

SEASONAL FLUCTUATIONS IN THE BENEFICIAL ARTHROPOD COMPLEX ASSOCIATED WITH CONVENTIONAL TILLED AND ZONE TILLED SUGAR BEETS

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ABSTRACT

Introduction: The species composition and relative abundance of the natural enemy complex encountered in conventional tilled and reduced tilled sugar beets have not been investigated to any great extent for the sugar beet production regions of western Nebraska. Variations in the abundance and species composition of these beneficial organisms throughout the season, both within a particular tillage system and between different tillage practices, could potentially lead to differences in the degree of ecosystem services rendered. This ongoing study aims at determining the beneficial arthropod complex and their relative abundance over the growing season in conventional tilled and zone tilled sugar beets in western Nebraska. It also aims at measuring the degree of ecosystem services rendered by arthropods in these two tillage regimes, as it relates to weed seed-removal and prey-removal. *Methodology:* Pitfall traps were used to monitor the activity-density of soil-dwelling predatory arthropods in conventional till and zone till sugar beets, starting in 2012. Each cultivation type was replicated five times, with six pitfall traps installed per plot. The traps were activated for a total of six times during the season and left open for five consecutive days. To determine the rate of weed seed-removal, four weed species were selected, namely two grasses (Yellow foxtail and Barnyardgrass) and two broad-leaf weeds (Common lambsquarters and Kochia). Seeds of these weed species were attached to petri-dishes by means of double-sided tape and placed into vertebrate exclusion cages in the field. Four petri dishes were included in each cage, each petri dish containing the seeds of a single weed species. Three cages were placed in each plot along with a control cage. The seeds were left in the field for ten consecutive days. Concomitant to the weed seed-removal study, a prey-removal study using waxworms (*Galleria mellonella*) as surrogate prey was also carried out. Larvae were pinned to a clay base and three larvae were placed in each exclusion cage. Two sampling periods were selected, namely a day sampling period (07:00 am - 18:00 pm) and a night sampling period (19:00 pm – 06:00 am). *Results & Discussion:* Results from the pitfall trapping showed that ground beetles (Coleoptera: Carabidae) were the most abundant beneficial taxa collected throughout the season in both tillage types ($n = 2,043$ individuals in the conventional tilled sugar beets and $n = 1,674$ individuals in the zone tilled sugar beets). Other abundant beneficial taxa included centipedes (Class: Chilopoda), staphylinid beetles (Coleoptera: Staphylinidae), and spiders (Order: Araneae). Overall, ground beetles did not show a preference for any particular tillage practice ($F=0.63$, $P=0.45$) which could be a function of their higher mobility, permitting free movement between plots subjected to different cultivation regimes. However, their abundance changed significantly throughout the season ($F=72.59$, $P<.0001$), rising steadily into mid-August and then dropping abruptly towards the last sampling date in September. Ground beetle species diversity was highest at the beginning of the season in both tillage practices with a total of $n = 20$ observed species in the conventional tilled plots, and $n = 23$ species in the zone tilled plots on the second sampling date (08 June). Species composition differed most between

the two tillage practices early in the season (Sorensen quantitative index = 0.59 on 24 May) and became progressively similar as the season progressed (Sorensen quantitative index = 0.87 on 11 September). Very few ground beetle species dominated the total number of individuals caught, most notably *Harpalus erraticus* and *Elaphropus anceps* (collectively accounting for 58% of the total number of individuals caught in the zone tilled plots and 74% of the total number caught in the conventional tilled plots). Functionally, both tillage type ($F=12.59$, $P=0.0015$) and weed species ($F=8.62$, $P<.0001$) had an effect on the probability of seeds being removed. The probability of weed seeds being removed was higher in the zone tilled plots for all weed species (odds ratio=6.41), with lambsquarters having the lowest probability of being fed upon. In contrast, the probability of prey-removal was not influenced by the tillage practice followed ($F=0.01$, $P=0.92$), but the sampling period (day or night) had a significant impact on the probability of prey removal ($F=47.74$, $P<0.0001$), with night predation being higher. *Conclusions:* Our results suggest that ground beetles may be the dominant beneficial arthropods in sugar beets based on the methods used in this study. Changes in ground beetle species seasonality both within and between different tillage practices might influence the degree of ecosystem services rendered. Higher weed seed-removal in zone tilled sugar beets indicates a role for a more integrated approach to weed management in reduced tillage systems. Greater nocturnal predation might indicate that beneficial arthropods temporally may avoid some field operations.