FIELD STUDIES ON THE REPRODUCTIVE DEVELOPMENT OF THE CABBAGE SEEDPOD WEEVIL

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INTRODUCTION

Several insects associated with winter rapeseed have been identified as key or potentially significant pests in North America because of the economic losses they impart (Lamb 1989, McCaffrey 1990, Turnock 1990,). By far, the most important insect pest of winter rapeseed in the established production regions of the U.S. is the cabbage seedpod weevil, Ceutorhynchus assimilis Paykull. This introduced insect was first collected in the U.S. from the state of Washington in 1936 (Baker 1936). It is an oligophagous insect that feeds and develops on plants of the genera Brassica and Raphanus. Yield reductions of the winter rapeseed cultivar 'Dwarf Essex' in the Palouse region of northern Idaho can exceed 30% in untreated fields. Current control strategies for C. assimilis in the Pacific Northwest are based primarily on the proper use of a single insecticide, parathion (McCaffrey et al. 1986). Endosulfan is registered, but it is not very effective and it is much more expensive (McCaffrey et al. 1986). All insecticide treatments are prophylactic since no control decision guidelines (economic thresholds) exist. If winter rapeseed production expands as anticipated, particularly in the Pacific Northwest and Southeast U.S., considerable amounts of parathion would be sprayed every year. This could lead to serious non-target impacts as well as the development of parathion resistance by the treated C. assimilis populations. Furthermore, parathion is currently under review by the U.S. Environmental Protection Agency under the provisions of FIFRA 1988 and its future availability is questionable.

A detailed understanding of the biology, ecology and behavior of this introduced pest is prerequisite to the most efficient use of insecticides and the development of an integrated pest management program. It is especially important to understand C. assimilis-host plant interactions and the effects of environmental factors such as temperature on the insect's life cycle.

Reproductively immature female weevils overwinter in the duff and soil in protected areas near or adjacent to rapeseed fields. As spring temperatures warm, weevils migrate to flowering rape plants where they feed. While its known that C. assimilis must feed on rape or other cruciferous plants in order to develop their ovaries (Heymons 1922, Bonnemaison 1957, Dmoch 1965b, Free &

Williams 1978, Ni et al. 1990), the phenology of reproductive development in the field has not been determined for North American populations of this insect.

MATERIALS AND METHODS

The seasonal phenology of the reproductive development of female C. assimilis was monitored during 1988 from four fields located in Latah Co., Idaho by periodically sweeping weevils from fields using a 38 cm diam. sweepnet. Samples were taken at the field border and 10 m and 20 m into the field. Female weevils were dissected and their reproductive developmental stage was scored on the 1-3 scale described above. Yellow sticky traps consisting of five #10 cans (15.5 cm diam. by 17.5 cm ht.) mounted on a 4.5 cm by 10.2 cm wooden post (1.8 m tall from ground level) at about 33 cm intervals starting at 30 cm from the ground were also monitored to assess the seasonal flight phenology of the weevils.

RESULTS

Seasonal sticky-trap and sweepnet weevil counts are summarized in Figs. 1-2. Total sweepnet weevil counts and stage-3 (oocytes present) females peaked between May 26 and June 2 at the Anderson, Blaine and Viola field sites (Figs. 1A-B, 2A). Sweepnet weevil counts peaked a week earlier, May 19, at the Lenville site while stage-3 female counts were fairly consistent from May 19 until June 9 (Fig. 2B). The peak sweepnet counts generally corresponded to the full bloom period of crop development. Some stage-3 females were found at all sites during late April, but their numbers were generally very low.

Sticky trap counts reflect seasonal flight activity. Most flight activity took place after May 13 with three peak flight periods occurring on May 13, May 26 or June 2, and finally June 16. Low temperatures most likely depressed flight activity during the period before May 19 and June 9.

DISCUSSION

Both Kirchner (1961) and Dmoch (1965b) found that approximately 14 d of supplemental feeding by female C. assimilis was required for egg laying to occur, but as Dmoch (1965b) noted, the period from the moment at which the weevils emerge in the field until the time they begin egg laying is different in different years, depending on the daily mean temperatures. Current C. assimilis control guidelines in the Pacific Northwest region of the U.S. recommend a single application of parathion after full bloom when approximately 10-25% bloom is left on the crop (McCaffrey et al. 1986). Because female weevils are reproductively mature during the period between full bloom and the time of spray application, some eggs may be laid and some larvae may hatch. If parathion is applied as noted above and when the temperatures are above 21° C, we can expect effective control of adults as well as the eggs and young larvae due to the fuming action of the insecticide. However, temperatures during the late bloom period can remain low for extended periods of time and farmers become quite anxious if they are not able to spray because of low temperatures even if there is little oviposition and development. Consequently, some paration sprays are applied when temperatures are too cool resulting in poor C. assimilis control. As noted earlier, parathion is currently being reviewed by the U.S. Environmental Protection Agency and may be banned for use in the near future. The only alternative insecticide, endosulfan, is primarily effective against the adults and also has limited efficacy at cool temperatures. It's effective and economical use will also depend upon properly timed sprays. Degree-day models predicting ovariole development and oviposition would provide the capability of field by field or area-wide forecasting of the reproductive status and activity of the weevils. Recent studies by Ni et al. (1990) have started to address these needs. They found that the lower base temperature for oogenesis was about 10 °C with optimum development occurring between 15 and 20 °C. Their findings support those of Bonnemaison (1957) who estimated that the base temperature and optimum temperatures for ovariole development were 9 and 22° C, respectively. Much work remains to further develop decision support tools that will allow the development of more accurate and precise control action guidelines for C. assimilis.

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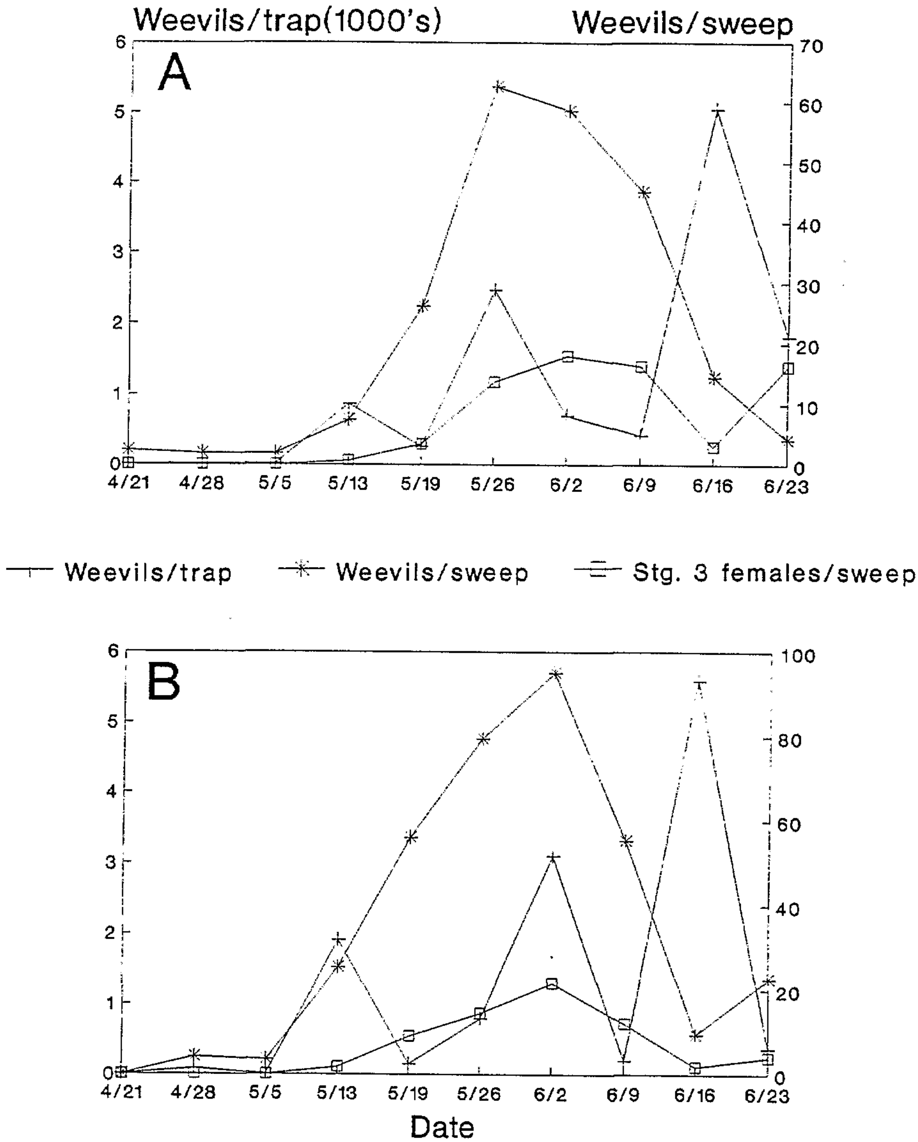

Fig. 1. Seasonal flight and reproductive phenology of C. assimilis at (A) Anderson and (B) Blaine field sites, 1988.

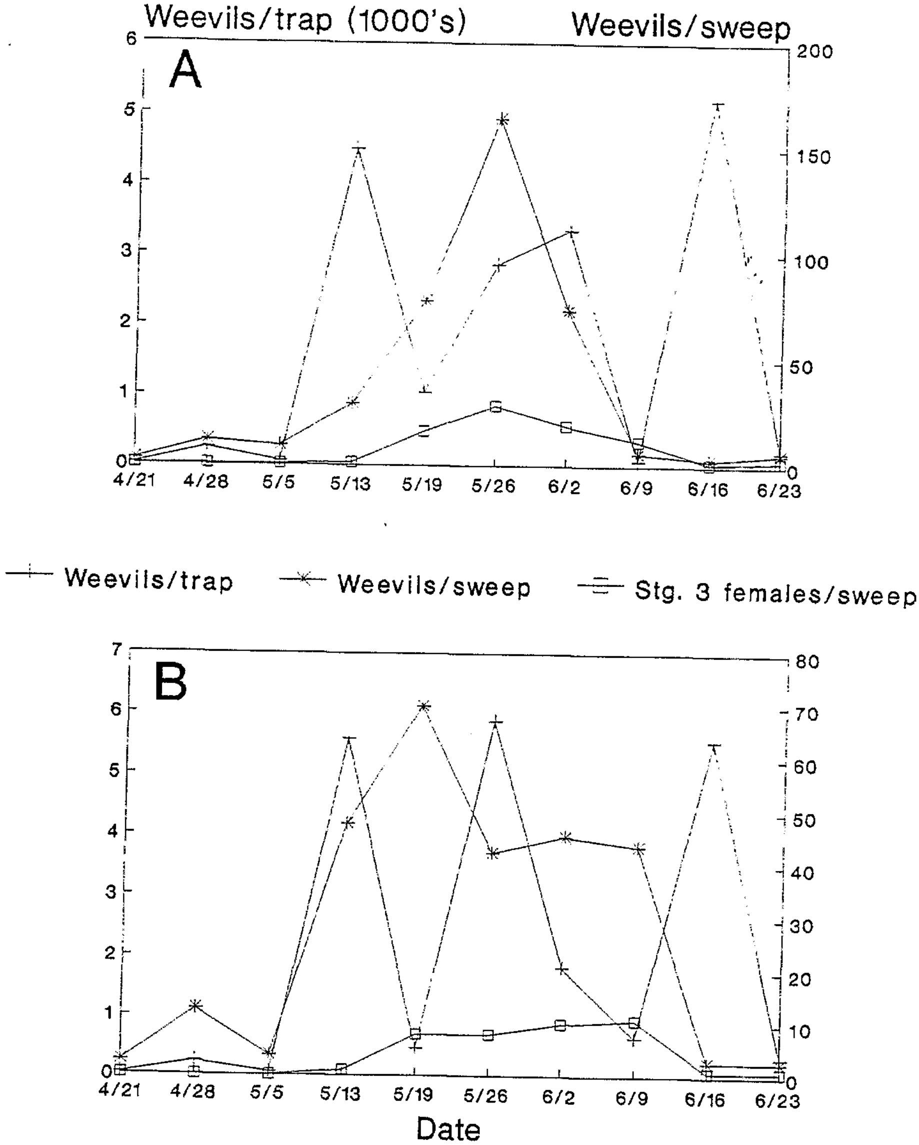

Fig. 2. Seasonal flight and reproductive phenology of C. assimilis at (A) Viola and (B) Lenville field sites, 1988.