Economic Threshold for Pea Aphid

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Abstract

Economic threshold for the pea aphid *Acyrthosiphon pisum* (Harris) was determined using an improved field pea variety, 'Mohanderfer' (1991-1993) and a local cultivar (1994-1996) at Kulumsa Research Centre of the Institute of Agricultural Research (IAR), Arsi, for six consecutive seasons, starting in 1991. The experiment was laid out in a randomized complete block design in four replications on plots 4 m long and 8 m wide. Maximum grain yield was obtained from plots fully protected from aphids and the lowest from unsprayed plots in all years. A calendar-based insecticide application was superior in all aspects. However, considering the cost-benefit ratio (CBR), one or two applications of pirimacarb recorded the highest at 35-40% level of infestation for 'Mohanderfer' and 40-45% for Arsi local. The highest CBR for 'Mohanderfer' at 35% infestation was 1:16 in 1991, followed by 1:6.73 at 40% in the 1992 season. The three years' CBRs for the local were 1:2.14, 1:2.37 and 1:3.01. These results indicated that more than two sprays are not justified for the control of *A. pisum* on field pea.

Introduction

Well over 400 thousand hectares of field pea is cultivated in Ethiopia, and yet the national average yield is 500-700 kg ha^{-1} (Asfaw et al. 1994). There are many reasons for this, one of them being insect pests. The pea aphid *A. pisum* is the most destructive pest of field pea reported from almost all growing regions in the country (Abate et al 1982). The pest is more severe in mid-altitude (1800-2200 m) areas of Shewa, Arsi, Bale and Gojam. Its preferred hosts are field pea, lentils and grasspea (*Lathyrus sativus*) though it has been reported attacking faba bean as well (IAR 1987, Kemal & Tibebu 1994).

Heavy infestations and total crop loss could occur when the distribution of rainfall is erratic or when the long rains stop early and are followed by hot dry weather which favors rapid increase in the aphid population. Yield losses due to pea aphid of 22%, 29% and 48% have been estimated at Holetta, Denbi and Kulumsa, respectively (IAR 1987, Kemal & Tibebu 1994).

Use of insecticides is one of the control options for aphids, and a well-timed application can provide economic control of the pest. Dimethoate, pirimicarb and pirimiphos-methyl sprays have been reported to give effective control of this pest (IAR 1987). However, what is not understood is the relationship between variations in the population density of aphids and the effect of these variations on yield. The determination of a pest density capable of causing economic damage as opposed to the mere presence of the pest in agricultural crops is an essential prerequisite developing an integrated pest management system which leads to a need-based application of insecticides.

The lack of knowledge on the yield-pest density ratio has led to frequent, unnecessary control measures. A lack of economic thresholds for major pests can easily lead to excessive treatments which in turn may cause outbreaks of secondary pests, development of resistance to pesticides and disruption of ecological systems (Stern et al. 1959).

The availability of this kind of information would be helpful to establish threshold limits in the development of a package of practices for pea aphid control in the country. This paper deals with the procedures and techniques that were used to accomplish a gradient of pea aphid infestations and its effect on yield.

Materials and Methods

This field experiment was carried out at Kulumsa Research Centre for six consecutive years during the rainy seasons of 1991-1996.

Table 3. Yield of field pea (cv 'Mohanderfer') and economic return of pirimicarb application against Acyrthosiphon pisum at Kulumsa, 1993.

Treatment applied at	*No. sprays*	*Pods per plant*	*Yield (kg ha^{-1})*	*Difference (kg ha^{-1})*	*Benefit over control (birr ha^{-1})*	*Cost (birr ha^{-1})*	*CBR*
15% infestation	*4*	*8.1*	*1215*	*691*	*1036*	*300*	*1:3.59*
20% infestation	*3*	*8.1*	*1112*	*588*	*882*	*225*	*1:3.92*
25% infestation	*3*	*7.8*	*1028*	*504*	*756*	*225*	*1:3.36*
30% infestation	*2*	*7.6*	*1111*	*587*	*800*	*150*	*1:5.33*
35% infestation	*2*	*7.8*	*1072*	*548*	*822*	*150*	*1:5.48*
40% infestation	*2*	*7.6*	*1084*	*560*	*840*	*150*	*1:5.60*
45% infestation	*2*	*7.9*	*1111*	*587*	*800*	*150*	*1:5.33*
50% infestation	*2*	*7.7*	*908*	*384*	*576*	*150*	*1:3.84*
Full protection	*7*	*8.6*	*1410*	*886*	*1329*	*525*	*1:2.53*
Untreated control	*-*	*4.6*	*524*			*-*	*-*
CV (%)		*4.8*	*16.3*				
LSD(0.05)		*0.7*	*250.0*				

Market price of field pea @ birr 1.50/ kg; Cost of pirimicarb (Pirimor) @ ETB 70 per kg; Cost of spraying @ birr 10/ha

Table 4. Yield of field pea (Arsi local) and economic return of pirimicarb application against *Acyrthosiphon pisum* on Arsi local, 1994.

Treatment applied at	No. sprays	Pods per plant	Yield (kg ha^{-1})	Difference (kg ha^{-1})	Benefit over control (birr ha^{-1})	Cost (birr ha^{-1})	CBR
15% infestation	3	10.2	968	312	468	240	1:1.95
20% infestation	3	9.8	926	270	405	240	1:1.70
25% infestation	2	9.1	826	170	255	160	1:1.60
30% infestation	2	8.7	866	210	315	160	1:1.97
35% infestation	2	9.0	831	175	262	160	1:1.64
40% infestation	1	8.7	750	94	141	80	1:1.76
45% infestation	1	8.2	785	129	193	90	1:2.40
50% infestation	1	8.9	762	106	159	90	1:1.99
Full protection	6	10.8	1099	443	664	480	1:1.40
Control	--	7.3	656		-	--	-
CV (%)		5.8	9.9				
LSD (0.05)		0.9	111.1				

Market price of field pea @ ETB 1.50/ kg; Cost of pirimicarb (Pirimor) @ birr 70 per kg; Cost of spraying @ birr 10/ ha

Table 5. Yield of field pea (Arsi local) and economic return of pirimicarb application against *Acyrthosiphon pisum* at Kulumsa, 1995.

Treatment applied at	No. sprays	Pods per plant	Yield (kg ha^{-1})	Difference (kg ha^{-1})	Benefit over control (birr ha^{-1})	Cost (birr ha^{-1})	CBR
15% infestation	4	7.4	730	310	558	380	1:1.47
20% infestation	4	6.8	780	360	640	380	1:1.68
25% infestation	4	6.4	700	280	504	380	1:1.33
30% infestation	3	5.6	710	290	522	385	1:1.83
35% infestation	3	6.6	650	230	414	285	1:1.45
40% infestation	2	5.9	640	220	396	190	1:2.08
45% infestation	2	5.8	670	250	450	190	1:2.37
50% infestation	2	6.5	660	240	432	190	1:2.27
Full protection	8	7.9	910	490	882	760	1:1.16
Control	-	4.8	420		-	--	-
CV (%)		11.3	21.8				
LSD(0.05)		0.7	Ns				

Market price of field pea @ birr 1.80 per kg; Cost of pirimicarb (Pirimor) @ birr 85 per kg; Cost of spraying @ birr 10/ha

Table 6. Yield of field pea (Arsi local) and economic return of pirimicarb application against *Acyrthosiphon pisum* at Kulumsa, 1996.

Treatment applied at	No. sprays	Pods per plant	Yield (kg ha^{-1})	Difference (kg ha^{-1})	Benefit over control (birr ha^{-1})	Cost (birr ha^{-1})	CBR
15% infestation	5	7.3	460	344	619	475	1:1.30
20% infestation	5	6.5	382	266	479	475	1:1.00
25% infestation	5	6.2	434	318	572	475	1:1.20
30% infestation	4	5.2	485	369	644	380	1:1.70
35% infestation	4	6.4	490	374	673	380	1:1.80
40% infestation	2	5.6	440	324	583	190	1:3.10
45% infestation	2	5.3	301	185	333	190	1:1.70
50% infestation	2	6.2	366	250	450	190	1:2.40
Full protection	8	8.0	493	377	679	760	1:0.90
Control	-	4.8	116		-	--	-
CV (%)		11.3	25.0				
LSD (0.005)		0.6	174.0				

Market price of field pea @ birr 1.80 per kg; Cost of pirimicarb (Pirimor) @ ETB 85 per kg; Cost of spraying @ birr 10/ha

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