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DISPERSAL OF DYE-MARKED EUROPEAN AND SOUTHWESTERN CORN BORER MOTHS IN AND AROUND AN IRRIGATED CORNFIELD IN SW KANSAS

by

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SUMMARY

This study evaluated dispersal of European corn borer (ECB), *Ostrinia nubilalis* (Hübner), and the southwestern corn borer (SWCB), *Diatraea grandiosella* Dyar. In the year 2001, dye-marked ECB and SWCB pupae were placed near the center of a center-pivot-irrigated cornfield. The moths were allowed to disperse as they emerged and then recaptured with black light and pheromone traps. There were 21 black light traps and 39 pairs of ECB and SWCB pheromone traps installed in transects around the release point across the cornfield. Feral moths of both species were readily captured throughout the Bt cornfield and the 1st flight was much lower than the 2nd flight for both species. The 1st flight peaked at 0.5 male and 0.38 female SWCB per trap and 8.6 male and 13.2 female ECB per trap. The 2nd flight peaked at 78.3 male and 60.1 female SWCB per trap and 183.3 male and 348.0 female ECB per trap. A total of 2337 dye-marked SWCB moths dispersed from the release point. An average of 18% males and 4.3% females were recaptured beyond the release point. SWCB males and females were recaptured all the way out to the traps located 1200 ft from the release point and one male was recaptured outside the release field over the native grasses. A total of 4933, 5258, and 3751 male and 3312, 3962 and 2703 female dye-marked ECB moths dispersed from the release point in June, July and August releases, respectively. An average of 3.6, 2.7 and 10.1 % of the males and 0.3, 0.6 and 4.4 % of the females were recaptured beyond the release point in the three releases. ECB males and females were recaptured all the way out to the 1200 ft traps. Four ECB males were recaptured outside the release field in the neighboring cornfield. No dye-marked ECB moths were recaptured over the native grasses.

INTRODUCTION

The European corn borer (ECB), *Ostrinia nubilalis* (Hübner), and the southwestern corn borer (SWCB), *Diatraea grandiosella* Dyar, are the two important corn borer pests of corn in North America. The ECB occurs throughout the Corn Belt while the SWCB occurs in the southern corn growing regions. Both corn borers cause damage by feeding on leaf and stem tissue of the developing plant causing physiological yield losses and also by causing harvest losses by causing ears or plants to break or drop. Harvest losses can be much more severe for the SWCB than for the ECB because SWCB larvae actually girdle the corn plants at the end of the season, causing most infested plants to fall to the ground. Harvest losses can exceed 70 bu/a for the SWCB.

Bt-corn will help control damage from these pests, but there is concern that the corn borers may develop resistance to Bt-corn. The success of Bt-corn will be short lived if corn borers develop resistance (or virulence) to Bt-corn. The Environmental Protection Agency (EPA) has made implementation of resistance management a condition for registration for Bt-corn. They have mandated the use of the High Dose/ Structured Refuge strategy as a prophylactic Insect Resistance Management (IRM) plan. This plan depends on dispersal of corn borer moths from non-Bt-corn refuge plantings into Bt-cornfields to mate with potential survivors. Insects from the susceptible refuge must be able to disperse into the Bt-corn fields to mate with survivors for the strategy to work (resulting in random mating). It is therefore important to determine how far these insects disperse so that we can determine appropriate refuge planting arrangements.

This study was designed to evaluate dispersal of European and southwestern corn borers by releasing

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marked moths and then trapping for recapture at various distances from the release point.

PROCEDURES

This study was undertaken in a 120-acre center-pivot-irrigated cornfield located 18 miles southwest of Garden City, Kansas (N37, E101). It was located in the "sand hills" south of town, where the corners beyond the reach of the center pivot sprinklers remained in native grass. The surrounding fields were wheat, potato, alfalfa, corn and native grass pasture. The study field had been in winter wheat that had been grazed out in spring and it was replanted to a YieldGard™ Bt-corn hybrid on 25 April 2001. The Bt-cornfield was chosen as the study field to reduce the number of corn borers coming to the traps and to insure that corn borers that were captured had to come from neighboring fields. The study field was not sprayed for corn borers or any other insect.

Southwestern corn borers were reared in the laboratory on SWCB diet containing Sudan Red 7B to dye the insects. Pupae were placed in the field starting the 4th week of May and releases continued until the 4th week of August. Dye-marked ECB were reared in Ames, Iowa and shipped to Garden City. There were three shipments in 2001, 17 June, 11 July and 5 August. Dye-marked ECB and SWCB pupae were taken to the release point near the center of the study field and placed in 19-liter plastic buckets. A wet sponge was added to each bucket to maintain humidity. Each bucket was covered with a sheet of corrugated steel to protect pupae from rain and irrigation. The corrugated lid allowed moths to disperse as they eclosed.

There were 21 black light traps (15 W) used to trap ECB and SWCB males and females. There were 21 to 39 Hartstack wire cone traps with ECB pheromone lures used to trap ECB males. There were 21 to 39 SWCB plastic bucket traps with pheromone lures in used to trap SWCB males. The black light traps were installed in east-west and the north-south transects across the field (Fig. 1). The pheromone traps were installed in proximity to each light trap and along two diagonal transects in the corn (Fig. 1). A light trap and a set of pheromone traps for each corn borer species were installed at the release point. Six pairs of pheromone traps were installed outside the center pivot, four in the native grass corners of the field and two in the nearest irrigated cornfield located southeast of the release field. The traps were monitored daily from the 4th week of May through the 4th week of August. Captured moths were counted, examined for presence of dye, and placed in plastic bags to be taken to the laboratory where they were refrigerated. Females were examined for the presence of a spermatophore to determine if they were mated.

RESULTS AND DISCUSSION

Feral moths of both species were readily captured throughout the Bt cornfield. As usual, the 1st SWCB flight was much lower than the 2nd flight (Fig. 2). The 1st flight peaked the 2nd and 3rd weeks of June at 0.5 males and 0.38 females per trap. The 2nd flight peaked the 2nd week of August at 78.3 males and 60.1 females per trap. The 1st ECB flight was also much lower than the 2nd flight (Fig. 3). The 1st flight peaked the 2nd week of June at 8.6 males and 13.2 females per trap. The 2nd flight peaked the 4th week of July at 183.3 males and 348.0 females per trap.

A total of 2337 dye-marked SWCB moths dispersed from the release point, 1292 male and 1045 female. Most of the SWCB moths were released in late July and August when the corn was in the reproductive stage (Fig. 4). Twenty seven percent of the males and 8.6% of the females were recaptured at the release point. Excluding those captured at the release point, 18% of the males and 4.3% of the females were recaptured beyond the release point. The recapture rate for SWCB males was similar for July and August releases, but the recapture rate for females appeared to be lower in the August releases (Fig. 5). Unfortunately, only a small number of moths were released or recaptured during the pre-reproductive stage.

There were a total of 4933, 5258, and 3751 male and 3312, 3962 and 2703 female dye-marked ECB moths dispersed from the release point in the June, July and August releases, respectively. At the release point, 2.7, 0.9, and 5.9% of the males and 0.5, 0.6, and 6.1% of the females were recaptured in the June, July, and August releases, respectively. Excluding moths captured at the release point, 3.6, 2.7, and 10.1% of the males and 0.3, 0.6, and 4.4% of the females were recaptured beyond the release point. The recapture rate for ECB males and females appeared to be higher in the August release than in earlier releases (Fig. 5). Male and female ECB recaptures at the release point peaked 5 and 7 days after the August release. The number of male and female ECB recaptured away from the release point peaked 3 days after the peak at the release point. Male recapture at the 350 and 1200 ft traps peaked 4 days after the peak at the release point. Female recapture at 350 and 1200 ft was not high enough to give a clear pattern.

Fig. 1. Trap layout in a center pivot circle of corn to study corn borer dispersal, 2001.

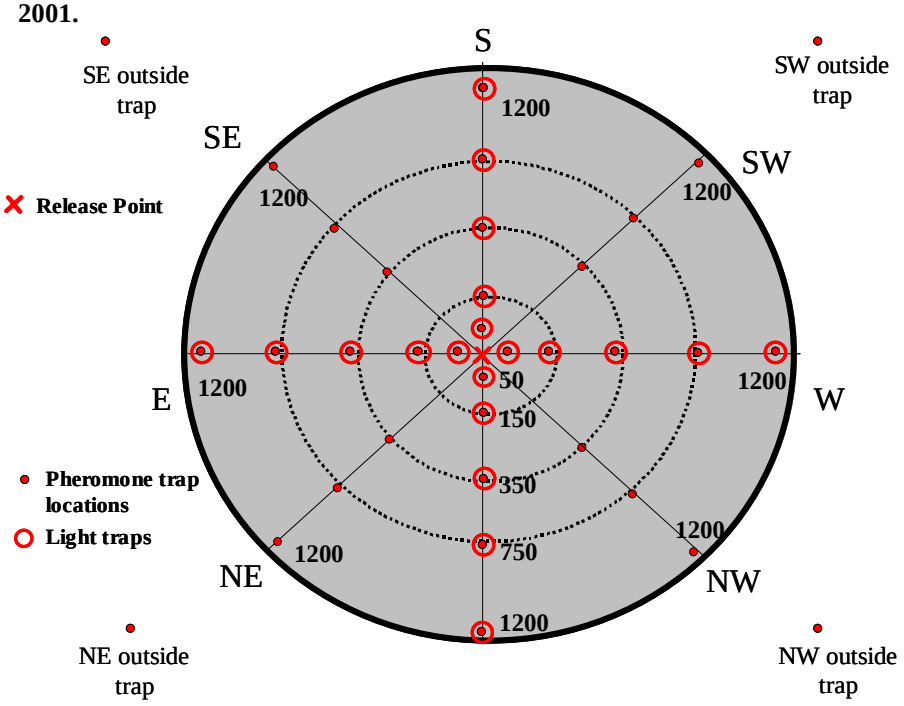
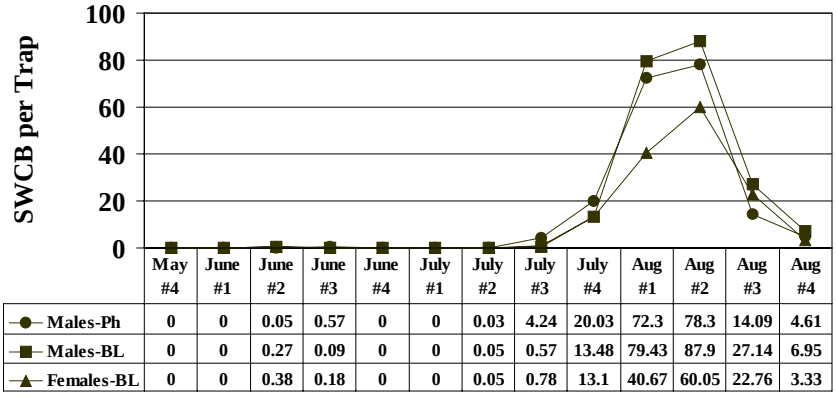


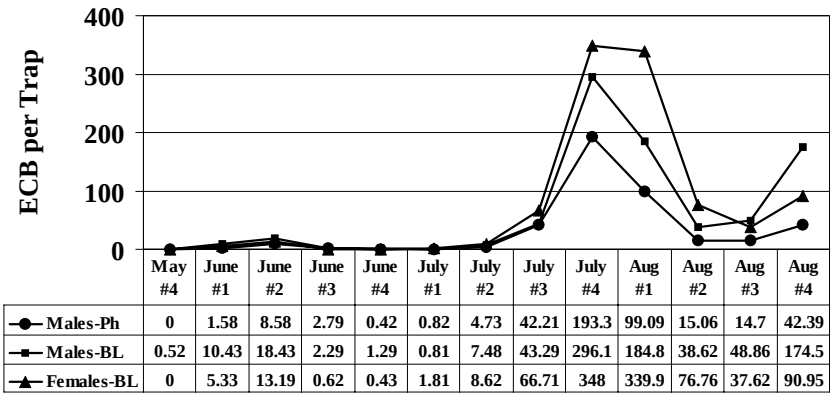
Fig. 2. Feral SWCB moths that flew into the Bt corn field from surrounding fields.



	May #4	June #1	June #2	June #3	June #4	July #1	July #2	July #3	July #4	Aug #1	Aug #2	Aug #3	Aug #4
Males-Ph	0	0	0.05	0.57	0	0	0.03	4.24	20.03	72.3	78.3	14.09	4.61
Males-BL	0	0	0.27	0.09	0	0	0.05	0.57	13.48	79.43	87.9	27.14	6.95
Females-BL	0	0	0.38	0.18	0	0	0.05	0.78	13.1	40.67	60.05	22.76	3.33

Weeks of Growing Season

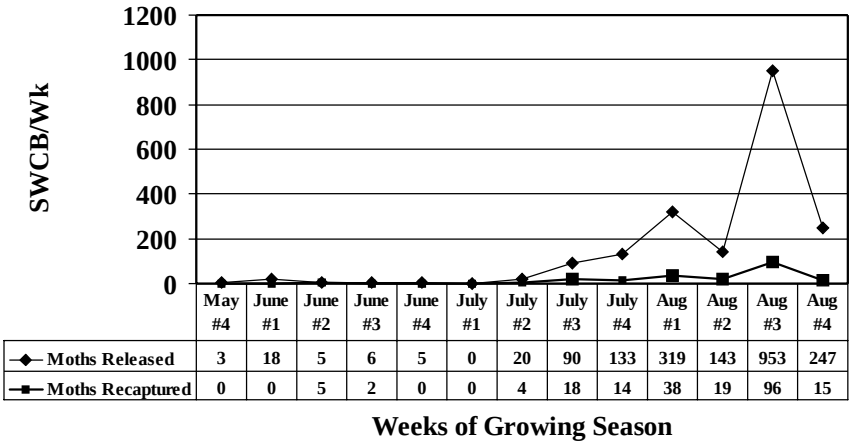
Fig. 3. Feral ECB moths that flew into the Bt corn field from surrounding fields.



	May #4	June #1	June #2	June #3	June #4	July #1	July #2	July #3	July #4	Aug #1	Aug #2	Aug #3	Aug #4
Males-Ph	0	1.58	8.58	2.79	0.42	0.82	4.73	42.21	193.3	99.09	15.06	14.7	42.39
Males-BL	0.52	10.43	18.43	2.29	1.29	0.81	7.48	43.29	296.1	184.8	38.62	48.86	174.5
Females-BL	0	5.33	13.19	0.62	0.43	1.81	8.62	66.71	348	339.9	76.76	37.62	90.95

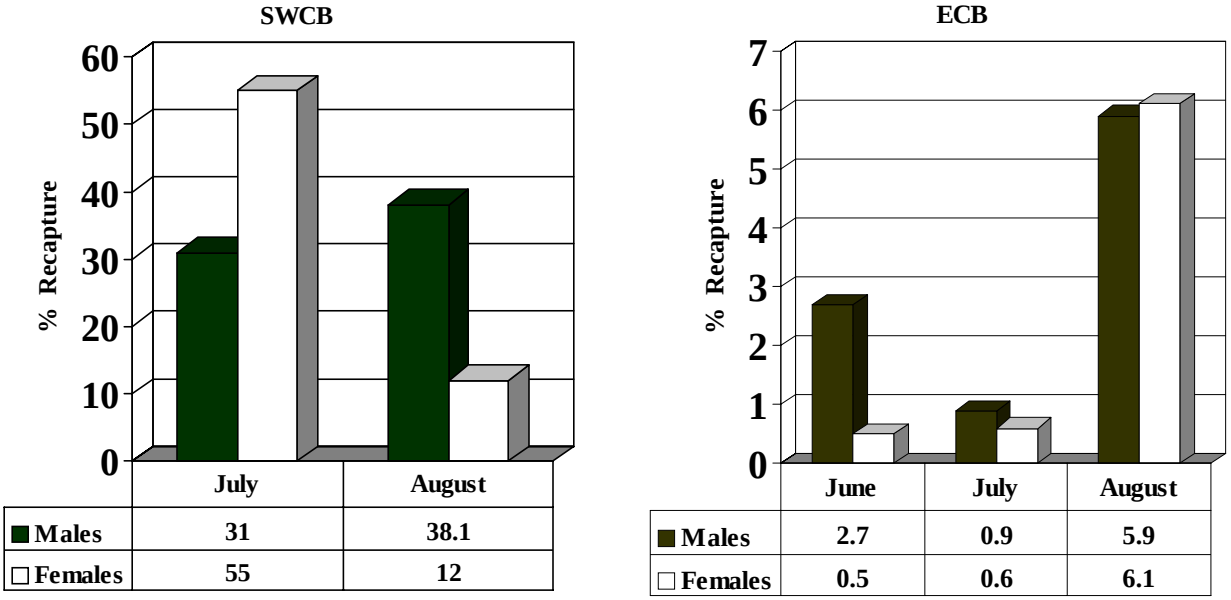
Weeks of Growing Season

Fig. 4. Dispersal and recapture of SWCB moths at the release point.



	May #4	June #1	June #2	June #3	June #4	July #1	July #2	July #3	July #4	Aug #1	Aug #2	Aug #3	Aug #4
Moths Released	3	18	5	6	5	0	20	90	133	319	143	953	247
Moths Recaptured	0	0	5	2	0	0	4	18	14	38	19	96	15

Fig. 5. Corn borer recapture relative to stage of corn development.



	July	August
Males	31	38.1
Females	55	12

	June	July	August
Males	2.7	0.9	5.9
Females	0.5	0.6	6.1

SWCB males were recaptured all the way out to the 1200 ft traps in pre-reproductive corn, but only a few females were released during this period so no conclusions can be made on females (Fig. 6). In post-reproductive corn, SWCB males and females were recaptured all the way out to the 1200 ft traps, and one male was recaptured outside the field. No dye-marked SWCB moths were recaptured in the next cornfield. In post-reproductive corn, the traps to the west and south of the release point appeared to recapture a few more moths than the other traps, but the trend was not very pronounced. There appeared to be a trend that more moths were captured in the pheromone traps that were near light traps than in traps that were separate from the light traps.

ECB males and females were recaptured all the way out to the 1200 ft traps in all three releases (Fig. 7-8). In post-reproductive corn, four ECB males were recaptured in the next field. No dye-marked ECB moths were recaptured over the native grasses. There were no clear trends in the recaptures of male or female ECB in the different directions from the release point.

The black light traps captured more ECB and SWCB males than the pheromone traps (Fig. 9). This was surprising because the SWCB pheromone lure is very effective and it usually captures more males than the black light trap.

Fig. 6. Recapture of SWCB at different distances away from the release point.

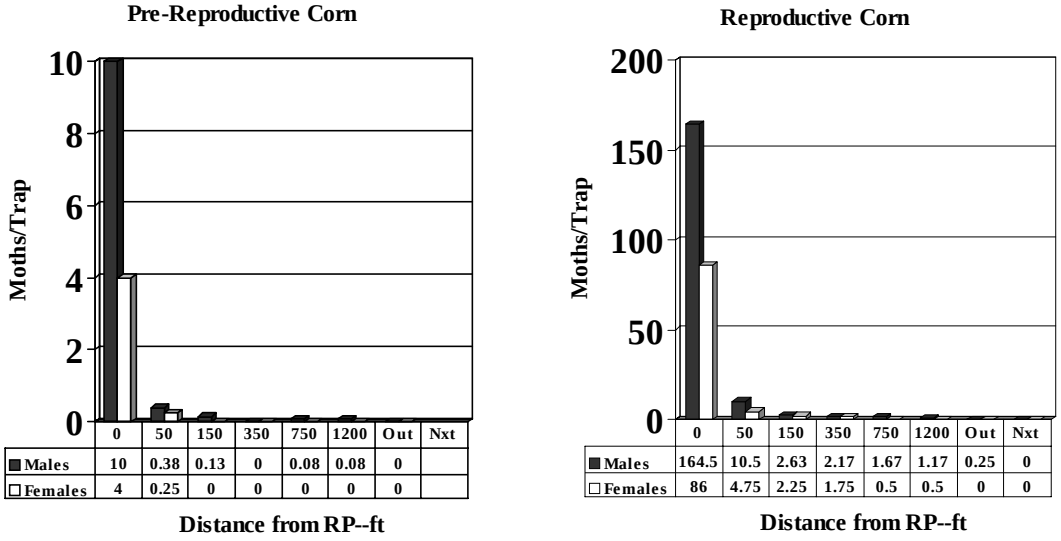


Fig. 7. Recapture of ECB at different distances away from the release point.

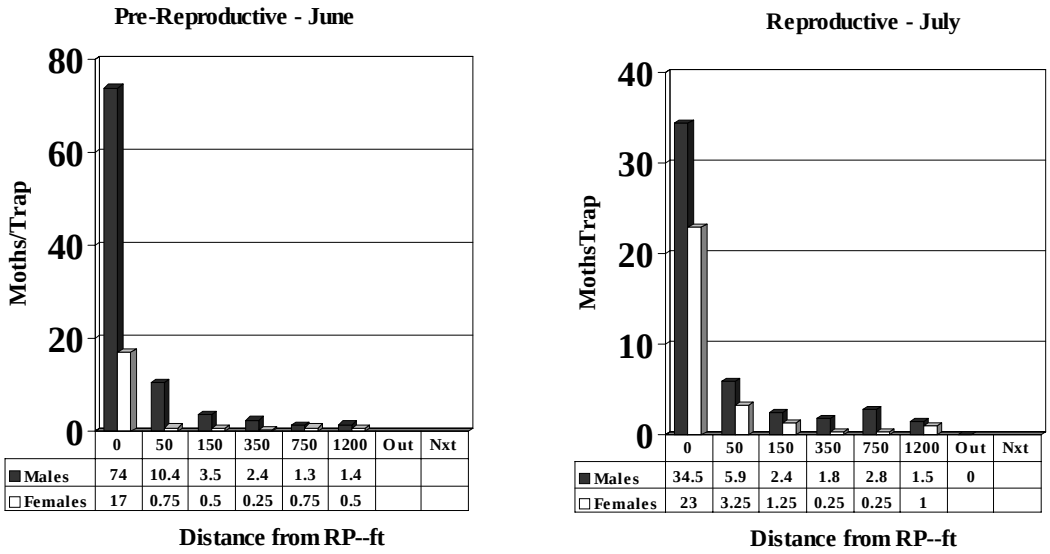


Fig. 8. Recapture of ECB at different distances away from the release point.

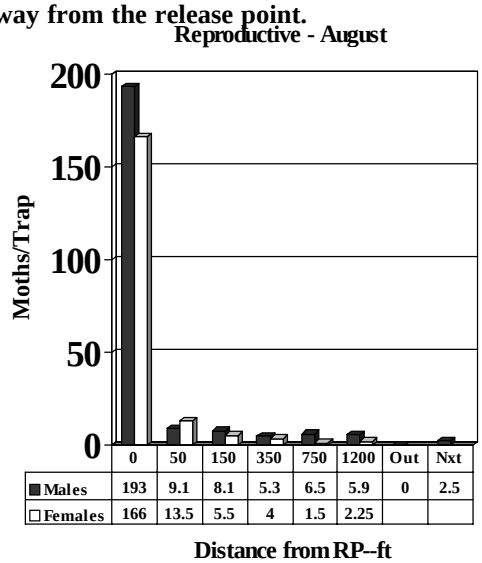
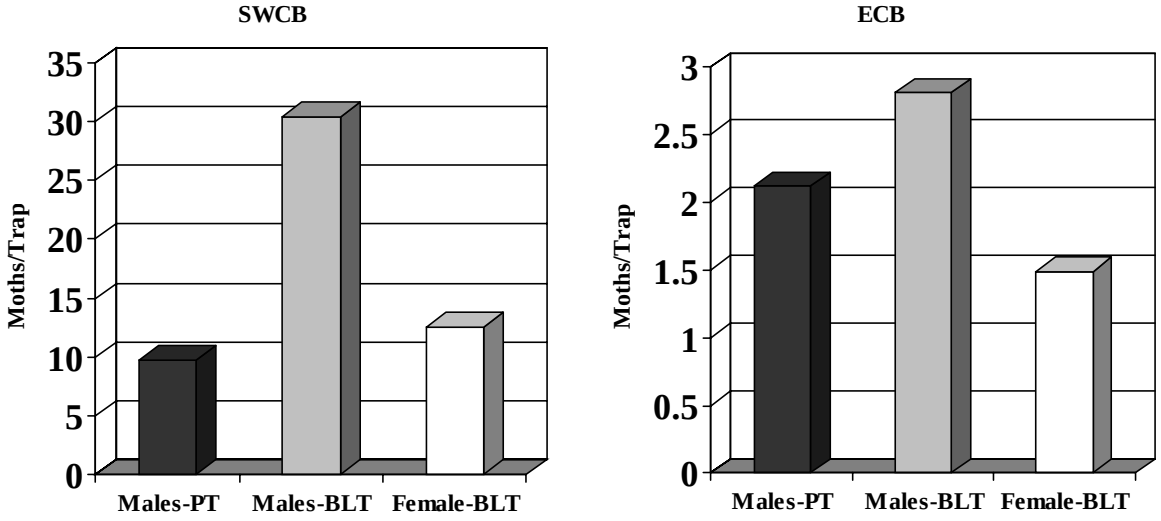


Fig. 9. Relative corn borer recapture at pheromone and black light traps.



Hartstack wire trap (left) used to capture ECB using ECB pheromone lure. Plastic bucket trap (right) used to capture SWCB using SWCB pheromone lure.

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