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Occurrence and severity of lucerne yellows disease in Australian lucerne seed crops

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Abstract

Production of lucerne seed is one of the most important seed industries in Australia. Anecdotal reports suggested that the disease lucerne yellows was having a marked impact on the industry, but no firm data existed on its occurrence and severity. An interview-based survey obtained detailed information from eight seedhouse offices and a telephone-based survey equivalent data from 62 individual growers. Only two of the 36 growers surveyed in New South Wales (NSW) and four of the 26 growers from South Australia (SA) had not observed the disease in their crops. In one instance the incidence of lucerne yellows was reported to be as high as 50–75 percent of plants but the majority of interviewees estimated the incidence to be less than five percent. Responses from farmers in NSW did not indicate a significantly greater severity for the disease than was apparent in SA. The results from the seedhouses support those from individual growers in showing that lucerne yellows disease occurs widely in both States and that its severity is such that significant economic losses are likely.

Introduction

Lucerne is one of the most valuable pasture legumes in Australia (Anon. 1998). Because of its deep root system and perenniality, it is increasingly important in managing aspects of environmental degradation such as rising water tables and soil salinity. Lucerne yellows is one of several significant lucerne diseases in Australia (McDonald *et al.* 1995) and severe crop losses have been recorded (Anon. 1974; McGechan 1978). Depending on its incidence, it is likely to have a severe impact on seed production as infected plants rarely recover (Stovold 1983).

Though lucerne yellows has been recorded in Australia for at least 18 years (Stovold 1981), little is known about its biology and etiology. A leafhopper-transmitted phytoplasma (mycoplasma-like organism) is suspected to be the cause (McGechan 1980; Fletcher 1980). However, definitive confirmatory research, which would allow the development of a disease management strategy, has not been undertaken. Such research would be warranted only if the distribution and severity of the disease indicated that a current problem existed. Since such information was entirely lacking, complementary surveys were undertaken to obtain relevant information from seedhouses and individual growers in the two major lucerne seed-growing States.

Methods

Survey of lucerne seed growers Contact details for established lucerne seed growers in South Australia (SA) and New South Wales (NSW) were obtained via certification scheme records for each State, and a total of 83 provisionally agreed to participate. These growers were then sent a 'fact sheet' (Gurr *et al.* 1998) and a brief questionnaire. The 'fact sheet' sought to maximise the reliability of responses by including colour illustrations and providing, in flow chart form (Figure 1), a guide to identify the disease and distinguish it from similar lucerne diseases and disorders.

Growers were subsequently contacted by telephone and their responses to each of the questions noted. During this interview, growers were also asked about the basis for the diagnosis of lucerne yellows in their crops (i.e. foliar symptoms, root examination or confirmation by a plant pathologist) and whether they viewed the disease as a potential, actual or non-problem. Some growers also volunteered additional information, which was noted. Telephone feedback was obtained from 24 growers in SA and 27 in NSW. The remaining 32 growers were sent a letter explaining that difficulty had been experienced in reaching them by telephone and inviting them to return their completed questionnaire in a post-paid envelope. Subsequently, written

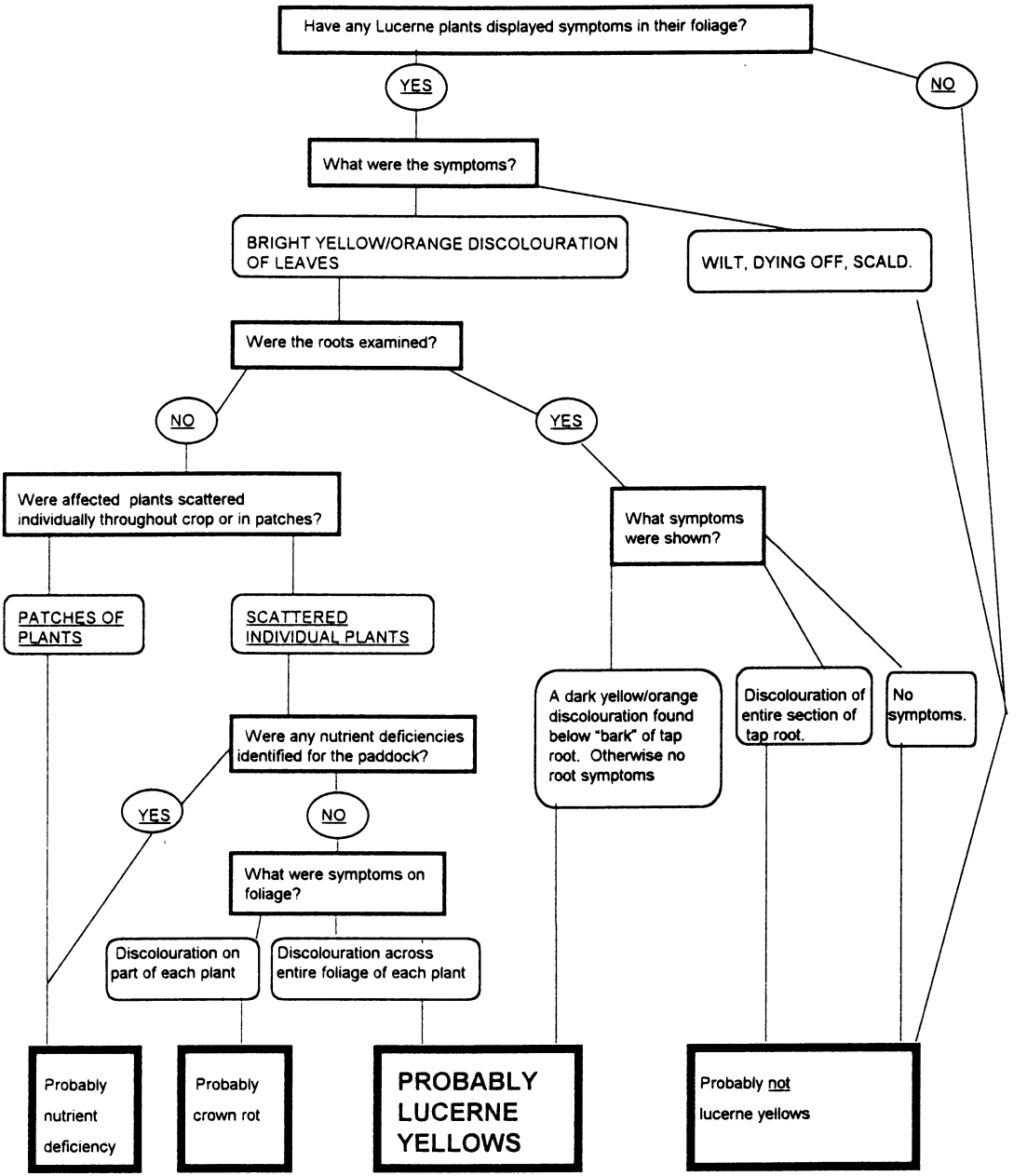

Figure 1 Guide to distinguishing lucerne yellows from similar lucerne diseases and disorders (as used in illustrated 'factsheet' for surveyed growers).

feedback was received from an additional nine NSW growers and two from SA.

Growers in NSW were located as far west as Condobolin, north to Nyngan and south to Cootamundra but the majority were in the commercially important Forbes/Eugowra district of the Lachlan Valley. In SA, growers were predominantly in the Keith-Naracoorte district with a smaller cluster to the north between Kapunda and Jamestown.

Survey of seedhouses Visits were arranged to the offices of five seedhouses involved in lucerne seed production. The most appropriate staff members were made available to provide, during a structured interview, information on the impact of the disease to each company's business. For one of the seedhouses, two separate interviews were held with staff based at different offices within NSW. For a second seedhouse, three separate interviews were held, two at offices in SA and one in NSW. This yielded data on the impact of lucerne yellows for four seedhouse offices in each state. Interviews were based on the questionnaire used for lucerne seed growers. Areas covered by seedhouse offices in NSW were the Lachlan and Macquarie valleys and the Riverina. In SA, offices covered the areas around Bordertown, Padthaway and Clare.

Because of the commercial sensitivity of data, the names of farmers and companies were suppressed, their locations indicated by State only and cultivars identified by code numbers.

Data analysis Results from the survey of lucerne seed growers were subject to Pearson chi-squared tests to compare data from the two States.

Results

Survey of lucerne seed growers Results were obtained from 36 seed growers in NSW and from 26 growers in SA. In NSW, 34 growers reported symptoms within their crops consistent with the descriptions and colour illustration on the 'fact sheet'. The equivalent figure for SA was 22 of the 26 growers (Table 1). Foliar symptoms were the most widely used basis for identifying the presence of the disease. Only two growers had inspected roots for symptom expression and only one had used a plant pathologist to confirm disease identity. In both States the most common response to the question about how frequently symptoms had been observed was 'every year' (Table 1).

In NSW, the majority of growers reported the disease in all or most of their lucerne stands, whereas, in SA, occurrence in very few stands was reported as frequently as the other categories (Table 1). In one instance the incidence of symptoms was

Table 1 Questionnaire responses of lucerne seed growers in New South Wales (NSW) and South Australia (SA) on the incidence of lucerne yellows disease

Question	Response category	NSW (n = 36)	SA (n = 26)	χ^2 analysis
Symptoms observed	Yes	34	22	$\chi^2 = 1.67$
	No	2	4	dof = 1
				$P = 0.196$
Frequency of symptoms	Every year	17	12	$\chi^2 = 0.30$
	Most years	10	6	dof = 3
	Occasionally	6	3	$P = 0.959$
	Rarely	1	1	
Occurrence on property	All stands	10	6	$\chi^2 = 5.35$
	Most stands	15	6	dof = 3
	Few stands	7	4	$P = 0.148$
	V. few stands	2	6	
Incidence within affected stands	>75%	0	0	$\chi^2 = 5.79$
	50–75%	1	0	dof = 4
	25–50%	2	0	$P = 0.215$
	10–25%	5	5	
	5–10%	5	2	
	2–5%	10	3	
	<2%	11	12	

reported to be as high as 50–75 %, but the majority of interviewees indicated 5% or fewer plants were affected (Table 1).

In NSW, three of the 34 growers who reported the disease used insecticides in an attempt to control it, one had ploughed-in affected crops and another had cut seed crops. No growers in SA reported taking action against the disease. Some growers indicated that marked differences were evident in susceptibility of cultivars and collectively commented on the perceived susceptibility/resistance of approximately 30 cultivars. However, responses were not consistent. Only one cultivar in NSW and one in SA was reported to have been unaffected. In NSW, 20 of the 26 growers who expressed an opinion viewed the disease as an actual or potential problem, whereas in SA this view was shared by 13 of 24 growers.

Though the results suggested that the disease was more serious in NSW than in SA, chi-squared analysis showed for each measure of severity that the States did not differ significantly ($P>0.05$).

Survey of seedhouses Seedhouse offices reported overseeing between 15 and in excess of 200 crops per annum. Three of the four offices based in NSW reported that lucerne yellows was evident in their crops every year. The fourth office reported it for most years. In SA, two offices reported the disease every year, and one office reported it for the 'occasional' and the 'rarely' response category. The identification of the disease was most commonly based on foliar symptoms alone. Two offices in NSW and one in SA reported inspecting plant roots for disease symptoms. Only one office (in NSW) had the identity of the disease confirmed by a plant pathologist.

The frequency of lucerne yellows in NSW crops tended to be higher than in SA. In the latter State, all interviewees reported the disease to occur in 'few' or 'very few' stands. Estimated levels of disease incidence within affected crops were in the 10–25% category or greater for NSW respondents. In contrast, all offices in SA reported levels in the 10–25% or lower categories.

Recommendations which seedhouses had made for action against lucerne yellows included high intensity grazing over winter and spring (one), ploughing plus insecticide sprays (one) and insecticide use (two). Half of the offices did not recommended action.

The overall view of seedhouse offices of the importance of lucerne yellows disease varied between States. All four offices in NSW considered it to be a problem but only one in SA shared this view. One office based in SA did not view the disease as a problem, and two regarded it as constituting a potential problem. Estimates of yield losses resulting from lucerne yellows included 25%, 50% (said to be worth $0.5 million (M) to that office in 1997), 10–60% and up to 90% in "bad" years.

Discussion

The results of this survey clearly indicate that lucerne yellows disease is a serious problem within the Australian lucerne seed industry. The impact of the disease is reflected by the actions of growers and staff from seedhouses. One grower had resorted to ploughing-in crops and four had taken other action in response to the disease in the form of cutting or spraying insecticide. A greater proportion of seedhouse offices (one half) had recommended action which included grazing affected seed crops. Such actions were taken despite the fact that the nature of the pathogen and how it is spread are unknown.

Findings suggest that a range of lucerne yellows susceptibility/resistance is exhibited within current cultivars so one avenue for future research is to undertake selective breeding to increase resistance levels. However, this strategy is a long term one and, as a unilateral approach, is unlikely to be effective. Some individual cultivars were considered by surveyed growers to have good resistance, yet other growers reported the same cultivars to have been severely affected. This suggests that resistance to lucerne yellows may be poly/oligogenic rather than vertical (i.e. major gene-based) and/or mediated by interaction with environmental factors. Resistance of this type is more difficult to select for and demands that the environmental factors which contribute to disease development in the field should be understood.

Investment in further research and development is therefore clearly warranted, especially as feedback from interviewees suggested that the disease was becoming more serious over time. This may be related to the more widespread use of cultivars from overseas, particularly from the United States of America; these imported cultivars were thought to be more susceptible by one seedhouse office based in SA and several growers.

The present results do not allow a precise quantitative estimate of the economic impact of lucerne yellows disease on the Australian lucerne seed industry. However, balancing the high number of growers reporting symptoms consistent with lucerne yellows against the relatively low incidence in terms of affected plants per stand (mostly below 25%), an average seed yield loss over the lifetime of a stand of 10% appears conservative. This equates to an economic loss in the order of $2M per annum in NSW alone. A more detailed economic analysis is possible for SA where 1997/98 production figures are available from the certification process. Based on the amount of seed produced and current retail prices, a value of $49.73 M per annum for the crop is indicated and the yield loss average of 10% suggested above equates to a loss of about $5M per annum in SA. Lucerne yellows disease is clearly a serious problem within an important industry. Research is planned for development of an appropriate control strategy.

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