FINAL REPORT
WTFRC Project # CH-02-200,

Project title: Cherry fruit fly distribution and trapping
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Objectives:
2002
- Determine if cherry fruit fly distributions and infestation levels can be predicted using traps and visual counts.
- Determine relationship between infestation rates in previous years (as determined by trap catches and infestation rates) and future infestations.

2003
- Determine effects of tree size on ability of traps to detect flies and predict infestation levels.
- Determine ability of traps to reduce fly infestations.

Significant findings:
2002
- Trap catches did predict infestation levels of fruit, with red spheres and late season catches yielding better relationships and possibly greater predictive power.
- Trap catches determined that 45% of trees were infested, while rearing of larvae from fruit indicated trees were 71% infested, suggesting trap sensitivity needs to be increased.
- Traps placed inside cages recaptured up to 35% of males and 46% of females, with a corresponding reduction in fruit infestation levels.
- All trees surveyed in 2000 and 2001 that were positive for flies on traps were also positive in 2002, but the absolute fly numbers were not predictable.

2003
- Red sphere traps with sustained ammonia release were effective in predicting infestation levels when fly populations were high.
- Red sphere traps detected flies and predicted infestation levels equally well on large and small trees.
- Red sphere traps reduced fly infestations and therefore can possibly be used suppress infestation levels.

Methods:
1. To test the effects of tree size on fly detection, either 1 or 4 red spheres baited with 10 g ammonium carbonate were hung on the south sides of 10-20 randomly selected small-moderate size (8-15 ft) or large trees (> 15 ft) in Tri-Cities and Yakima areas (40-80 total trees). Traps were deployed in late May and early June and left on trees for 2-2.5 weeks. In mid June, 200-500 fruit were collected from around the trees. Fruit were placed on screens and larvae allowed to emerge from the fruit. Larvae were counted each day over 3 weeks. The percentages of trees that were fly positive based on trap catches, visual inspections, and larval infestations were compared as in 2002. The hypothesis tested was that the small-moderate size trees provide more consistent fly detections than the large trees.
2. To determine the effects of traps on larval infestations, 9 or 12 cages were placed over individual 10-12 ft tall trees in the USDA Moxee Farm in May. Either one or 4 red sphere traps baited with 2 g ammonium carbonate (to be consistent with 2002) were hung on each of 3 or 4 trees. A control with no traps was included. Flies were collected from the field, maintained in the lab, and then released inside cages in mid June. The numbers collected on traps and infestation rates in the fruit were determined in early-mid July.

Results and Discussion:

2002

In 2002 in Union Gap and Yakima, fly catches on red spheres and yellow panels indicated that 45-48% of the 31 trees in the study were infested, whereas collection of fruit and rearing of the larvae indicated that 71% were actually infested (Table 1). These data suggest that traps as deployed (probably low ammonia release from 2 g ammonium carbonate) can be used to detect and predict infestations by flies only to a limited degree. Both spheres and yellow panels failed to detect moderately high infestations.

Even though traps failed to detect some infestations, red sphere and yellow panel catches were positively correlated with infestation levels in most cases, although usually not significantly (Fig. 1 and 2). Trap catches on spheres generally were better correlated with larval infestations than were yellow panels. However, because tree sizes and structure varied, some of the differences may have been caused by these factors and not by trap type. Proximity to other cherry trees, such as in an orchard setting, and fly density may influence reliability. In large trees, more traps may be required, or traps must be placed at higher levels, for accurate assessment of fly populations. The location of the trees also needs to be taken into account. Almost all the trees used in this study were isolated in yard or had only a few trees nearby. Thus the trees were probably not infested by immigrating flies. In a few cases, the high numbers of flies and low infestation rates suggest that flies may have been dispersing through some of the yards and not staying on the trees. Tree size, fruit load, and tree location all will influence the behavior and movement of the flies and needs to be studied in relation to trap captures.

Visual inspections were usually positively correlated with trap catches. This suggests that when flies are difficult to see, the traps are also less likely to capture flies. However, in one case 81 and 69 flies were collected on one yellow trap in consecutive weeks but only 2 and 3 flies were seen. Periodic visual examinations on trees thus seem less reliable than longer-term trap catches in determining infestations.

Nine trees spread over Kennewick, Richland, Prosser, Yakima, and Cle Elum that were positive for flies on traps in 2000 and 2001 were positive again in 2002, indicating that infestations persist in trees year after year. Whenever fruit are available, flies will tend to stay on the same trees and will not disperse far from it, as dispersal tendencies by the fly are relatively low. Surprisingly, the actual numbers caught on unbaited yellow traps were not predictable from year to year, except between 2000 and 2002 ($r = 0.624$, $P = 0.073$; 2000 and 2001 and 2001 and 2002, $P > 0.07$), suggesting either these traps are not sensitive enough or that fly populations naturally fluctuate greatly from year to year, depending on fruit load, weather conditions, and other factors. Increased trap sensitivity is important because reliable predictions of infestation levels can lead to better planning for control measures in the following years.

In 2002, traps placed inside caged trees recaptured up to 30% of released flies (Table 2). The actual infestations were not significantly reduced, but trapped trees did tend to have lower infestation rates (Table 2). Because the supercharger lures used in the study may have lost all their ammonia after 1 week, a longer-lasting ammonia source may be needed to continually trap flies throughout the season and reduce infestations.

2003

Relationships between flies caught on ammonia-baited red spheres and infestation of fruit in Kennewick and Yakima, where fly populations were high, were significant (Fig. 3). In Moxee, where populations were lower, relationships were not significant (Fig. 3). As in 2002, the visual inspections yielded weaker relationships (Fig. 4), perhaps because they were conducted once during the season. There was not a strong relationship between tree height and predictability of larval infestations using the red sphere traps, as traps worked equally well on short or tall trees (Fig. 5). Infestation levels of fruit were lower in trees trapped with 4 ammonia-baited red spheres (Table 3). This suggests that when populations are low, these traps can reduce infestation levels. Only 10% of flies were recovered, suggesting that the traps removed males that were needed to inseminate the females, and that the eggs of females not trapped may not have hatched.

Overall Conclusions

The overall results of this study indicate that red sphere traps baited with ammonia can be used to predict the level of infestations. In the infested back yard tree, this ability could determine whether it is necessary to exert control measures or not. By removing flies in trees with low, difficult to detect infestations, the threat of flies immigrating into commercial orchards can be substantially reduced. Additionally, the removal of flies by traps can reduce populations to a level that may allow more effective control using non-insecticide methods. Both of these outcomes will benefit the environment and the cherry industry.

Table 1. Relationship between numbers of trees infested with *Rhagoletis indifferens* and fly-positive trees based on numbers caught on traps and seen on cherry trees in the Yakima Valley, May-June 2002. E, early, 22 May-4 June; L, late, 4-13 June.

			2002 % Trees Positive for Flies Based On:			
		% Trees	Trap Catch		Visual Counts	
Treatment	*N*	Infested[c]	E	L	E	L
1 Red sphere[a]	9[b]	56	33	33	33	33
4 Red spheres[a]	9	67	44	44	22	44
1 Yellow Panel	8	75	50	62	25	38
4 Yellow Panels	5	100	60	60	20	20
Totals – all treatments	31	71%	45%	48%	25%	35%

			2003 % Trees Positive for Flies Based On:	
		% Trees		
Treatment	*N*	Infested[c]	Trap Catch	Visual Counts
1 Red sphere, backyard	28	96.4	85.6	85.6
1 Red sphere, orchard	40	97.5	82.5	20.0

[a]Spheres not baited with ammonium carbonate early sampling, but was for late sampling.
[b]One tree that was trapped only during the late period not included; [c]Based on larvae in fruit.

Table 2. Percentages of *Rhagoletis indifferens* ± SE recaptured by red sphere traps (baited with 2 g ammonium carbonate) and infestation rates inside field cages in Moxee, WA, 19 June to 15 July, 2002 and 2003. Cumulative total flies released inside parentheses. Three cages per treatment. M = males, F = females.

	2002						
	No. Flies Released Per Cage			Cumulative Percent Recaptured			
Release			Control	1 Red Sphere		4 Red Spheres	
No.[a]	F	M		M	F	M	F
1	13	90	------	16.3 ± 6.4a	28.2 ± 9.3a	28.2 ± 3.1a	46.2 ± 27.7a
2	9 (22)	44 (134)	------	14.0 ± 4.0a	30.3 ± 7.6a	22.0 ± 1.0a	32.7 ± 21.5a
3	7 (29)	19 (153)	------	14.4 ± 4.5 a	33.3 ± 8.1a	22.1 ± 0.9a	35.1 ± 15.8a

	Infestation of Fruit		
	Control	1 Red Sphere	4 Red Spheres
Total No. Larvae/Tree	355.0 ± 93.5a	240.0 ± 87.7a	103.0 ± 35.8a
No. Larvae/Fruit	0.322 ± 0.086a	0.251 ± 0.092a	0.102 ± 0.36a

[a]18 June, 25 June, 5 July. Means followed by the same letter within rows are not significantly different (ANOVA, $P > 0.05$).

Table 3. Effects of trapping trees with ammonia-baited red spheres on infestation of fruit by cherry fruit flies inside field cages, Moxee, WA, 2003.

	2003	
15 females, 50 males released	Control – 4 replicates	4 Red Spheres – 5 replicates
Total No. Larvae/Tree	29.50 ± 2.63a	1.40 ± 0.98b
No. Larvae/Fruit	0.272 ± 0.040a	0.010 ± 0.008b

Means followed by the same letter within rows are not significantly different (ANOVA, $P > 0.05$).

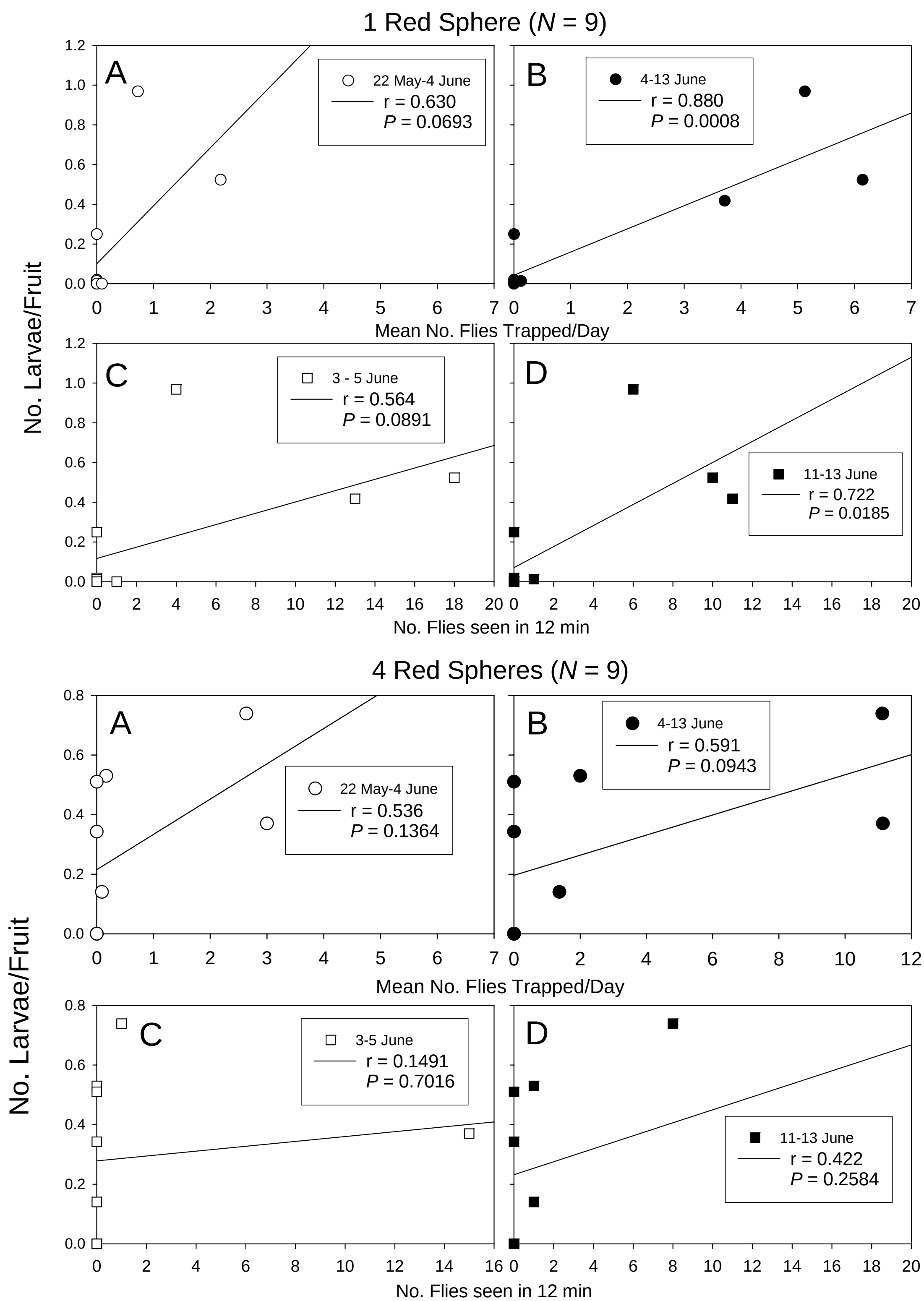

Fig. 1. Relationships between red sphere trap catches, numbers seen, and numbers of larvae inside cherry fruit in Union Gap and Yakima, WA, 2002.

Trapping study3

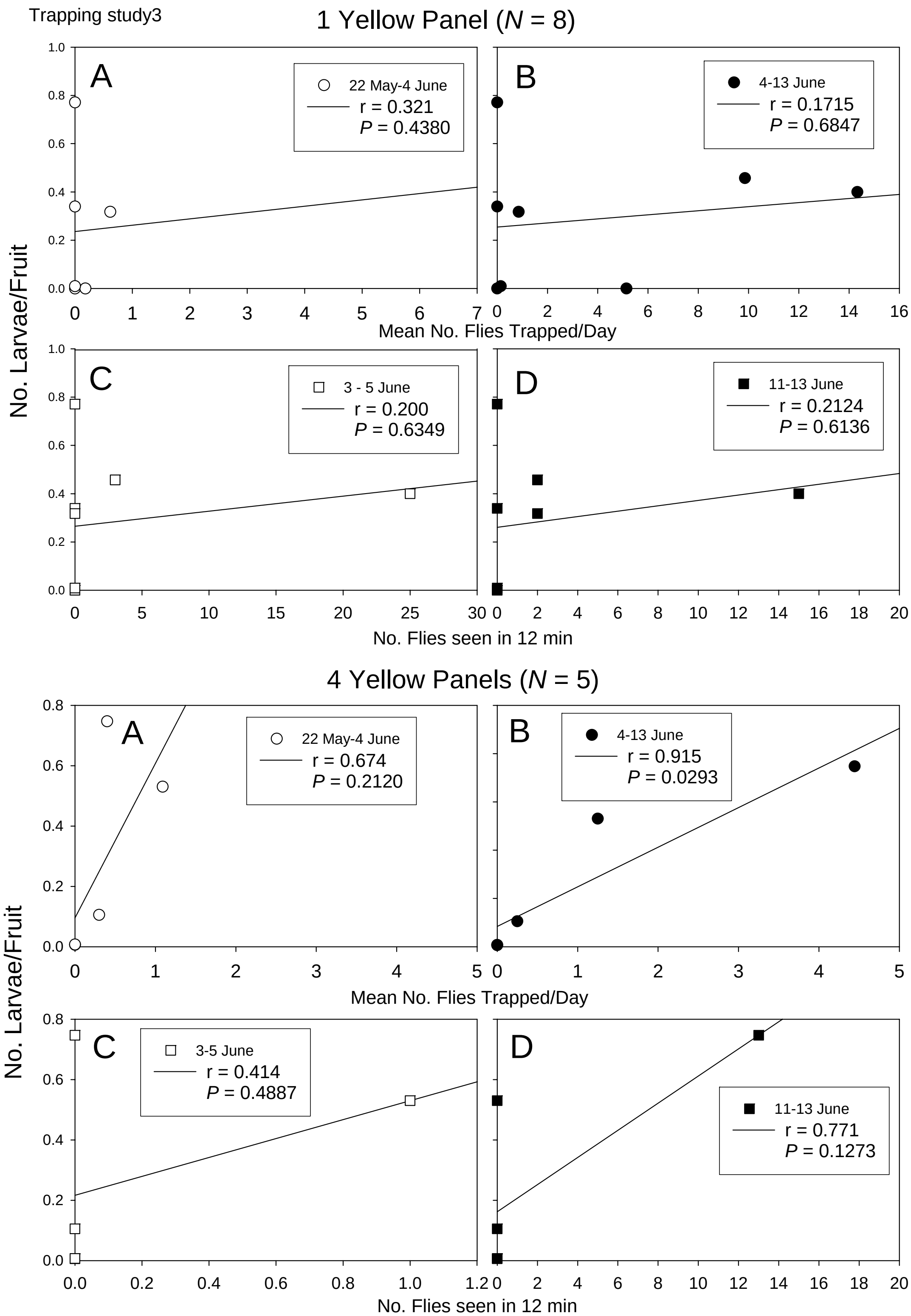

Fig. 2. Relationships between yellow panel trap catches, numbers seen, and numbers of larvae inside cherry fruit in Union Gap and Yakima, WA, 2002.

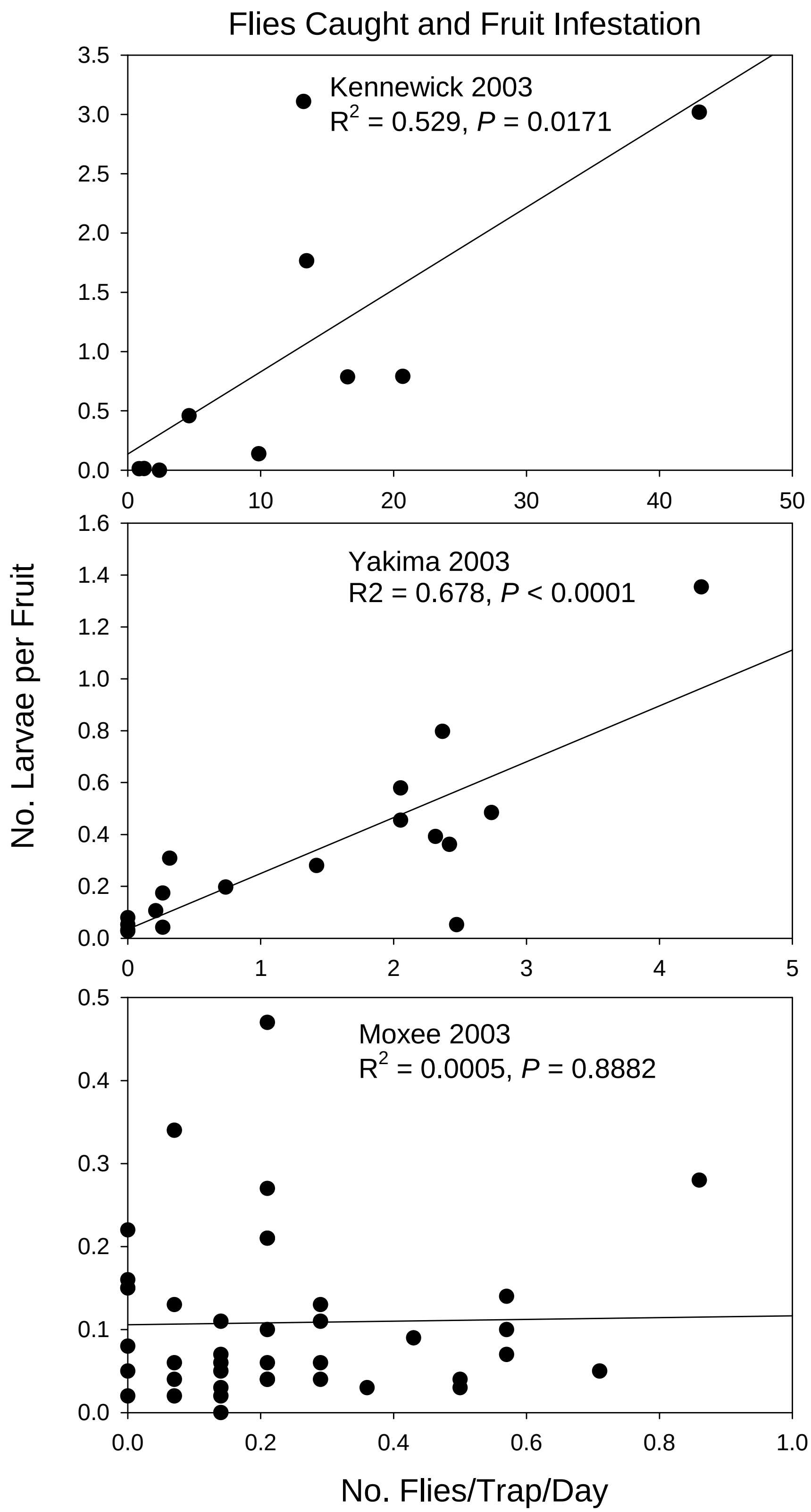

Fig. 3. Relationship between numbers of flies caught on red spheres and infestation of fruit, 2003.

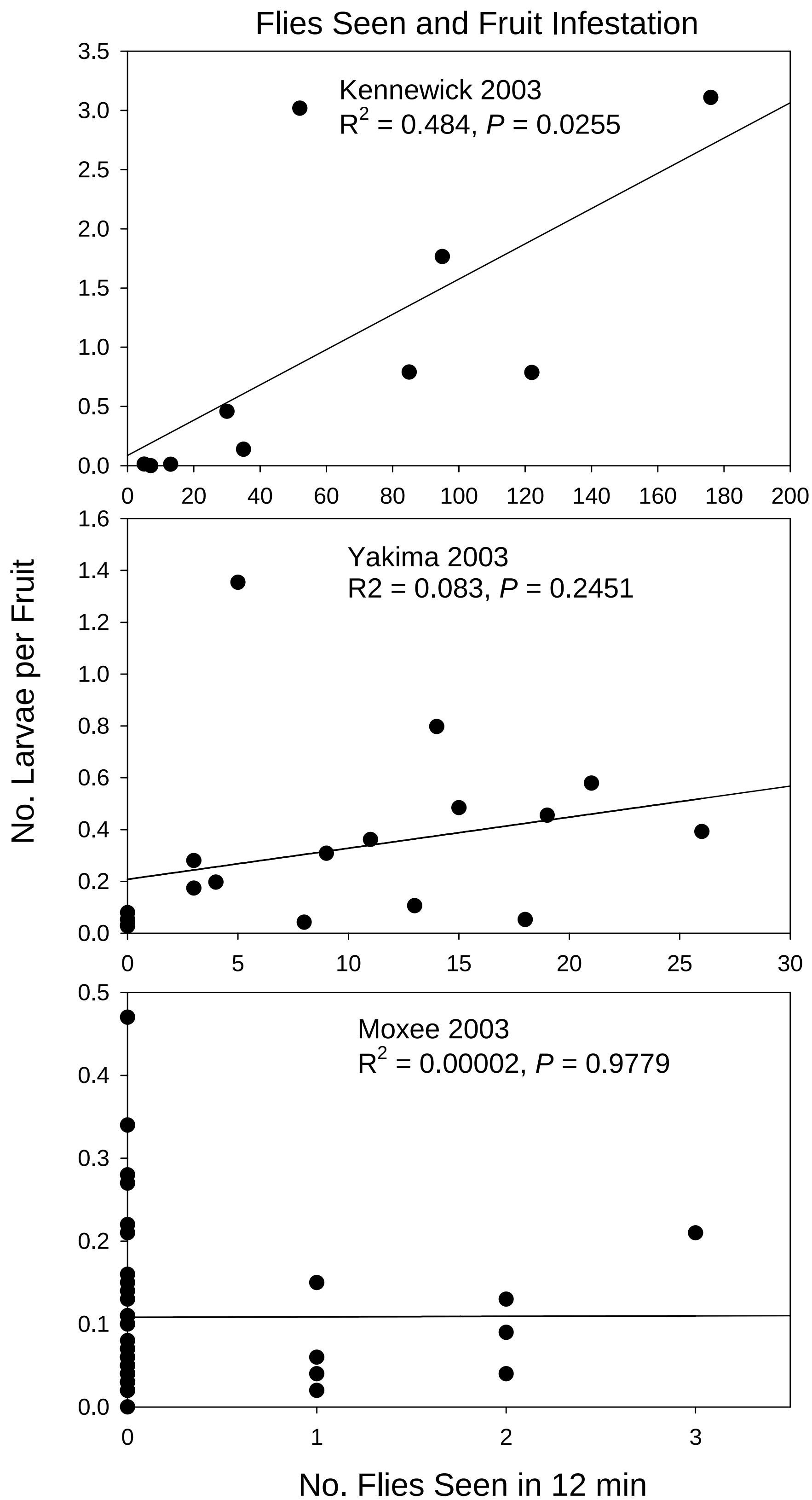

Fig. 4. Relationship between flies seen and infestation of fruit, 2003.

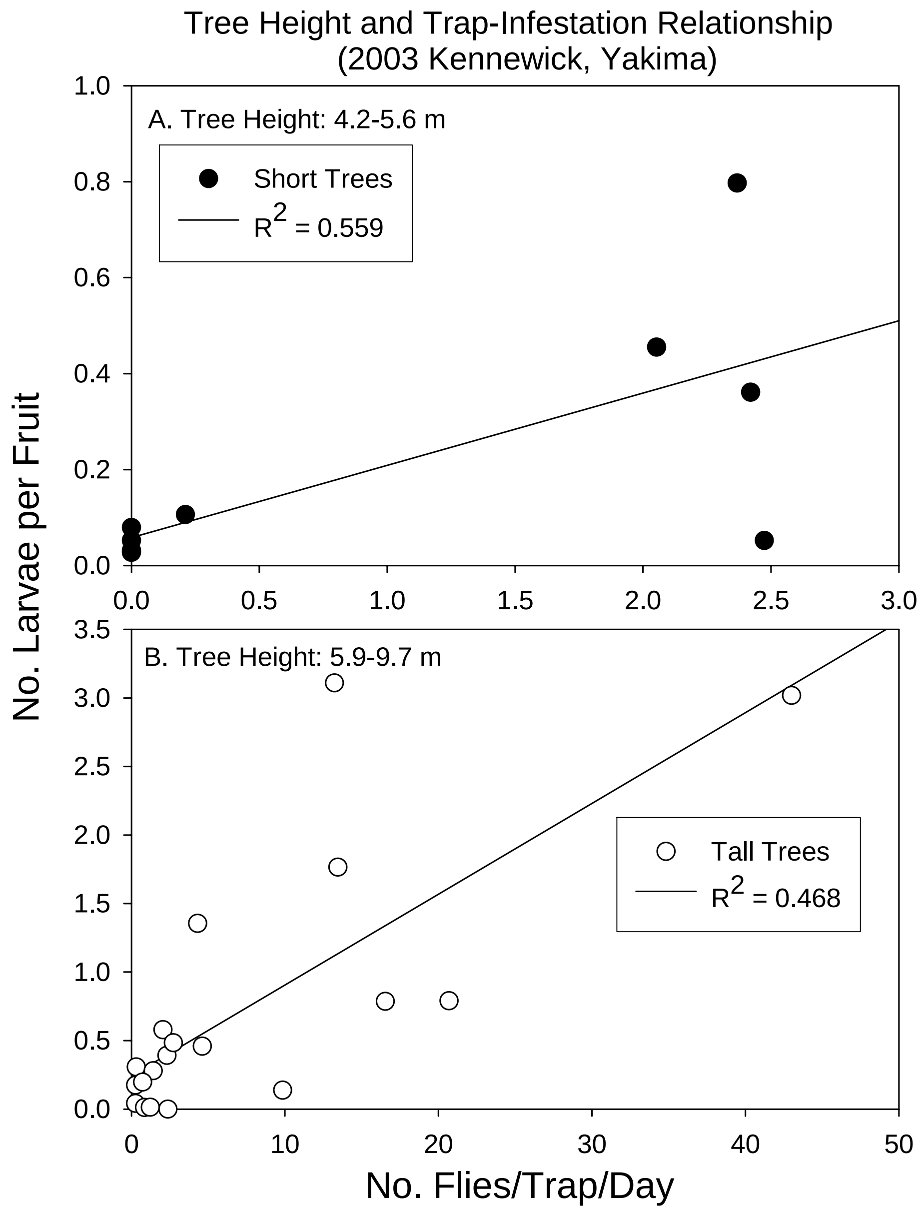

Fig. 5. Relationship between flies caught and infestation of fruit, 2003.

Budget:

Project title: Cherry fruit fly distribution and trapping
PI: Wee Yee
Project duration: 2002-2003
Current year: 2003
Project total (2 years): **$22,660.72**
Current year requested: **$12,660.72**

Year	Year 1 (2002)	**Year 2 (2003)**
Total	10,000	**12,660.72**

Current year breakdown

Item	Year 1(2001)	**Year 2 (2003)**
Salaries	9,000	**11,055.20**[1]
Benefits (%)		
Wages		**1,105.52**
Benefits (%)		
Equipment		
Supplies	1,000	**500**[2]
Travel		
Miscellaneous		
Total	10,000	**12,660.72**

[1]GS-5 ($11.84/h) and GS-3 ($9.42/h), full time, 3 months; [2]Traps