WEEDEM: a user-friendly software package for predicting annual ryegrass and wild radish emergence

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Summary WEEDEM is an interactive software package designed to predict the timing of emergence for the two most troublesome weeds of southern Australian dryland cropping regions: annual ryegrass and wild radish. WEEDEM predicts emergence based on weather conditions supplied by the user for specific sites. The software is targeted for use by farmers, farm advisers, and extension personnel. Consequently, it is designed to be user-friendly and to require minimal data inputs.

Keywords Model, software, emergence, annual ryegrass, wild radish.

INTRODUCTION

Timeliness is one of the most critical issues in weed management, particularly where weed control options are limited due to the development of herbicide resistant weeds. Weed control efforts that occur too early or too late are less effective and lead to wasted time and expense. Understanding the timing and extent of weed seedling emergence can improve timeliness of weed control efforts.

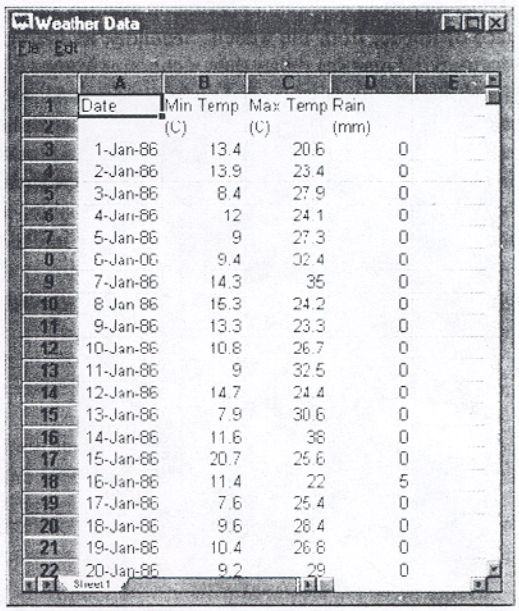
There has been considerable progress in our ability to predict weed seedling emergence (Forcella *et al.* 2000). However, it is important to not only be able to predict seedling emergence, but to make the predictions quickly and easily, in a readily accessible form, for site-specific conditions, in real time. It is with these goals in mind that the WEEDEM model is being developed.

MODEL DESCRIPTION

WEEDEM is an interactive software package designed to predict the timing of emergence for the two most troublesome weeds of southern Australian dryland cropping regions: annual ryegrass (*Lolium rigidum*) and wild radish (*Raphanus raphanistrum*). WEEDEM uses emergence models based upon Australian laboratory and field data. The software model predicts emergence based on microclimate conditions near the soil surface relating these conditions to seed dormancy status and extent and timing of seedling emergence. Microclimate values are estimated based on weather inputs supplied by the user.

Weather inputs are limited to items that are thought to be widely available to users. Values for daily rainfall and minimum and maximum air temperatures are required. These values are converted internally into soil water potential and soil temperature, which represent the primary driving variables within the model. Weather data are stored in a text file format, and can be entered directly in the model through a spreadsheet interface (Figure 1). Data may be typed into the spreadsheet or copied and pasted into the model from text or other spreadsheet sources.

The software is targeted for use by farmers, farm advisers, and extension personnel. Consequently, it is designed to be user-friendly and to require minimal data inputs. Besides weather data, initial data inputs include previous crop residue type, tillage system, soil texture class, and a qualitative estimate of initial soil moisture content (Figure 2). These inputs are entered through simple, drop-down selection boxes. The model



Weather Data

	A	B	C	D	E
1	Date	Min Temp	Max Temp	Rain	
2		(C)	(C)	(mm)	
3	1-Jan-86	13.4	20.6	0	
4	2-Jan-86	13.9	23.4	0	
5	3-Jan-86	8.4	27.9	0	
6	4-Jan-86	12	24.1	0	
7	5-Jan-86	9	27.3	0	
8	6-Jan-86	9.4	32.4	0	
9	7-Jan-86	14.3	35	0	
10	8 Jan 86	15.3	24.2	0	
11	9-Jan-86	13.3	23.3	0	
12	10-Jan-86	10.8	26.7	0	
13	11-Jan-86	9	32.5	0	
14	12-Jan-86	14.7	24.4	0	
15	13-Jan-86	7.9	30.6	0	
16	14-Jan-86	11.6	38	0	
17	15-Jan-86	20.7	25.6	0	
18	16-Jan-86	11.4	22	5	
19	17-Jan-86	7.6	25.4	0	
20	18-Jan-86	9.6	28.4	0	
21	19-Jan-86	10.4	26.8	0	
22	20-Jan-86	9.2	29	0	

Figure 1. WEEDEM weather data entry spreadsheet.

can use both observed and forecasted daily weather data to predict timing of emergence. WEEDEM is a useful tool for managers to ask 'What if?' questions in planning their weed control activities. For example, suppose a manager is planning a weed control treatment for a field and WEEDEM shows annual ryegrass emergence is currently at 20% indicating that 80% of the weeds will potentially emerge after the treatment. The manager might ask, 'What if I wait a week?' Using forecasted weather, WEEDEM predicts annual ryegrass emergence to be at 75% at the end of the week. The manager can then decide whether it is worth the wait to gain an additional 55% in potential weed control.

In addition to predicting current and future emergence levels, historical weather observations can be used in WEEDEM to estimate and explain past phenomena. For example, results reported in the literature that show greater weed competition in one year than another year may be explained by differential emergence timing of the weeds, which can be estimated through WEEDEM.

Model output can be viewed in both a tabular and a graphical form (Figure 3). Weather data may be displayed graphically along with predicted emergence to provide a visual display of events that trigger emergence flushes (Figure 4).

An initial version of the model was developed in October 2000. It is currently being tested in field locations across Australia. Plans are to modify WEEDEM as necessary and adapt the user interface in accordance with desires of farmers, farm advisers, and extension personnel in southern Australia

REFERENCES

Forcella, F., Benech Arnold, R.L., Sanchez, R. and Gherza, C.M. (2000). Modelling seedling emergence. *Field Crops Research* 67, 123-239.

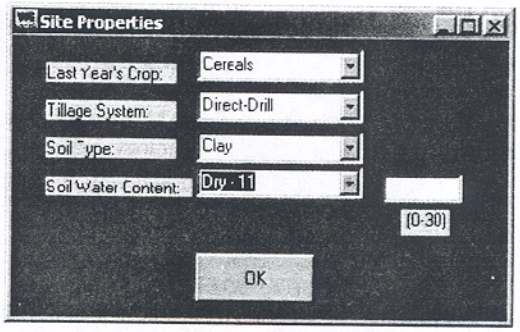


Figure 2. WEEDEM site properties data entry form.

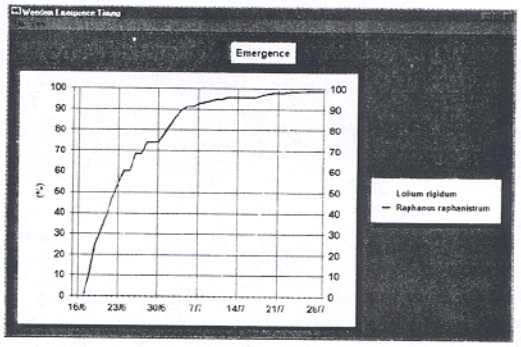


Figure 3. Graphical display of predicted emergence.

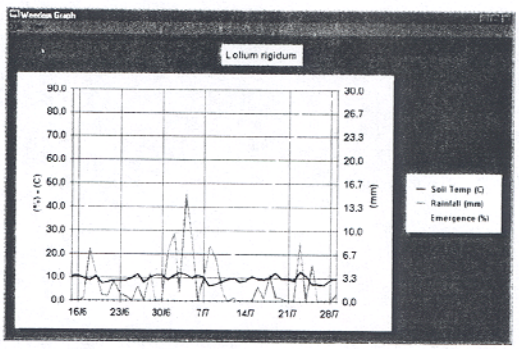


Figure 4. WEEDEM graphical display of predicted emergence, daily rainfall and soil temperature.