

INSECTS AND DISEASE: IMPACT ON FORAGE PRODUCTION AND STAND PERSISTENCE

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INTRODUCTION

While data exists on the impact of insect pests on individual alfalfa cuttings (Summers and Coviello, 1984; Stern et al., 1980; Cothran and Summers, 1974) few data are available on the impact of such pests over the life of a normal stand. Virtually no information is available on disease impact (Gilchrist and Martensen, 1976). Data on disease/insect interactions is restricted to a few highly specialized relationships (Summers and McClellan, 1975; Lamp et al., 1985). In California's San Joaquin Valley, stand life is limited to approximately 3.5 years (Flint et al., 1984). While the reasons for this are not entirely clear, a multitude of responsible factors can be postulated. This paper reports the results of field studies established to determine the impact of insects and plant pathogens on alfalfa growth, yield, stand persistence, and weed encroachment.

METHODS

Studies were conducted at the Kearney Agricultural Center, Parlier, the heart of the San Joaquin Valley, where 60% of the irrigated forage alfalfa is grown. Pest stress differences were created by the application of specific insecticides and fungicides. Four treatments; no pest stress (insecticide and fungicide), insect stress only (fungicide), disease stress only (insecticide) and insect and disease stress (untreated) were established in a randomized complete block design with eight replications. Chemicals were applied singularly and in combination at regular intervals based on the half-life of the fungicide and as needed for the insecticide. Eptam was applied pre-plant and no other herbicides were applied throughout the course of the study. It is emphasized that neither the insecticides or fungicides used nor their frequency of application were intended to suggest this as an economic approach for dealing with these various pest problems. Indeed, some materials used are not currently registered on alfalfa forage. The chemicals were used as tools to establish the desired levels of pest stress and not as a potential management strategy.

RESULTS

The annual forage yields for the five year period, 1979 through 1983, revealed a normal expected decline in yield following the second production year for the untreated control plots shown as unshaded bars (Fig. 1).

Beginning in the second year, 1980, the plots which received either insecticides or fungicides yielded significantly more than the untreated control while the yield of the plots receiving both pesticides were significantly higher than either pesticide alone. These data indicate that both insect and disease stress were significant loss factors by the second year and that their combined impact was essentially equivalent.

The yields in all plots declined in the third year, but their relative relationship remained the same although the yield of the control plots had declined nearly to the level of the state average.

By the fourth year, both the control and the insecticide only treated plots (disease stressed) yielded below the state average (heavy black line). Plots protected from both forms of stress produced yields significantly greater than the other treatments and yields well above the state average. Plots protected only from disease (fungicide treated) continued to yield significantly more than the control or insect protected plots and maintained a yearly production at the level of the state average. These data clearly show the impact of fungal pathogens as the overriding factor in the observed yield decline.

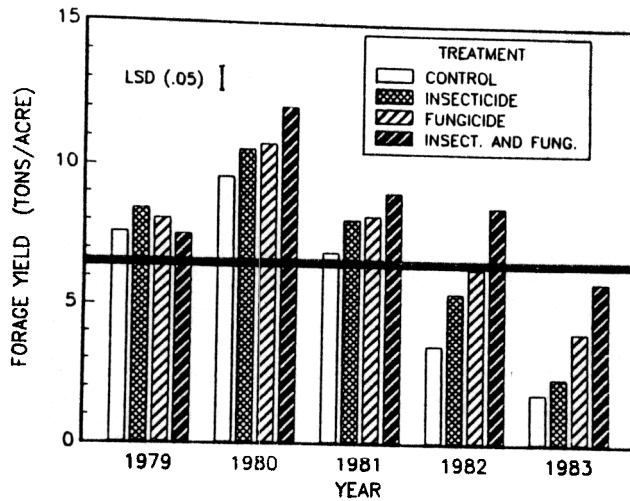


Figure 1. Forage yields obtained from plots protected from insects, fungi, insects and fungi, and unprotected plots from a field study in Parlier, California.

Based on the average differences recorded over the five year period for protection provided by the respective pesticides compared to the control, the annual forage losses attributed to insects, fungi, and insects and fungi were 1.12, 1.62, and 2.74 tons per acre per year, respectively. When costed out at \$90 per ton (a conservative figure) and multiplied by the one million acres in the state the potential total costs are substantial (i.e. 1.0, 1.5, and 2.5 million dollars in statewide costs for insects, fungi, and insects and fungi, respectively). The key point here is that only the insects causing damage in this study are presently receiving any pest management attention. The diseases responsible for losses at least equal to the insects are not controlled in any fashion.

Figure 2 illustrates the actual pest costs for insects and diseases recorded in this study in tons per acre by year.

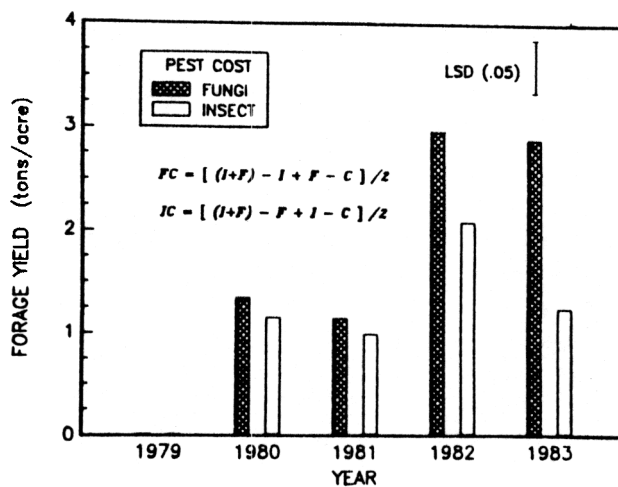


Figure 2. The loss in forage yield due to fungi and insects pests from 1979 to 1983 from an alfalfa field study in Parlier, California

The data are presented as an average of the loss measured for each pest type in the presence and the absence of control imposed against the other. The results highlight the substantial impact of the fungi in particular.

While the impact of both insects and fungi on forage yield is significant the mechanism by which the two pest types contribute to yield decline appears to differ. Figure 3 indicates the relative cost recorded for fungi and insects on the number of plants lost per unit area of land.

The fungi appear to exert a significantly greater pressure on plant loss than insects, whereas the effect of insect pressure resides primarily in reducing the amount of forage produced on the plants living at any given time. In addition, the impact of the foliar pathogens, recorded before significant differences in stand density appear in the third year, were equal to that caused by insects in the first two years.

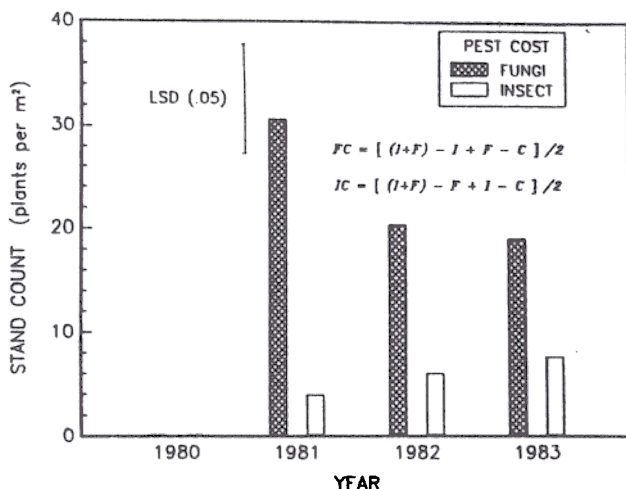


Figure 3. Plant loss as a function of either insects or fungi from 1980 to 1983 from an alfalfa field study in Parlier, California.

The insect losses were due primarily to the Egyptian alfalfa weevil (*Hypera brunneipennis*). The disease losses were attributed to losses in two different yield components: a) leaf loss due to infection by two foliar pathogens *Pseudopeziza medicagenis* and *Stemphylium botryosum* and b) crown decay due to *Stagonospora melliloti* which is associated with loss in plant numbers.

Lastly, the data revealed an interesting interaction between the impact of insects and fungi on forage loss and a dramatic increase in the ratio of weed dry matter to alfalfa in this study (Fig. 4).

It was noted earlier that no herbicides were used on these plots. There was a significant reduction in the rate and amount of weeds that appeared in those plots receiving protection against insects and diseases. Also consistent with the role postulated for the fungal pathogens in stand loss, it appears that protection against these pathogens affords significantly greater reduction in the rate of weed encroachment into the existing alfalfa population; presumably by maintaining a healthier plant canopy for a longer period of time.

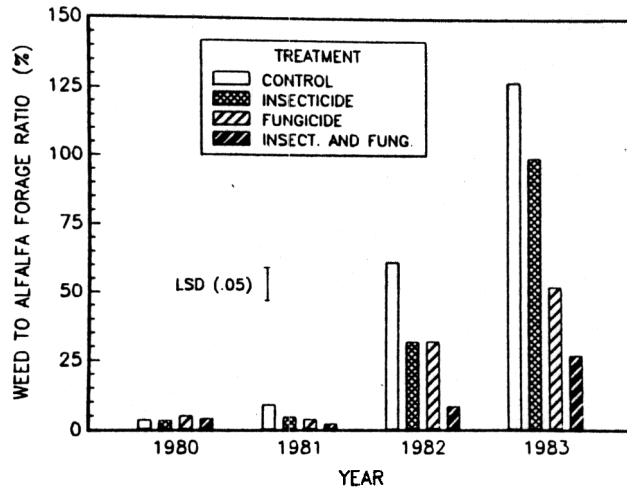


Figure 4. Weed to alfalfa ratio from plots protected from insect, fungi, insects and fungi, and no protection from 1980 to 1983 from a field study in Parlier, California.

CONCLUSION

In conclusion, these data provide the first quantitative estimates of the impact of fungal pathogens on alfalfa in California, confirm the impact of insect stress, indicate a significant interaction between pathogen and insect stress and weed encroachment, and provide the justification for studies which are focused on the development of multiple pest resistant germplasm.

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