countries. India produces about 300 million kg. of VFC tobacco and occupies third place after China and USA (Anonymous, 2009). Among the tobacco growing states Andhra Pradesh, Karnataka and Gujarat are important. In Karnataka, VFC Tobacco production is mainly concentrated in the districts of Mysore, Shimoga and Hassan. However, tobacco is plagued by several insect pests throughout its growth and developmental stages, of which the tobacco aphid, *Myzus nicotianae* Blackman (Homoptera : Aphididae) assumes significance, particularly since it not only feeds on the plant sap but also produces honeydew on which sooty mould grows and spoils the leaf quality (McPherson *et al.*, 1989), the aphid activity also hinders the curing process of VFC Tobacco and it is also known to transmit several viral diseases. This pest has got serious implications on VFC Tobacco production, particularly considering the fact that India is one of the top twelve flue-cured tobacco producers in the world. India occupies second place in area, third place in production and eighth place in exports of VFC Tobacco (Chari, 1995). The aphid, *M. nicotianae* has been reported to be most serious in USA during 1987 and 1988 and also in south eastern Canada (Lampert, 1989). This pest broke out in epidemic form in Andhra Pradesh during 1990-91 and 1991-92 seasons, during which the economic threshold level (ETL) has been estimated to be around 2 per cent or lesser (Anon, 1992-93). In this context, feeler studies conducted under laboratory and green house proved the usefulness of 3 predators, *viz.*, *C. transversalis*, *C. sexmaculata* and *C. carnea* in the suppression of the aphid . Therefore, the present investigation was conducted to evaluate their performance in actual field situation so as to develop suitable bio-control strategies for the management of this pest in VFC tobacco.

MATERIALS AND METHODS

Bioefficacy of *C. transversalis*, *C. sexmaculata* and *C. carnea* of these predators were tested at the following dosages and schedules, which was decided based on the results of the feeler study conducted earlier under green house conditions in two doses like D1 [8 larvae/plant (early second instar larvae)] and D2 [16 larvae/plant (early second instar larvae)] with three release schedules *viz.*, S1 [one release/spray at 5th week after planting (WAP)], S2 [two release/sprays, one each at 5th & 7th WAP)] and S3 [three release/sprays, one each at 5th, 7th & 9th WAP)]. Monocrotophos (@ 2 ml/litre) was used as the standard recommended check. The design of the experiment followed was three factor RCBD with three replications. Each treatment plot was separated from the neighboring treatments by a distance of 1 metre all around the plot. One observation on aphid density was recorded one day

before release of the predator and three observations were recorded after release of the predators at 6th, 8th and 10th WAP. During the first observation each of the 5 plants were labeled by specifying the treatment, dosage, schedule and replication number. In each sample plant, one leaf each from the bottom, middle and top portion of the plant were considered and in it, the aphid numbers per sq. inch (i.e., density) was recorded. Even the post-release observations were carried out in the same manner as the pre-release observation. Further, the per cent reduction in the aphid density due to release of predators was worked out by using the modified Abbot's formula, as suggested by Cunningham (1982), viz.,

$$\text{Per cent reduction in aphid density due to treatment} = \frac{1 - \frac{\text{Post release density in treatment}}{\text{Pre release density in treatment}}}{\text{X}\ \frac{\text{Pre release density in control}}{\text{Post release density in control}}} \times 100$$

RESULTS AND DISCUSSION

The aphid density before release of the predators (Table 1) was almost uniform in all the treatments and no significant difference was found between the individual treatments and different levels of interaction. At 6th week after planting (WAP), highly significant differences were observed among the treatments, however, the efficacy of these predators was not comparable with the standard check (Monocrotophos). The aphid density between treatments ranged between 3.54 to 23.47/inch^2. The lowest aphid density was found in case of *C. transversalis*, followed by *C. sexmaculata* and *C. carnea* release. Moreover, there was no significant difference between the two dosages, between the three schedules of release and between the first order interactions of treatments x dosages, treatments x schedules, dosages x schedules and the second order interaction of treatments x dosages x schedules (Table 2)

At 8th WAP (Table 3) highly significant differences were observed between the treatments, however, the efficacy of the three predators was not comparable with the standard check (monocrotophos). The aphid density ranged between 1.77 to 25.90/inch^2, the least aphid density was recorded in case of *C. transversalis*, followed by *C. sexmaculata* and *C. carnea* releases. No significant differences were observed between the three schedules of release, the two dosages, interactions of treatment x dosage, treatment x schedule, dosage x schedule and treatment x dosage x schedule. At 10th WAP (Table 4) also, significant differences was observed among the treatments however, none of the 3 predators were superior to the standard check. The aphid density ranged between 0.42 to 33.04/inch^2. Among the 3 predators, the lowest aphid density was recorded in case of *C. transversalis* release (8.19/inch^2), followed by *C. sexmaculata* and *C. carnea*, respectively. Significant differences were observed among the three schedules of releases, the lowest aphid density was observed in case of three release of predators (11.44/inch^2),as compared to two releases and single release.

Reduction in aphid density as influenced by release of predators

Highly significant differences were observed between the treatments at 6th WAP (Table 6), although none of the 3 predators were superior to the standard check (monocrotophos) in reducing the aphid density. However, among the 3 predators, *C. transversalis* gave the highest reduction in pest density (54.38%), followed by *C. sexmaculata* (40.76%) and *C. carnea* (35.08%). Significant

Table 1. Aphid density before release of predators

Treatments	D1				D2			Mean	Grand Mean
	S1	S2	S3	Mean	S1	S2	S3		
C. carnea	6.08(2.58)	8.46(2.91)	14.37(3.81)	9.64(3.09)	9.04(3.01)	11.35(3.34)	19.44(4.38)	13.27(3.57)	11.46(3.33)a
C. sexmaculata	9.28(2.99)	10.88(3.30)	9.93(3.13)	10.03(3.14)	6.33(2.58)	10.84(3.35)	10.66(3.25)	9.27(3.06)	9.65(3.10) a
C. transversalis	9.30(3.05)	14.30(3.82)	9.21(3.06)	10.94(3.31)	9.02(2.97)	9.30(3.09)	10.24(3.04)	9.52(3.03)	10.23(3.17)a
Monocrotophos	12.88(3.56)	12.72(3.55)	12.50(3.52)	12.70(3.54)	12.24(3.47)	12.82(3.55)	12.40(3.49)	12.48(3.50)	12.59(3.52)a
Untreated check	16.91(3.99)	16.52(3.96)	17.07(4.07)	16.83(4.01)	16.57(3.99)	16.88(3.99)	15.46(3.82)	16.30(3.93)	16.57(3.97)b
Mean	10.89(3.23)	12.58(3.51)	12.62(3.52)	12.03(3.42)	10.64(3.20)	12.24(3.46)	13.64(3.59)	12.17(3.42)	-
	F. test	S. Em(±)	CD (P=0.05)						
Treatments (T)	(**)	(0.20)	(0.57)						
Dosage (D)	(NS)	(0.13)	-						
Schedules (S)	(NS)	(0.16)	-						
T x D	(NS)	(0.29)	-						
D x S	(NS)	(0.22)	-						
T x S	(NS)	(0.35)	-						
T x D x S	(NS)	(0.50)	-						

Figures in parentheses indicate square root transformed values. ($\sqrt{x}$ +0.50); N.B. : D1 → Low dose (8 larvae/plant) D2 → High dose (16 larvae/plant); S1 → One release at 5th WAP, S2 → Two release at 5th and 7th WAP, S3 → Three releases at 5th, 7th and 9th WAP

Table 2. Aphid density at 6th week after planting (WAP)

Treatments	D1				D2			Mean	Grand Mean
	S1	S2	S3	Mean	S1	S2	S3		
T1: *Chrysoperla carnea*	5.57(2.46)	7.97(2.83)	13.62(3.69)	9.05(2.99)	8.15(2.84)	11.64(3.37)	18.06(4.23)	12.61(3.48)	10.83(3.24)c
T2 :*Cheilomenes sexmaculata*	8.10(2.83)	8.75(2.98)	8.53(2.91)	8.46(2.90)	4.59(2.24)	7.93(2.89)	8.28(2.87)	6.93(2.67)	7.70(2.78) bc
T3 :*Coccinella transversalis*	7.35(2.74)	10.62(3.28)	7.06(2.71)	8.34(2.91)	5.22(2.34)	5.57(2.38)	6.13(2.38)	5.64(2.37)	6.99(2.64) b
T4:Monocro tophos	3.43(1.95)	3.27(1.91)	3.81(2.04)	3.50(1.97)	3.46(1.96)	3.48(1.97)	3.81(2.05)	3.59(1.99)	3.54(1.98) a
T5 : Untreated check	22.86(4.73)	22.88(4.71)	24.53(4.92)	23.42(4.79)	24.15(4.90)	22.19(4.67)	24.20(4.89)	23.51(4.82)	23.47(4.80)d
Mean	9.46(2.94)	10.69(3.14)	11.51(3.25)	10.55(3.11)	9.11(2.86)	10.16(3.06)	12.10(3.28)	10.46(3.06)	-

	F. test	S. Em(±)	CD (P = 0.05)
Treatments (T)	(**)	(0.17)	(0.49)
Dosage (D)	(NS)	(0.11)	-
Schedules (S)	(NS)	(0.13)	-
T x D	(NS)	(0.25)	-
D x S	(NS)	(0.19)	-
T x S	(NS)	(0.31)	-
T x D x S	(NS)	(0.43)	-

Figures in parentheses indicate square root transformed values. ($\sqrt{x}$ +0.50), N.B. : D1 → Low dose (8 larvae/plant) D2 → High dose (16 larvae/plant), S1 → One release at 5th WAP, S2 → Two release at 5th and 7th WAP, S3 → Three releases at 5th, 7th and 9th WAP

Table 3. Aphid density at 8th week after planting (WAP)

Treatments	D1				D2			Mean	Grand Mean
	S1	S2	S3	Mean	S1	S2	S3		
T1:*Chrysoperla carnea*	8.22(2.94)	7.94(2.82)	12.35(3.51)	9.50(3.09)	10.64(3.26)	10.53(3.23)	15.88(3.96)	12.53(3.48)	10.93(3.29)c
T2:*Cheilomenes sexmaculata*	10.75(3.31)	6.95(2.66)	7.17(2.67)	8.29(2.88)	7.39(2.79)	5.50(2.42)	6.24(2.50)	6.38(2.57)	7.33(2.73)b
T3 : *Coccinella transversalis*	9.82(3.18)	8.33(2.94)	4.86(2.25)	7.67(2.79)	8.41(2.94)	3.17(1.87)	3.46(1.90)	5.01(2.24)	6.34(2.51) b
T4:Monocro tophos	1.93(1.55)	1.74(1.49)	1.64(1.46)	1.77(1.50)	1.85(1.53)	1.98(1.57)	1.47(1.39)	1.77(1.49)	1.77(1.49) a
T5 : Untreated check	25.77(5.03)	26.35(5.08)	25.97(5.07)	26.03(5.06)	26.05(5.07)	25.63(5.02)	25.65(5.01)	25.78(5.03)	25.90(5.05)d
Mean	11.30(3.20)	10.26(3.00)	10.40(2.99)	10.65(3.06)	10.87(3.12)	9.36(2.82)	10.54(2.95)	10.26(2.96)	-

	F. test	S. Em(±)	CD (P=0.05)
Treatments (T)	(**)	(0.16)	(0.45)
Dosage (D)	(NS)	(0.10)	-
Schedules (S)	(NS)	(0.12)	-
T x D	(NS)	(0.23)	-
D x S	(NS)	(0.18)	-
T x S	(NS)	(0.28)	-
T x D x S	(NS)	(0.40)	-

Figures in parentheses indicate square root transformed values. ($\sqrt{x}$ +0.50), N.B. : D1 → Low dose (8 larvae/plant) D2 → High dose (16 larvae/plant), S1 → One release at 5th WAP, S2 → Two release at 5th and 7th WAP, S3 → Three releases at 5th, 7th and 9th WAP

differences were obtained between the dosages; higher dosage (16 larvae/plant) gave greater reduction (46.04%) as compared to the lower dosage of release (41.39%). However, there was no significant difference among the three schedules of release and other interactions. At 8th WAP, the reduction in aphid density was significantly influenced by the treatments (Table 7), although none of the 3 predators were superior than the standard check (monocrotophos). The reduction in aphid density ranged between 0.56 to 91.55 percent, *C. transversalis* gave higher reduction in aphid density, as compared to *C. sexmaculata* and *C. carnea*. No significant differences were observed

Table 4. Aphid density at 10th week after planting (WAP)

Treatments	D1				D2			Mean	Grand Mean
	S1	S2	S3	Mean	S1	S2	S3		
T1:*Chrysoperla carnea*	13.22(3.69)	12.39(3.56)	16.01(4.03)	13.87(3.76)	15.10(3.90)	14.93(3.86)	15.28(3.92)	15.10(3.89)	14.49(3.83)c
T2:*Cheilomenes sexmaculata*	14.88(3.89)	11.04(3.35)	5.82(2.40)	10.58(3.21)	11.50(3.45)	9.57(3.15)	4.30(2.06)	8.46(2.89)	9.52(3.05) b
T3 : *Coccinella transversalis*	12.98(3.65)	13.46(3.73)	2.79(1.76)	9.74(3.05)	11.52(3.45)	7.20(2.72)	1.22(1.24)	6.64(2.47)	8.19(2.76) b
T4 : Mono-crotophos	0.49(0.99)	0.42(0.95)	0.55(1.01)	0.48(0.98)	0.06(0.75)	0.42(0.95)	0.61(1.05)	0.36(0.92)	0.42(0.95) a
T5 : Untreated check	32.84(5.67)	33.08(5.70)	35.20(5.87)	33.71(5.75)	34.00(5.78)	30.49(5.50)	32.63(5.66)	32.37(5.65)	35.04(5.70)d
Mean	14.88(3.58)	14.08(3.46)	12.07(3.02)	13.68(3.35)	14.44(3.47)	12.52(3.24)	10.81(2.79)	12.59(3.16)	-

	F. test	S. Em(±)	CD (P=0.05)
Treatments (T)	(**)	(0.16)	(0.44)
Dosage (D)	(NS)	(0.10)	-
Schedules (S)	(**)	(0.12)	(0.34)
T x D	(NS)	(0.22)	-
D x S	(NS)	(0.17)	-
T x S	(**)	(0.27)	(0.76)
T x D x S	(NS)	(0.39)	-

Figures in parentheses indicate square root transformed values. ($\sqrt{x}$ +0.50), N.B. : D1 '! Low dose (8 larvae/plant), D2 High dose (16 larvae/plant), S1 →One release at 5th WAP, S2 → Two release at 5th and 7th WAP, S3 → Three releases at 5th, 7th and 9th WAP

Table 5. Density of tobacco aphids as influenced by the release of predators

Treatments	Aphid density / inch^2			
	One day before release	At 6th WAP	At 8th WAP	At 10th WAP
T1 : *Chrysoperla carnea*	11.46 a	10.83 c	10.93 c	14.49 c
T2 : *Cheilomenes sexmaculata*	9.65 a	7.70 bc	7.33b	9.52 b
T3 : *Coccinella transversalis*	10.23 a	6.99 b	6.34 b	8.19 b
T4 : Monocrotophos	12.59 a	3.54 a	1.77a	0.42 a
T5 : Untreated check	16.57 b	23.47	25.90	33.04
F. test	(**) (**)	(**)	(**)	
S. Em (±)	(0.20) (0.17)	(0.16)	(0.16)	
C.D. (P=0.05)	(0.57) (0.49)	(0.45)	(0.45)	

Table 6. Per cent reduction in aphid density at 6th week after planting (WAP)

Treatments	D1				D2			Mean	Grand Mean
	S1	S2	S3	Mean	S1	S2	S3		
T1 : *Chrysoperla carnea*	27.23(29.31)	36.28(36.87)	38.16(38.06)	33.89(34.75)	41.79(40.21)	31.37(33.31)	35.64(36.31)	36.26(36.61)	35.08(35.68) b
T2 : *Cheilomenes sexmaculata*	43.34(41.02)	44.01(41.39)	42.62(40.57)	43.32(40.99)	51.52(45.88)	51.01(45.58)	48.06(43.84)	50.20(45.10)	46.76 (43.05) c
T3 : *Coccinella transversalis*	46.22(42.81)	49.96(45.05)	46.86(43.17)	47.66(43.68)	57.34(49.29)	62.97(52.71)	62.93(52.67)	61.08(51.55)	54.38(47.62) d
T4:Monocr otophos	81.87	82.02	80.72	81.54	82.42	82.18(65.11)	81.86(64.86)	82.15(65.12)	81.85(64.86) e
T5 : Untreated check	0.00(0.00)	0.82(5.18)	0.76(4.99)	0.52(3.39)	0.40(3.59)	0.54(3.92)	0.66(4.68)	0.53(4.06)	0.53(3.72) a
Mean	39.73(35.60)	42.62(38.68)	41.89(38.16)	41.39(37.48)	46.69(40.87)	45.61(40.13)	45.83(40.47)	46.04(40.49)	-

	F. test	S. Em(±)	CD (P=0.05)
Treatments (T)	(**)	(1.19)	(3.31)
Dosage (D)	(**)	(0.75)	(2.09)
Schedules (S)	(NS)	(0.92)	-
T x D	(NS)	(1.68)	-
D x S	(NS)	(1.30)	-
T x S	(NS)	(2.06)	-
T x D x S	(NS)	(2.92)	-

Figures in parenthesis indicate angular transformed values. N.B. : D1 → Low dose (8 larvae/plant), D2 → High dose (16 larvae/plant), S1 → One release at 5th WAP, S2 → Two release at 5th and 7th WAP, S3 → Three release at 5th, 7th and 9th WAP

Table 7. Per cent reduction in aphid density at 8th week after planting (WAP)

Treatments	D1				D2			Mean	Grand Mean
	S1	S2	S3	Mean	S1	S2	S3		
T1 : *Chrysoperla carnea*	22.94(23.83)	40.38(39.28)	50.80(45.44)	38.04(36.18)	27.66(26.60)	43.13(40.16)	51.16(45.68)	40.65(37.75)	39.34(36.97)
T2 : *Cheilomenes sexmaculata*	18.73(23.66)	60.96(51.63)	56.85(49.19)	45.51(41.49)	28.62(31.83)	70.76(57.41)	66.19(54.62)	55.19(47.95)	50.35(44.72)
T3 : *Coccinella transversalis*	33.66(35.23)	64.61(53.75)	69.85(56.79)	56.04(48.59)	35.55(31.27)	81.47(64.65)	77.39(61.75)	64.80(52.56)	60.42(50.58)
T4 : Mono crotophos	90.50(72.05)	92.51(74.18)	91.00(72.56)	91.34(72.93)	90.75(72.30)	92.42(74.12)	92.15(73.81)	91.77(73.44)	91.55(73.19)
T5 : Untreated	check	0.40(2.87)	0.57(4.32)	0.54(4.22)	0.50(3.80)	0.68(4.72)	0.58(4.10)	0.63(4.55)	0.63(4.46)
0.56(4.13)									
Mean	33.24(31.53)	51.80(44.63)	53.81(45.64)	46.29(40.60)	36.65(33.34)	57.67(48.25)	57.50(48.10)	50.61(43.23)	-

	F. test	S. Em(±)	CD (P=0.05)
Treatments (T)	(**)	(1.99)	(5.51)
Dosage (D)	(NS)	(1.25)	-
Schedules (S)	(**)	(1.54)	(4.27)
T x D	(NS)	(2.81)	-
D x S	(NS)	(2.18)	-
T x S	(**)	(3.44)	(9.55)
T x D x S	(NS)	(4.87)	-

Figures in parenthesis indicate angular transformed values, N.B. : D1 → Low dose (8 larvae/plant), D2 → High dose (16 larvae/plant), S1 → One release at 5th WAP, S2 → Two release at 5th and 7th WAP, S3 → Three release at 5th, 7th and 9th WAP

Table 8. Per cent reduction in aphid density at 10th week after planting (WAP)

Treatments	D1				D2			Mean	Grand Mean
	S1	S2	S3	Mean	S1	S2	S3		
T1 : *Chrysoperla carnea*	12.41(14.17)	26.91(25.99)	45.59(42.17)	28.30(27.44)	20.65(21.21)	32.93(34.06)	61.56(51.94)	38.38(35.74)	33.34(31.59)b
T2 : *Cheilomenes sexmaculata*	15.97(18.85)	51.23(45.69)	73.58(59.50)	46.93(41.35)	28.45(29.54)	59.48(50.56)	83.11(66.37)	57.01(48.82)	57.97(45.08)c
T3 : *Coccinella transversalis*	23.34(22.10)	55.61(48.26)	83.87(66.59)	54.27(45.65)	36.17(31.63)	65.72(54.20)	95.05(77.35)	65.64(54.39)	59.96(50.02)c
T4 : Monocro tophos	97.34(80.73)	97.50(81.11)	94.63(76.68)	96.49(79.51)	95.35(77.64)	96.25(79.09)	98.01(82.07)	96.53(79.60)	96.51(79.55)d
T5 : Untreated check	0.12(1.17)	0.41(3.00)	0.72(4.86)	0.42(3.01)	0.36(3.43)	0.30(2.93)	0.34(3.37)	0.33(3.24)	0.37(3.13) a
Mean	29.84(27.40)	46.33(40.81)	59.68(49.96)	45.28(39.39)	36.19(32.69)	50.93(44.17)	67.61(56.22)	51.58(44.36)	-

	F. test	S. Em(±)	CD (P=0.05)
Treatments (T)	(**)	(2.80)	(7.75)
Dosage (D)	(NS)	(1.77)	-
Schedules (S)	(**)	(2.16)	(6.01)
T x D	(NS)	(3.95)	-
D x S	(NS)	(3.06)	-
T x S	(**)	(4.84)	(13.43)
T x D x S	(NS)	(6.85)	-

Figures in parenthesis indicate angular transformed values. N.B. : D1 → Low dose (8 larvae/plant), D2 → High dose (16 larvae/plant), S1 → One release at 5th WAP, S2 → Two release at 5th and 7th WAP, S3 → Three release at 5th, 7th and 9th WAP

Table 9. Reduction in the tobacco aphid density as influenced by the release of predators

Treatments	Aphid density / inch²			
	At 6th WAP	At 8th WAP	At 10th WAP	Cumulative reduction (%)
Chrysoperla carnea	35.08b	39.34 b	33.34b	35.92
Cheilomenes sexmaculata	46.76c	50.35 c	51.97 c	49.69
Coccinella transversalis	54.38 d	60.42 d	59.96 c	58.25
T4 : Monocrotophos	81.85 e	91.55 e	96.51 d	89.97
T5 : Untreated check	0.53 a	0.56 a	0.37 a	0.48
F. test	(**)	(**)	(**)	
S. Em (±)	(1.19)	(1.99)	(2.80)	
C.D. (P=0.05)	(3.31)	(5.51)	(7.75)	

between the dosages, between the three schedules of release and among the first and second order interactions. At 10th WAP, highly significant differences were observed between the treatments (Table 8), however, none of the 3 predators were superior than the standard check (monocrotophos). The reduction in the aphid density ranged from 0.37 to 96.5 per cent. Among the 3 predators, highest reduction in aphid density was achieved in *C. transversalis* released plots (59.96%), followed by *C. sexmaculata* (51.97%) and *C. carnea* (33.34%) releases. Highly significant differences among the 3 schedules of release were observed, the reduction in aphid density was observed in case of 3 releases, followed by two releases and one release. Highly significant differences existed among the interaction of treatments x schedules, while no significant difference between the dosages, first and second order interactions was observed. In a nutshell, none of the 3 predators were superior to the standard check, however, among the 3 predators, *C. transversalis* not only recorded the lowest aphid density, but also gave the highest reduction in aphid density at 6th, 8th and 10th WAP. Moreover, three releases of the predators was significantly superior than either two or single release. Similar findings were earlier reported by Scopes (1969), Shands *et al.* (1972) and Heinz and Parrella (1990), although the pest, predator and crops involved then were different from those evaluated in the present study. Further studies to integrate *C. transversalis* into IPM programmes in tobacco is the need of the hour, particularly because of the fact that , VFC tobacco free from insecticidal residues will fetch greater foreign exchange in the overseas market , because much of India's VFC tobacco is exported.

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