Effect of Various Agronomic Practices on Arthropod Ground Predators in a Soybean-Wheat Double-cropping System

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INTRODUCTION

Double-cropping of wheat *(Triticum aestivum* spp.) and soybeans *(Glycine max* L.) in Louisiana has increased significantly in recent years. Double-cropping enables producers to derive additional income from more intensive land use. As cropping systems change, the effects of these changes on pest and beneficial arthropod populations must be examined. Arthropod ground predators that may be significantly affected by changes in agronomic practices and cropping systems represent an important component of the soybean agroecosystem. Buschman et al. (1984) examined the effects of planting date, row spacing and maturity group on several foliar-inhabiting soybean arthropod populations. Predator populations were found to be only mildly influenced by the three cultural practices. Ferguson at al. (1984a) examined foliar-inhabiting predators in four soybean cropping systems (full season, conventionally plowed; drill planted; no-till, double-cropped soybeans after barley; and no-till, double-cropped soybeans after wheat) and concluded that at least three factors (planting date, row spacing and the presence of previous crop stubble) may contribute to the enhancement of the natural predator complex found in the narrow-row and no-till cropping systems. Ferguson et al. (1984b) also examined both foliar-inhabiting and ground-dwelling spiders in four soybean cropping systems and found that ground-dwelling spiders were more numerous in barley-soybean and wheat-soybean double-cropping systems than in drilled or conventionally planted soybeans not double-cropped. McPherson et al. (1982) examined the seasonal incidence of a number of foliar-inhabiting predator species in conventionally seeded, drill-seeded and double-cropped soybeans and concluded that cropping system significantly influenced the abundance of predatory species. In Louisiana, Troxclair and Boethel (1984) examined insect populations for two years by sweepnet in conventionally tilled and no-till soybeans in both narrow and wide row spacings. The only species to exhibit a consistent population response at all locations was the banded cucumber beetle, *Diabrotica balteata* (LeConte).

The following study was conducted to determine the response of arthropod ground predators to soybeans grown under several management systems with an emphasis on conservation tillage and double-cropping with wheat.

MATERIALS AND METHODS

The study was conducted on a Moreland silty clay soil on the Red River Research Station, Bossier City, Louisiana, during 1984 and 1985. Experimental design was a randomized complete block with a split-split-plot arrangement of treatments and four replications. Main plots and subplots were management practices for the handling of wheat straw residue. Main plots were burned and not burned with subplots being disked and not disked. Sub-subplots were tillage practices and were as follows: 1) 10-in. no-till beans following wheat, 2) 20-in. no-till beans following wheat, 3) 40-in. no-till beans following wheat, 4) 40-in. tilled beans following wheat and 5) 40-in. tilled beans with plots winter fallowed. Sub-subplots were 15.23 m by 8.12 m.

In 1984, 'Centennial' soybeans were planted on 6 June after the harvesting of 'Coker 916' wheat. Burning and disking of wheat straw stubble was conducted the day prior to bean planting. Pitfall traps consisted of an outer 16-oz plastic cup, which was buried so that the lip was level with the soil surface and remained in the ground during the entire trapping period, and an inner 4-02 plastic cup, which was placed inside the buried outer cup only during specific two-day periods. Approximately 2-3 oz of ethylene glycol was placed in the inner cup as a preservative. Pitfall traps were operated (inner cup with ethylene glycol in place) only two days each week during July and August. Two-day pitfall trap

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collections were removed in 1984 on 3, 10, 18, 24 and 31 July and 9, 15, 22 and 28 August. Plots were harvested on 8 November and planted to Coker 916 wheat.

In 1985 'Tracy-M soybeans were planted on 5 June after burning and disking of wheat stubble. Two-day pitfall collections were removed on 16 and 30 July and on 6, 13, 20 and 28 August. Soybeans were harvested on 12 November. No insecticides were used in the test plots during the course of this study.

This study reports the pitfall trap data for carabids (ground beetles), formicids (ants, primarily fire ants) and spiders only. Data were analyzed using the GLM procedure, Duncan's multiple range test and Student's t-test (SAS Institute, 1982). Statistical differences are shown only for total trap catches (Fig. 6) and not for individual sampling dates (Figs. 1-5).

RESULTS AND DISCUSSION

Carabids

In both 1984 and 1985, pitfall traps in the burned plots generally captured more carabids than traps in the non-burned plots (Fig. 1). In 1984, the peak two-day trap catch in the burned plots occurred on the first sampling date (3 July), while in the non-burned plots the peak trap catch occurred on 31 July. Total seasonal carabid captures were higher in the burned plots than in the non-burned plots although only in 1985 was the total significantly higher for the burned plots (Fig. 6). Disking had no significant effect on total carabid numbers captured in 1984 or 1985 (Fig. 6).

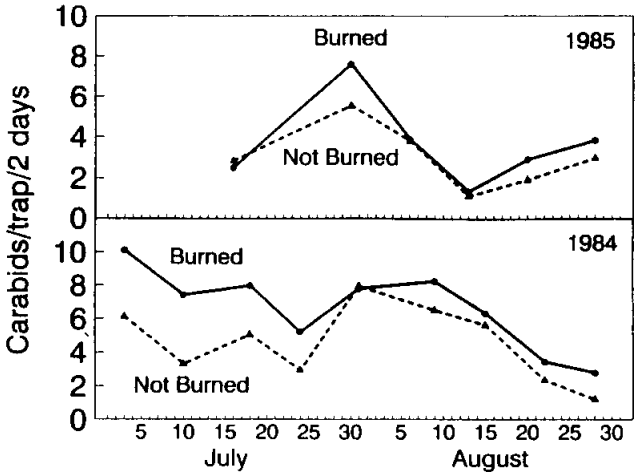
In 1984 on each sampling date, more carabids were captured in pitfall traps in the 40-in. no-till plots than in either the 10-in. or 20-in. no-till plots (Fig. 2). Total carabids captured was significantly higher in the 40-in. no-till plots than in the 10-in. and 20-in. no-till plots in 1984 (Fig. 6). Although the trend was similar for 1985, no significant differences occurred among row spacings in total numbers of carabids captured. No significant differences in carabid numbers occurred among tillage practices (40-in. no-till, following wheat; 40-in. tilled, following wheat; 40-in. tilled, winter fallowed) in 1984 or 1985.

Formicids

Although the burned plots had numerically more formicids captured on each sampling date in both 1984 and 1985 (Fig. 3), the total number of formicids captured was not significantly affected either year by burning (Fig. 6). In 1985, approximately 10-fold more formicids were captured in pitfall traps than in 1984. Disking reduced formicid numbers on most individual dates in 1984 and 1985 (Fig. 4). Total number of formicids captured was lower in the disked plots in both 1984 and 1985, although the difference was statistically different only in 1984 (Fig. 6). Row spacing and tillage practice (tilled versus no-till and tilled following wheat versus tilled following winter fallowed) did not significantly affect formicid numbers (Fig. 6).

Spiders

Burning of wheat stubble reduced the number of spiders captured on most dates in both 1984 and 1985 (Fig. 5). The number of spiders captured in



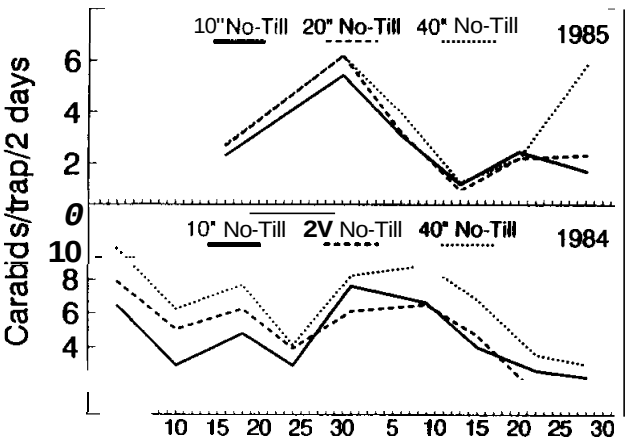


Fig. 1. Effects of burning wheat straw residue on carabid numbers in soybeans in 1984 and 1985.

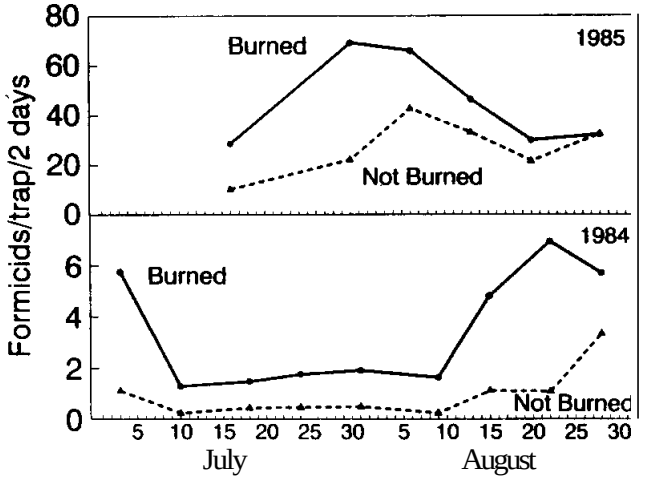


Fig. 3. Effects of burning wheat straw residue on formlcid numbers in soybeans in 1984 and 1985.

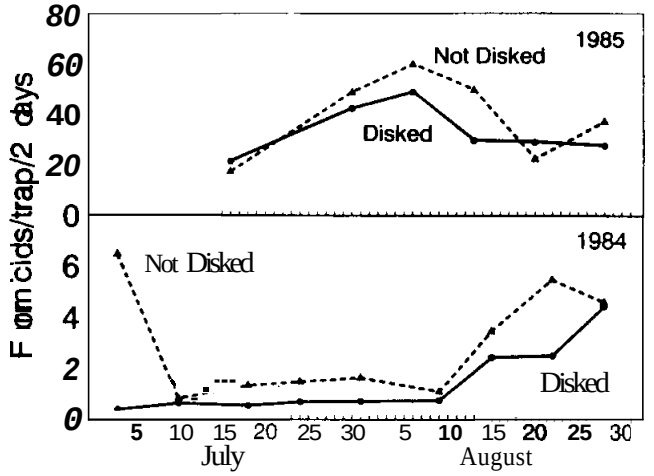


Fig. 4. Effect. of prepiant disking of wheat straw residue on formlcid numbers in soybeans in 1904 and 1985.

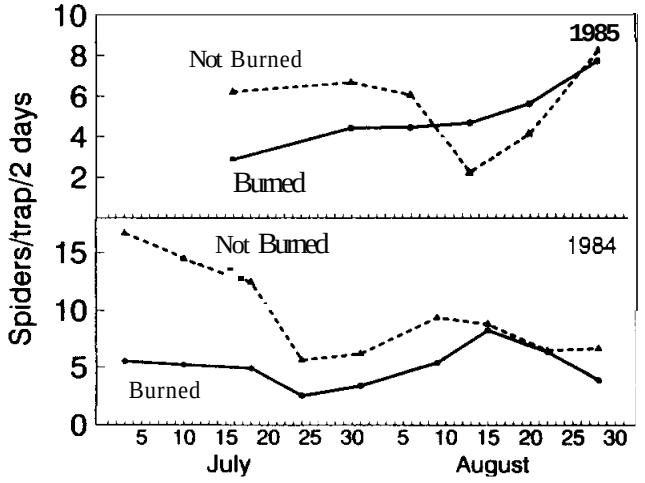


Fig. 5. Effects of burning wheat straw residue on spider numbers In soybeans in 1904 and 1985.

the burned plots, however, increased in mid-August of 1985, and by mid-August more spiders were captured in the burned plots than in the non-burned plots. As a result, only in 1984 was the total number of spiders captured during the season significantly lower in the burned plots compared to the non-burned plots (Fig. 6). Disking, row spacing and tillage practice did not significantly affect total spider numbers captured in either 1984 or 1985 (Fig. 6).

Data on ground-dwelling spiders in the study differ from those obtained by Ferguson et al. (1984b), who found ground that spiders were more numerous in both barley-soybean and wheat-soybean double-cropped systems than in a conventional system. This study did not demonstrate an increase in ground-dwelling spider numbers in double-cropped systems versus a conventional system.

This study also failed to indicate an increase in ground arthropod predators in a no-tillage system compared with a conventional tillage system. This contrasts with the results of House and Alzugaray (1989) in North Carolina demonstrating that arthropod predators were more numerous in no-till corn than in conventional tillage corn. However, they sampled below-ground macroarthropods by the use of a soil corer in contrast to our use of pitfall traps.

CONCLUSION

In conclusion, carabid and formicid numbers were greater both years in the burned plots compared with the non-burned plots. This increase was statistically significant only for the carabids in 1985. The total number of spiders captured in pitfall traps was lower both years in the burned plots compared with the non-burned plots, however, the difference was statistically significant only in 1984.

Pre-plant disking of wheat stubble resulted in significantly fewer total formicids captured in 1984 but had no significant effect in 1985. The number of carabids and spiders captured both years was unaffected by disking.

Row spacing did not significantly affect the number of formicids or spiders captured during 1984 and 1985 but did significantly affect the number of carabids captured during 1984. In 1984, significantly more carabids were captured in the 40-in. rows than in the 10-in. or 20-in. rows. Carabid, formicid and spider numbers were not significantly affected by tillage practices (no-tilled versus tilled and tilled following wheat versus tilled following winter fallowed).

Results from this study indicate that ground predators are significantly affected by changes in

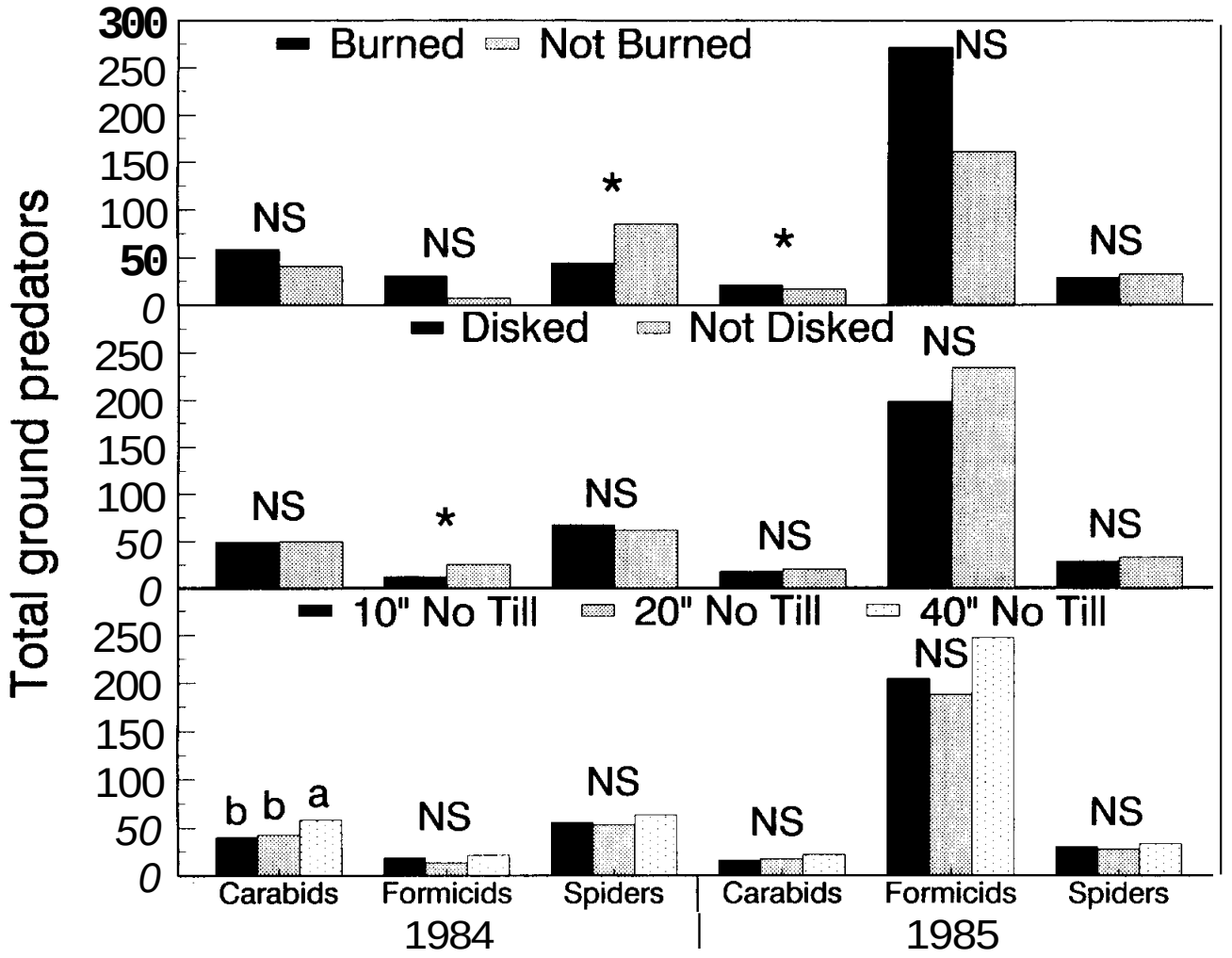


Fig. 6. Effect. of burning, disking, and row spacing on total carabid, formicid, and spider number during 1984 and 1985.

agronomic practices. The study also indicates, however, that each ground predator group responds differently to each agronomic practice.

LITERATURE CITED

1. Buschman, L.L., H.N. Pitre and H.F. Hodges. 1984. Soybean cultural practices: Effects on populations of geocorids, nabids, and other soybean arthropods. Environ. Entomol. 13:305-317.
2. Ferguson, H.J., RM. McPherson and W.A. Allen. 1984. Effect of four soybean cropping systems on the abundance of foliage-inhabiting insect predators. Environ. Entomol. 13:1105-1112.
3. Ferguson, H.J., RM. McPherson and W.A. Allen. 1984b. Ground- and foliage-dwelling spiders in four soybean cropping systems. Environ. EntomoL 13:975-980.
4. House, G.J., and M.D.R. Alzugaray. 1989. Influence of cover cropping and no-tillage practices on community composition of soil arthropods in a North Carolina agroecosystem. Environ. Entomol. 18:302307.
5. McPherson, RM., J.C. Smith and W.A. Allen. 1982. Incidence of arthropod predators in different soybean cropping systems. Environ. Entomol. 11:685-689.
6. SAS Institute. 1982. SAS user's guide: statistics, 1982. ed. SAS Institute, Cary, N.C.
7. Troxclair, N.N., and D.J. Boethel. 1984. Influence of tillage practices and row spacing on soybean insect populations in Louisiana. J. Econ. Entomol. 77:1571-1579.