Review of 2008 Studies on Integrated Pest Management Strategies to Reduce Damage from the Sunflower Seed Maggot

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Introduction

The sunflower seed maggot, *Neotephritis finalis* (Loew), is an emerging pest of cultivated sunflower throughout the Great Plains sunflower production region. It is a seed-feeding pest and infests the sunflower plant from late bud stage through the flowering (Arthur and Campbell 1979). There are two complete generations of this insect in North Dakota. Adults of first generation emerge during the first week of July and second generation in the end of the August. During the day, adult maggots occur on sunflower heads either resting or mating and mated females lay their eggs in the developing sunflower heads. Larvae of the second generation fall to the ground overwinter as puparia (Arthur and Campbell 1979).

Crop injury is caused by feeding of the larval stages. After hatching, first instar larvae start to feed on developing seeds. The magnitude of damage to sunflower seeds by sunflower seed maggot larvae is largely dependent on the density of larva and stage of crop development. One larva can cause seed sterility by feeding on 10 or 12 young florets Mature larvae feeding on older sunflower heads will destroy one to three seeds. Injury to sunflower can result in a deformed head caused by a creasing and folding toward the center of the head (Arthur and Campbell 1979).

Effective pest management strategies are needed because of the increasing impact of sunflower seed maggot in commercial sunflower fields in the northern Great Plains. However, the exact extent of damage and economic loss from sunflower seed maggot in North Dakota is not known. In this study, we investigated the economic threshold and impact of planting date on the sunflower seed maggot and evaluated the timing and efficacy of selected insecticides for the management of sunflower seed maggot damage.

Materials and Methods

Economic Threshold

Field studies were carried out at the NDSU Agricultural Research Farm at Prosper, ND. A 30m x 30m plot was planted with Advanta-Pacific 6111 oil seed sunflower seeds treated with Apron fungicide on 15 May 2008. Sunflower heads with seed maggot damage were rated on a scale from 0-4 (0= no damage, 4= severe damage) (see the attached paper). Twenty heads from each damage rating were randomly harvested and brought into the laboratory for analysis. Heads were dried, threshed individually and healthy and sterile seeds separated. Before threshing, the diameter of each sunflower head was measured at two locations. Finally, the weight (g) of the healthy and sterile seeds was measured using an electronic balance.

Impact of Planting Date on Sunflower Seed Maggot Damage

Trials were also conducted at the NDSU Agricultural Research Farm at, Prosper, ND. Advanta-Pacific 6111 oil seed sunflower treated with Apron fungicide was seeded on two planting dates: 15 May 2008 (early planting date) and 18 June 2008 (late planting date) using randomized complete block design with four replicates. After the physiological maturity ten heads from each replicate were harvested randomly, dried,

threshed individually and healthy and sterile seeds separated. Before threshing, the diameter of each sunflower head was measured at two locations. Finally, the weight (g) of the healthy and sterile seeds was measured using an electronic balance.

Evaluate the Efficacy and Application Timing of Insecticides

Insecticide timing studies were carried out in a separate study plot at the NDSU Agricultural Research Farm in Prosper, ND. Seeds of oilseed hybrid Advanta-Pacific 6111 treated with Apron fungicide were planted on 15 May 2008, using randomized complete block design with four replicates. Treatments included foliar applications of Asana XL (esfenvalerate) insecticide applied at the R1, R3, and R5.1 sunflower stage and Cruiser Seed Treatment (ST) (thiamethoxam) alone and Cruiser ST + Asana XL applied at R5.1 stage. Asana XL was applied at 5.5fl oz/ac using a handheld boom and backpack CO_2 sprayer. After physiological maturity, ten heads from each treatment were harvested randomly and brought back into the laboratory. Heads were dried and then threshed by hand. The healthy and sterile seeds were separated. Before threshing, two diameters of the each sunflower head were measured. Finally, the weight (g) of the healthy and sterile seeds was measured using an electronic balance and graduated cylinder, respectively.

Statistical Analysis

Data were analyzed using SAS 9.1.3 software. Since the number of seeds has a linear relationship with the average diameter of the head, ANCOVA was performed using average diameter as covariate. Significantly different means were separated using least significant difference (LSD) ($P<0.05$).

Results and Discussion

Impact and Economic Threshold

There was no significant difference between the injury ratings based on the weight of healthy seeds (Treatment effect $F_{4,90} = 0.75$, P=0.56, treatment x average diameter $F_{4,90}= 0.50$, P= 0.73) (Fig.1). The lack of significant differences may be due to the low population densities of sunflower seed maggots at Prosper in 2008.

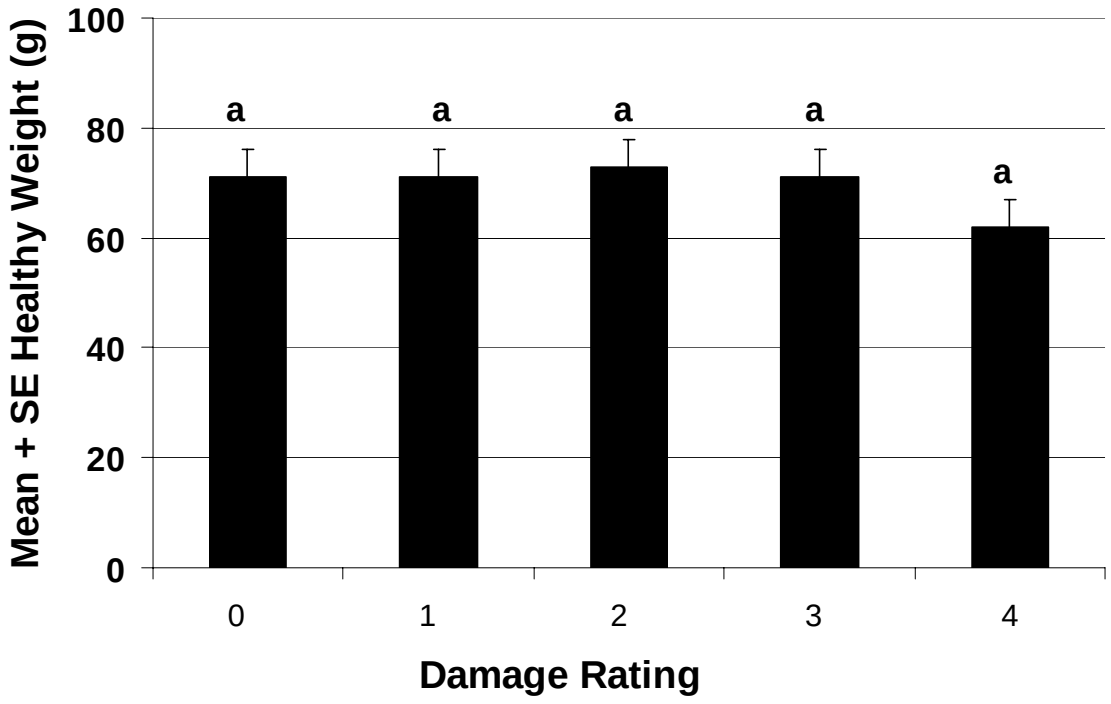

Figure 1. Healthy seed weight (g) for sunflower heads at five different damage ratings, Prosper, ND, 2008.

Impact of Planting Date on Sunflower Seed Maggot Damage

Planting date studies with other sunflower pests, such as banded sunflower moth, sunflower stem weevil, sunflower moth, sunflower midge, and sunflower beetle have demonstrated that delayed planting is effective in reducing damage (Osteo et al. 1982,

1987, 1989, Charlet, 1998, Charlet et al. 1999). However, comparison of healthy seed weight from the two planting dates did not show any significant difference ($F_{1,51}$=3.91, P= 0.053) (Figure 2).

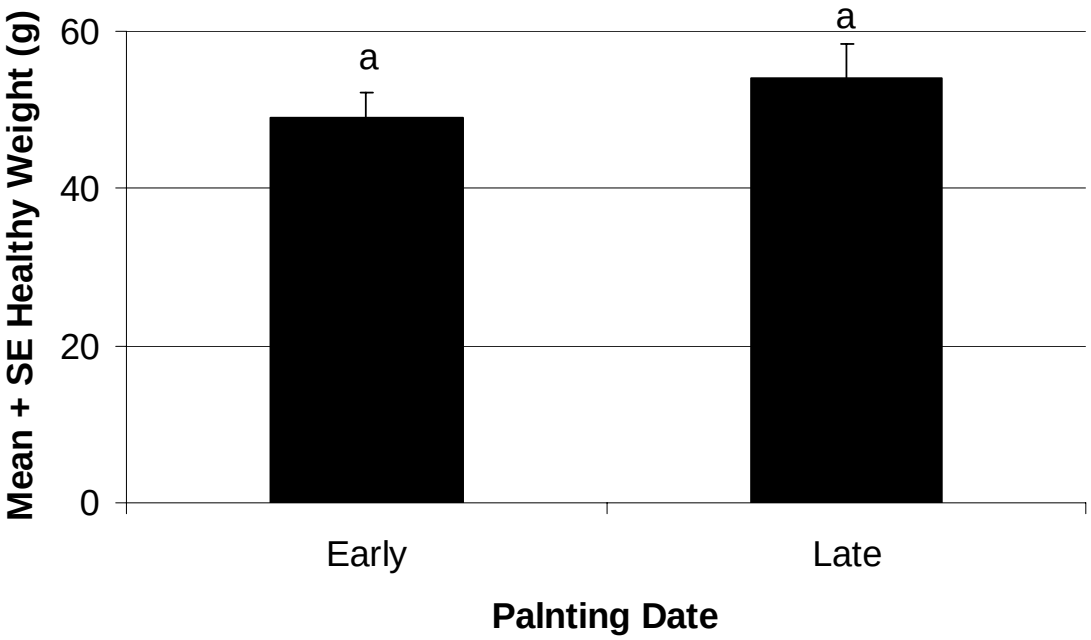

Figure 2: Healthy seed weight (g) for sunflower heads per head from two different planting dates at Prosper, ND 2008.

Evaluate the Efficacy and Application Timing of Insecticides

Results from the evaluation of insecticides and timing of spraying showed a significant impact on the yield among treatments. Based on current study, treatment with Asana XL at the R5.1 stage resulted in a higher weight of healthy seeds than the untreated check (Treatment effect $F_{5,188}$=3.84, P=0.0024, Treatment x Average diameter $F_{5,188}$=0.19, P= 0.96) (Figure 3). These findings are similar to the investigations of insecticide timing for other sunflower pests like the sunflower seed weevil (Osteo and Burr 1990).

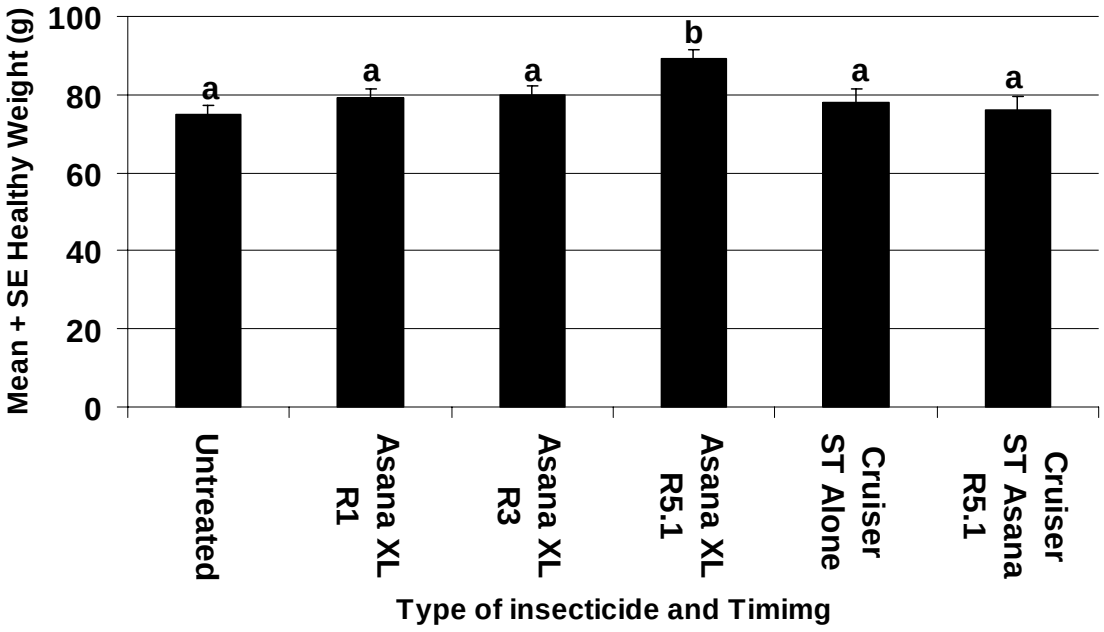

Figure 3: Healthy seed weight (g) for sunflower heads from sunflower treated with five different insecticides timing

Preliminary results indicate that insecticide spraying can be targeted at the adult maggot to prevent egg laying and larvae reduce larval damage. Although insecticides applied to sunflower at the bud stage will likely kill adult maggots, treatments at that stage, as indicated by this study may not be economical or effective, because of the extended adult maggot emergence period, long pre-oviposition period (20 days), and lack of economic populations.

Little information is available on the biology and pest management of sunflower seed maggot in sunflower growing areas in the United States. This was the first detailed study on the development of management strategy for this potential pest. Research will continue in 2009 with improved methodology to detect differences in treatments.

Experiments in 2009 will be conducted at additional locations in North Dakota including Prosper, Carrington, Langdon, and Minot. The damage rating scale will be

extended from four to eight levels. The length of the crease in damaged head also will be measured and correlated with the weight of the healthy seeds. The size of each plot in the planting date and the insecticide timing trials will be increased from four to eight rows and the number of heads collected will be increased to strengthen the accuracy of data.

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