was assessed 20 days after inoculation by adopting standard scale 1-5 (Anon., 1978).

RESULTS AND DISCUSSION

The studies clearly indicated that plant products *viz.*, Alitin (commercial), bulb extract of *Allium sativum*, leaf extracts of *Lantana camera* and *Sorghum bicolor* (K 5 variety) were highly inhibitory to spore germination and mycelial growth of *E. turcicum in vitro*. Seed extract and seed oil of *Azadirachata indica* were the next best treatments (Table). The inhibitory action might be due to the sulphur containing compounds like allicin, alyl propyl disulphide, diallyl disulphide etc. in *Allium sativum*, the bitter principle "Nimbidin" which is also a sulphur containing compound in *Azadirachta indica* (Anon., 1948). Further studies are necessary to identify the antifungal principle. However, when these plant extracts/products were tested in the field conditions, mancozeb treatment only recorded minimum intensity while the plant products were not effective. This might be due to the quick degradation of plant products under tropical temperature.

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EFFECT OF INTERCROPPING OF PULSES IN CEREALS ON THE INCIDENCE OF MAJOR PESTS

N. NATARAJAN, P.V. SUBBA RAO and S. GOPAL
National Pulses Research Centre, Vamban 622 303.

ABSTRACT

Effect of intercropping of greengram, cowpea, blackgram and soybean in maize and sorghum on the incidence of stem fly, whitefly, yellow mosaic and pod borer of pulses and shoot fly and stem borer of cereals indicated no significant effect on the pests except stem fly in blackgram, whitefly in cowpea, yellow mosaic and pod borers in green gram. Stem fly in blackgram and whitefly in cowpea were high when intercropped with maize. Greengram had low incidence of yellow mosaic when intercropped with maize and sorghum than raised as pure crop. Pod borer damage in greengram was significantly lesser in pure crop than raised with maize and sorghum. There was no difference in shoot fly and stem borer of sorghum and maize between pure crop and mixed with intercrops.

KEY WORDS : Intercropping, Pest management.

A suitable intercropping in polycrop systems will reduce the pest incidence or minimize the risks involved in monoculture. Bhatnagar and Davies (1978) reported that the intercropping systems helps a single crop from damage of pests by its compensatory ability thereby maintaining an overall stability of production. Lawani (1982) opined that intercropping in the tropics has been an important component of small farm agriculture and one of the reasons for the evolution of these cropping pattern may be attributed to the reduced incidence of insect pests (Batra, 1962). With view to study the effect of intercropping pulses in cereals on the incidence of major pests, a study was carried out at National Pulses Research Centre, Vamban, Pudukottai during 1986 and 1987.

MATERIALS AND METHODS

Three field experiments were conducted during Kharif 1986, 1987 and Rabi 1987 having two cereal main crops (maize and sorghum) and four pulse intercrops *viz.*, greengram, cowpea, blackgram and soybean. The treatments were maize pure, maize + greengram, maize + cowpea, maize + blackgram, maize + soybean, sorghum pure, sorghum + greengram, sorghum + cowpea, sorghum + blackgram, sorghum + soybean, greengram pure, cowpea pure, blackgram pure and soybean pure.

Sorghum with intercrops was raised in paired row systems. The experiments were of a randomised block design with a plot size of 5 x 4 m. Spacing and variety used were as follows:

Crop	Variety	Spacing (cm)
Maize	Co 1	60 x 20
Sorghum	Co 26	45 x 15 (paired row system for intercropping
Greengram	Co 3	30 x 10
Cowpea	Co 4	45 x 10
Blackgram	ADT 3	30 x 10
Soybean	Co 1	30 x 10

Observations were made on stem fly, *Ophiomyia phaseoli* Tryon. damage and whitefly, *Bemisia tabaci* Glen. incidence at 10 days interval from sowing, while on the incidence of yellow mosaic and pod borer damage at harvest. Stem fly damage was worked as percentage of affected plants to the total plants. The incidence of whitefly was recorded on five randomly selected plants per plot. Per cent damage by pod borers *Maruca testulalis* Geyer, *Lampides boeticus* L. *Catechrysops cnejus* F., *Heliothis armigera* (Hubner) was assessed as number of pods affected out of 200 randomly selected pods. The yellow mosaic incidence was also calculated as percentage of affected plants to the total plants per plot.

Shoot fly, *Atherigona soccata* Rond. (within 30 DAS) and stem borer *Chilo partellus* Swinhoe (dead heart after 30 DAS and leaf injury) damage were recorded as percentage of affected plants to the total plants per plot. Stem tunnelling in percentage was assessed by measuring length of the tunnel and total stem length from 10 randomly selected plants by splitting into two halves.

Observations made in three seasons were pooled and subjected to factorial randomised design analysis. All the percentage values were transformed using arc sine

$\sqrt{\text{percentage}}$ while the number of whitefly for five plants was subjected to $\sqrt{x+0.5}$ transformation as there were 'O' values.

RESULTS AND DISCUSSION

Pest incidence in Pulses

(i) **Stem fly (Table 1).** Damage by stem fly in greengram, cowpea and blackgram was higher in Rabi '87 than in Kharif '87 and Kharif '86 and in soybean there was no difference between the three seasons studied. Greengram, cowpea and soybean showed no difference in stem fly damage when raised as pure crop or as intercrops. Blackgram recorded 18.16 per cent damage when raised as intercrop with maize while with sorghum and as pure crop had low damage of 9.17 and 5.25 per cent respectively.

(ii) **White fly (Table 2) :** Number of whiteflies per five plants in pulse crops revealed that there was no difference between pure crop and as intercrops with maize or sorghum except in the case of cowpea which recorded significantly more whiteflies (3.8/5 plants) when raised with maize than as pure crop (3.1) and as intercrop with sorghum (2.7). Among the three seasons studied, the population was high in Kharif '86 followed by Rabi '87 and Kharif '87.

(iii) **Yellow mosaic (Table 3) :** Per cent yellow mosaic incidence in greengram was higher (10.40%) in pure stand than as intercrops with maize (2.76%) and sorghum (1.82%). There was no difference between pure crop and as intercrop in yellow mosaic incidence in blackgram and soybean. Among the three seasons, Kharif '87 had significantly more incidence in all the intercrops except cowpea which is not infected by yellow mosaic.

(iv) **Pod borer (Table 4) :** There was no difference in pod borer damage when raised as pure or intercrops except in greengram which recorded low pod borer damage (8.25%) as pure crop when compared to intercrop of maize (10.90%) and sorghum (10.90%). Pod borer damage was high in Kharif '87.

Pest incidence in cereals

(i) **Shoot fly :**There was no incidence of shoot fly in maize. In sorghum, the maximum incidence of 30.77 per cent was observed in Rabi '87 and least in Kharif '87 (0.17%). Pure stand and crop with pulse intercrops showed no significant different (Table 5) in shoot fly damage.

(ii) **Stem borers :** High incidence of stem borer recorded in Rabi '87 was 6.06, 9.83 and 22.70 per cent in sorghum and 2.74, 7.02 and 2.68 per cent in maize as dead heart, leaf injury and stem tunnelling respectively (Tables 5 and 6). There was no effect of intercropping pulses with maize and sorghum on stem borer incidence.

In contrast to the present study Mahadevan (1984) observed low incidence of stem borer in sorghum grown along with lablab or cowpea and the extracts of these plants in various solvents when sprayed on sorghum was not preferred by stem borer. Elangovan (1987) also reported that pure crop had more damage (33.2%) by stem borer than grown in association with legumes. In the present study, stem fly in blackgram and whitefly in cowpea were high when intercropped

Table 1. Stem fly damage in pulses raised as pure crop and as intercrops along with maize and sorghum

Crop/crop combination	Stem fly damage (%)			
	Kharif '86	Kharif '87	Rabi '87	Mean
Greengram	6.06(14.00)	0.0(0.57)	25.94(30.58)	10.67(15.05)
Greengram + maize	4.37(11.85)	1.45(6.76)	43.90(41.50)	16.57(20.14)
Greengram + sorghum	5.64(13.72)	0.0(0.57)	50.54(45.36)	18.57(19.88)
Mean	5.36(11.19)	0.48(2.63)	40.13(39.17)	
CD (P = 0.05)	Crop = NS;	Season = 10.09;	Interaction = NS	
Cowpea	2.28(8.62)	0.20(2.10)	4.36(11.98)	2.28(7.57)
Cowpea + maize	4.05(11.61)	0.0(0.57)	4.30(11.63)	2.78(7.94)
Cowpea + Sorghum	0.89(5.40)	0.0(0.57)	3.05(10.01)	1.31(5.83)
Mean	2.41(8.54)	0.07(1.08)	3.90(11.21)	
CD (P = 0.05)	Crop = NS;	Season = 2.75;	Interaction = NS	
Blackgram	2.53(9.19)	0.12(1.69)	13.10(21.00)	5.25(10.63)
Blackgram + maize	4.76(12.35)	2.14(8.46)	47.50(43.39)	18.16(21.46)
Blackgram + sorghum	4.71(12.51)	1.89(5.60)	20.91(27.08)	9.17(15.06)
Mean	4.00(11.35)	1.38(5.24)	27.20(30.56)	
CD (P = 0.05)	Crop = 6.50;	Season = 6.50;	Interaction = NS	
Soybean	2.59(9.17)	0.0(0.57)	0.0(0.57)	0.86(3.44)
Soybean + maize	0.61(3.43)	0.0(0.57)	0.75(3.80)	0.45(2.60)
Soybean + sorghum	2.60(6.06)	0.0(0.57)	1.14(6.02)	1.05(4.22)
Mean	1.70(6.22)	0.0(0.57)	0.63(3.46)	
CD (P = 0.05)	Crop = NS;	Season = NS;	Interaction = NS	

Figures in parentheses are arc sine $\sqrt{\text{percentage}}$ transformed values.

NS = Not significant

Table 2. Whitefly incidence in pulses raised as pure and as intercrops along with maize and sorghum

Crop/crop combination	Whitefly (No./5 plants)			
	Kharif '86	Kharif '87	Rabi '87	Mean
Greengram	8.3(3.0)	0.0(0.7)	0.5(1.0)	2.9(1.7)
Greengram + maize	7.8(2.9)	0.0(0.7)	2.0(1.6)	3.3(1.7)
Greengram + sorghum	4.3(2.1)	0.0(0.7)	0.5(1.0)	1.6(1.3)
Mean	6.8(2.7)	0.0(0.7)	1.0(1.2)	
CD (P = 0.05)	Crop = NS;	Season = 0.34;	Interaction = NS	
Cowpea	8.3(3.0)	0.0(0.7)	1.0(1.2)	3.1(1.6)
Cowpea + maize	8.0(2.9)	0.0(0.7)	3.5(2.0)	3.8(1.9)
Cowpea + sorghum	7.8(2.9)	0.0(0.7)	0.5(1.0)	2.7(1.5)
Mean	8.0(2.9)	0.0(0.7)	1.7(1.4)	
CD (P = 0.05)	Crop = NS;	Season = 0.3;	Interaction = NS	

Crop/crop combination	Whitefly (No./5 plants)			
	Kharif '86	Kharif '87	Rabi '87	Mean
Blackgram	7.0(2.7)	0.0(0.7)	0.5(1.0)	2.7(1.4)
Blackgram + maize	8.0(2.9)	1.0(1.2)	0.0(0.7)	3.0(1.6)
Balckgram + sorghum	7.0(2.7)	0.0(0.7)	0.0(0.7)	2.3(1.0)
Mean	7.3(2.8)	0.3(0.9)	0.2(0.8)	
CD (P = 0.05)	Crop = NS;	Season = 0.3;	Interaction = NS	
Soybean	7.0(2.7)	0.0(0.7)	0.5(1.0)	2.5(1.4)
Soybean + maize	6.8(2.7)	1.0(1.2)	1.0(1.2)	2.9(1.7)
Soybean + sorghum	7.3(2.8)	0.0(0.7)	1.0(1.2)	2.8(1.6)
Mean	7.0(2.7)	0.3(0.8)	0.8(1.1)	
CD (P = 0.05)	Crop = NS;	Season = 0.4;	Interaction = NS	

Figures in parentheses are $\sqrt{x+0.5}$ transformed values

NS = Not Significant

Table 3. Yellow mosaic incidence in pulses* raised as pure and as intercrops along with maize and sorghum

Crop/crop combination	Yellow mosaic incidence (%)			
	Kharif '86	Kharif '87	Rabi '87	Mean
Greengram	4.19(10.28)	27.00(30.84)	0.0(0.57)	10.40(13.93)
Greangram + maize	0.0(0.57)	8.27(16.68)	0.0(0.57)	2.76(5.94)
Greengram + sorghum	0.41(2.37)	5.06(12.99)	0.0(0.57)	1.82(5.29)
Mean	1.53(4.41)	13.44(20.20)	0.0(0.57)	
CD (P = 0.05)	Crop = 5.93;	Season = 5.93;	Interaction = NS	
Blackgram	2.20(8.25)	7.26(15.32)	0.0(0.57)	3.15(8.05)
Blackgram + maize	0.0(0.57)	2.50(9.09)	0.0(0.57)	0.83(3.41)
Blackgram + sorghum	1.00(5.62)	5.00(11.69)	0.0(0.57)	2.00(5.76)
Mean	1.10(4.81)	4.92(12.03)	0.0(0.57)	
CD = (P = 0.05)	Crop = NS;	Season = 4.56;	Interaction = NS	
Soybean	0.0(0.57)	8.54(15.72)	0.0(0.57)	2.85(5.62)
Soybean + maize	0.0(0.57)	11.16(18.70)	0.0(0.57)	3.72(6.61)
Soybean + sorghum	0.0(0.57)	7.07(15.06)	0.0(0.57)	2.36(5.40)
Mean	0.0(0.57)	8.92(16.49)	0.0(0.57)	
CD (P = 0.05)	Crop = NS;	Season = 5.82;	Interaction = NS	

Figures in parentheses are arc sine $\sqrt{\text{percentage}}$ transformed values

*Cowpea is not infected by yellow mosaic

NS = Not Significant.

Table 4. Pod borer damage in pulses raised as pure and as intercrops along with maize and sorghum

Crop/Crop combination	Pod borer damage (%)			
	Kharif '86	Kharif '87	Rabi '87	Mean
Greengram	3.50(10.78)	13.00(21.13)	*	7.25(15.96)
Greengram + maize	7.30(5.60)	14.50(22.24)	*	10.90(18.92)
Greengram + sorghum	5.30(13.22)	16.50(23.89)	*	10.90(18.56)
Mean	5.36(13.20)	14.67(22.42)	*	
CD (P = 0.05)	Crop = 2.25;	Season = 2.25;		Interaction = NS
Cowpea	7.50(15.82)	12.00(20.07)	11.00(19.37)	10.17(18.42)
Cowpea + maize	7.90(16.18)	19.30(20.09)	7.60(16.00)	11.60(19.43)
Cowpea + Sorghum	7.50(15.89)	15.00(22.72)	11.20(19.53)	11.23(19.38)
Mean	7.63(15.97)	15.43(22.96)	9.93(18.3)	
CD (P = 0.05)	Crop = NS;	Season = NS;		Interaction = NS
Blackgram	5.80(13.04)	12.30(20.12)	*	9.05(16.58)
Blackgram + maize	5.30(13.20)	7.30(15.44)	*	6.30(8.32)
Blackgram + sorghum	2.00(8.07)	14.00(21.97)	*	8.00(15.02)
Mean	4.37(11.44)	11.20(19.18)		
CD (P = 0.05)	Crop = NS;	Season = 4.40;		Interaction = NS
Soybean	5.00(12.92)	7.50(15.76)	6.30(14.37)	4.27(14.35)
Soybean + maize	6.90 (14.94)	5.30(13.22)	17.50(24.22)	9.90(13.46)
Soybean + sorghum	4.80(12.59)	3.00(9.94)	26.50(36.05)	11.43(17.72)
Mean	5.57(13.48)	5.27(12.97)	16.67(23.08)	
CD (P = 0.05)	Crop = NS	Season = 6.23		Interaction = NS

Figures in parentheses are transformed arc sine $\sqrt{\text{percentage}}$ value

*No of pods formed as a result of flower shedding

NS = Not Significant.

ble 5. Pest damage in sorghum raised as pure and along with pulse intercrops

Crop/crop combination	Shoot fly damge (%)				Dead heart %				Stem tunnelling (%) Leaf injury (%)				Stem borer damage			
	Kharif '86	Kharif '87	Rabi '87	Mean	Kharif '86	Kharif '87	Rabi '87	Mean	Kharif '86	Kharif '87	Rabi '87	Mean	Kharif '86	Kharif '87	Rabi '87	Mean
Sorghum	2.68 (9.17)	0 (0.57)	37.58 (38.79)	13.42 (15.85)	1.64 (5.52)	0.35 (2.67)	6.56 (14.81)	2.85 (7.67)	2.81 (9.63)	1.82 (5.76)	7.14 (10.86)	3.92 (8.75)	5.60 (13.14)	1.94 (5.98)	19.30 (26.03)	8.95 (15.07)
Sorghum + greengram	3.32 (10.90)	0.23 (2.36)	31.82 (34.26)	11.78 (15.73)	0.39 (3.58)	0.50 (3.16)	6.99 (15.38)	2.63 (7.63)	4.04 (11.61)	1.31 (6.79)	14.13 (21.85)	6.49 (13.42)	2.32 (8.72)	5.71 (11.53)	23.33 (28.41)	10.48 (16.22)
Sorghum + cowpea	4.05 (11.47)	0.32 (2.56)	35.78 (37.89)	13.38 (16.93)	1.19 (6.18)	0.99 (14.35)	7.02 (15.16)	3.07 (3.56)	0.22 (6.27)	0.29 (2.47)	8.09 (16.30)	2.87 (8.35)	10.35 (20.78)	0.86 (4.97)	22.77 (28.35)	13.54 (18.97)
Sorghum + blackgram	2.63 (9.35)	0.32 (2.58)	26.69 (37.18)	13.21 (16.37)	2.53 (9.25)	0 (0.57)	5.07 (12.37)	2.53 (7.41)	5.07 (12.37)	2.71 (9.39)	10.29 (18.43)	6.02 (18.43)	14.55 (20.68)	0.86 (4.97)	22.77 (28.35)	12.73 (18.00)
Sorghum + soybean	1.77 (7.04)	0 (0.57)	51.25 (45.73)	17.67 (16.67)	0.86 (4.03)	0 (0.57)	4.66 (12.43)	1.84 (5.63)	3.78 (10.35)	2.52 (6.75)	9.51 (17.66)	5.27 (11.65)	3.69 (9.67)	6.14 (14.36)	19.79 (26.42)	9.87 (16.82)
Mean	2.39 (9.59)	0.17 (1.73)	38.62 (30.77)		1.32 (5.68)	0.61 (2.26)	6.06 (14.06)		3.18 (0.09)	1.73 (6.23)	7.83 (17.02)		7.30 (13.73)	3.33 (8.97)	22.70 (28.34)	
CD (P=0.05)																
Crop			NS				NS				NS				NS	
Season			3.14				3.20				5.24				6.49	
Interaction			NS				NS				NS				NS	

Figures in parentheses are tranformed arc sine $\sqrt{\text{percentage}}$ values

NS = Not Significant

able 6. Pest damage in sorghum raised as pure and along with pulse intercrops

Crop/crop combination	Dead heart (%)				Leaf injury				Stem tunnelling %			
	Kharif '86	Kharif '87	Rabi '87	Mean	Kharif '86	Kharif '87	Rabi '87	Mean	Kharif '86	Kharif '87	Rabi '87	Mean
Maize	1.06 (4.45)	0 (0.57)	1.16 (6.12)	0.74 (3.70)	0 (0.57)	0 (0.57)	7.72 (14.50)	2.57 (5.21)	0.25 (2.31)	0 (0.57)	4.22 (8.71)	1.49 (3.86)
Maize + greengram	0.5 (1.19)	0 (0.57)	2.94 (9.77)	1.15 (3.84)	3.14 (10.18)	0 (0.57)	8.23 (16.37)	8.79 (9.01)	2.21 (6.13)	0 (0.57)	1.20 (4.65)	0.47 (3.78)
Maize + cowpea	0.43 (2.95)	0 (0.57)	3.15 (19.11)	1.19 (4.54)	0.13 (1.75)	0 (0.57)	8.23 (16.37)	1.98 (5.03)	1.93 (5.98)	0 (0.57)	3.61 (10.16)	1.85 (5.57)
Maize + blackgram	0.44 (2.96)	0 (0.57)	4.67 (12.43)	1.70 (5.32)	1.31 (4.93)	0 (0.57)	9.19 (17.63)	3.50 (7.71)	0 (0.57)	0 (0.57)	0.39 (93.92)	0.20 (1.69)
Maize + soybean	0.76 (3.80)	0 (0.57)	1.77 (7.65)	0.84 (4.00)	0.46 (2.93)	0 (0.57)	4.15 (11.52)	1.54 (5.01)	0.9 (4.14)	0 (0.57)	3.78 (11.15)	1.56 (5.29)
Mean	0.64 (3.07)	0 (0.57)	2.74 (9.21)		1.01 (4.05)	0 (0.57)	7.02 (14.56)		0.66 (3.83)	0 (0.57)	2.68 (7.72)	
CD (P= 0.05)												
Crop		NS				NS				NS		
Season		2.11				4.21				4.86		
Interaction		NS				NS				NS		

Figures in parentheses are transformed $\sqrt{\text{percentage}}$ transformed values.

NS = Not Significant

with maize while yellow mosaic was high and por borer damage was low in pure crop of greengram.

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STUDIES ON *Humbertiella Ceylonica* SAUSSURE (DICTYOPTERA : MANTIDAE) WITH SPECIAL REFERENCE TO THE NUMBER OF OVARIOLES IN THE SEASONAL CYCLES

U. KARUPPANAN and M. MOHANASUNDARAM

ABSTRACT

The structure and number of ovarioles of adult female mantids *Humbertiella ceylonica* Saussure revealed that the position on the ovarioles changed during the developmental changes related to the oocyte maturity ; rainy and summer seasons favoured higher egg production, while body length and season had no correlation with the number of ovarioles.

KEY WORDS : Mantids, Ovarioles

The total number of ovarioles is significantly related to the body length of adult female in Acrididae (Phipps, 1949, 1950). Though the ovarioles number significantly varies from species to species in relation to their size, yet it is fairly stable for each species. There is little information on the number of ovarioles in mantids during different periods of the year. The present investigations were take up to observe the position, structure and the number of ovarioles in relation to the body length during different periods of the year.

MATERIALS AND METHODS

The adult female mantids *Humbertiella ceylonica* Saussure newly emerged and gravid were periodically collected from fields from

1. Department of Zoology, Government Arts College, Coimbatore
2. Department of Entomology, Tamil Nadu Agricultural University, Coimbatore