Sequence and Rotation Effects on Pest Incidence and Yield of Winter Wheat and Canola Double-Cropped with Pearl Millet and Soybean

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INTERPRETIVE SUMMARY

Double-cropping is an important practice in areas of the southern U. S., where length of growing season and adequate rainfall or irrigation permit timely stand emergence, development, and maturity of a summer crop. The predominant double-crop sequence is winter wheat (*Triticum aestivum* L.) and soybean [*Glycine max* (L.) Merr.], although grain sorghum and cotton are sometimes grown as a double-crop with wheat. Double-cropping has advantages of increased cash flow for producers and reduced soil erosion and water loss by having ground cover most of the year and cost savings from more intensive use of the land and better utilization of crop inputs, labor and capital investments. However, double-cropping essentially can result in a continuous production of crops in the same field each year, which can cause a build up of damaging levels of disease, insect, and weed populations. Indeed, in the 1970s and 1980s continuous double-crop production of winter wheat resulted in serious damage in many fields by take-all root and crown rot caused by the fungus *Gaeumannamyces graminis* var. *tritici* (Ggt), and by devastating outbreaks of the Hessian fly, *Mayetiola destructor* (Say). Incorporating alternative crops that are culturally and biologically compatible with a soybean/wheat double-crop system could help reduce pest incidence and severity and also provide farmers with commodity marketing alternatives. Canola (*Brassica napus* L.) is an alternative winter grain crop that provides high quality edible oil for various uses and defatted meal for livestock, particularly poultry. Pearl millet [*Pennisetum glaucum* (L.) R. Br.] is a new alternative summer crop that produces high-quality feed grain for poultry. Grain millet is an attractive alternative to other summer crops in non-irrigated systems because of its short growing season and inherent tolerance to hot and droughty conditions.

We established a five-year study in the Coastal Plain region of GA to examine the effects of incorporating canola and pearl millet in multiple-year rotational sequences on the agronomic performance and pest incidence and severity in a wheat-soybean double-crop system. The experiment was conducted on a Greenville sandy loam at the Southwest Branch Experiment Station near Plains, GA. A twelve crop sequence and rotational treatments were established in a randomized complete block design with four replications. Plots measured 40 ft by 40 ft (1600 ft^2). Rotations included winter wheat, winter canola, winter rye or fallow, and summer crops were soybean or pearl millet for grain production.

Winter wheat productivity was affected by previous crop sequences and rotation history. A single year of canola production greatly reduced the severity of infection take-all root and crown rot in wheat. Wheat rotation with canola every few years was very effective in suppressing take-all stem and root rot. Canola as the previous winter crop reduced winter infestations and, to some extent, spring infestations of Hessian fly. Furthermore, the wheat-soybean rotation had lower winter infestations levels of the Hessian fly than a wheat-millet rotation. Reduced Hessian fly infestation in rotations with canola is understandable because of the lack of a host plant. The reason for increased infestation levels following millet compared with soybean is not clear. Possibly the herbicide regime in millet did not control volunteer wheat in late summer as well as in soybean, thereby providing a bridging host for the first fall generation of Hessian fly which develops in volunteer wheat before the planting of the winter wheat crop.

Canola grain yields were not affected by previous summer and winter crops and cropping sequences in any year. However, continuous canola production tended to yield

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about 200 lbs per acre less than first time and rotated canola in the last three years of the study. Planting canola after canola also enhanced Sclerotinia infection levels in both years where the disease was present. Current canola production guidelines recommend planting canola only one in four years to help avoid infection by blackleg, caused by the fungus *Leptospharia maculans*. More frequent rotations of every one or two years may be feasible if highly blackleg-resistant varieties are grown.

Pearl millet stands were lower following canola than wheat in two of the four years. Stand loss was mainly the result of seedling feeding damage caused by the false chinch bug, (*Nysius raphanus* Howard) following canola. Soybean stands also were consistently reduced by 18 - 25% following canola as compared with small grains in all years except 1998. As with millet, false chinch bugs were more numerous on soybean seedlings following canola than winter wheat in some years, but the level of injury from chinch bugs does not explain the reductions in soybean stands. Although the cause of soybean stand reductions was not determined, losses most likely were caused by physical interference of the canola stubble with planter performance or possibly by undetermined chemical or biological factors associated with canola stubble.

Except for seedling damage by false chinch bugs, the sequence of previous winter crops had little consistent effect on insect populations on soybean or grain millet or on soybean diseases. In millet, the incidence of stalk and neck rot (caused by *Fusarium graminearum*) infection was greater following canola than wheat, and the severity of smut (caused by *Moesziomyces penicillariae*) was enhanced after three continuous years of millet cultivation (Wilson *et al*., 1999). Despite these effects on stand and disease incidence, previous winter or summer crops or the number of sequential years of cultivation had no detrimental, limiting impacts on grain yields of either pearl millet or soybean (Wilson *et al*., 1999).

These results show that the continuous planting of a crop can enhance host-specific pests such as Hessian fly and take-all disease in wheat. Stands of soybean and grain millet usually were reduced when planted into canola stubble as compared to winter wheat, rye, or fallow. However, the previous cropping sequence did not reduce grain yields of pearl millet or soybean. Both soybean and millet tolerate a considerable range of plant populations without affecting grain yield. Therefore, rotating canola with wheat to disrupt pest cycles in wheat can be done without detrimental, limiting effects on subsequent soybean or millet crops as long as plant populations are not near or below the minimum for a full stand.

LITERATURE CITED

Wilson, J. P., B. M. Cunfer, and D. V. Phillips. 1999. Double-cropping and crop rotation effects on diseases of grain yield of pearl millet. J. Prod. Agric. 12:198-202.