WEEDEM: turning information into action

Michael Walsh[1], Frank Forcella[2], David Archer[2] and James Eklund[2]
[1] Western Australia Herbicide Resistance Initiative, Faculty of Natural and Agricultural Sciences, University of Western Australia, 35 Stirling Highway, Crawley, Western Australia 6009, Australia
mwalsh@agric.uwa.edu.au
[2] North Central Soil Conservation Research Laboratory, USDA-Agricultural Research Service, 803 Iowa Avenue, Morris, MN 56267, USA

Summary WEEDEM and the wild radish emergence model contained within this program were field tested in the Western Australian wheatbelt during the 2001 growing season. Predictive emergence curves mirrored actual emergence curves at three locations in the northern region of the wheatbelt. Further refinement of the model is required to meet the farmer demands of accurate predictions of early season emergence patterns.
Keywords Wild radish, annual ryegrass, emergence model.

INTRODUCTION

WEEDEM can provide predictions of cumulative emergence for annual ryegrass (*Lolium rigidum*) and wild radish (*Raphanus raphanistrum*) using daily rainfall and temperature data (Archer *et al*. 2002). These are the two most troublesome weeds in southern Australian dryland farming systems and the accurate prediction of their emergence patterns would be extremely valuable in the planning and implementing of weed management practices. In particular the ability to predict the initial emergence patterns of annual ryegrass and wild radish would be invaluable in the control of these weed species. Because it is at this stage that weed management decisions are made in an attempt to provide crops a weed free environment during the critical early post-emergence period.

The longer-term planning of weed management options for particular paddocks will also potentially be improved through the use of WEEDEM. Long-term rainfall and temperature data can be used to predict average emergence patterns of annual ryegrass and wild radish for specific cropping regions. These predictions would be valuable information in the whole farm planning of the timing of weed management strategies.

The emergence models contained within the WEEDEM program are still in the preliminary developmental stages and therefore they currently have a somewhat limited ability to deliver accurate predictions of the emergence patterns. In particular, the emergence model for wild radish contained within WEEDEM was developed from published emergence data. Five sets of emergence data consisting of four sets collected from Western Australia (Cheam 1986, Panetta *et al*. 1988) and one from Victoria (Reeves *et al.* 1981) were used in the development of the wild radish emergence model. However, in most instances the emergence data that was recorded was not the primary focus of the research being conducted. Consequently emergence counts were generally conducted on an irregular basis and at best recorded at monthly intervals over the growing season. Therefore there is a need to validate the wild radish emergence model using emergence data collected at frequent intervals over the growing season.

It is envisaged WEEDEM, when development is completed, would be used to accurately predict on a daily basis the emergence of selected weed species. Therefore, the people most likely to use WEEDEM would be farmers and advisers for the planning of weed control practices. Therefore, the WEEDEM program needs to be developed accordingly. This paper reports on the collection of wild radish emergence data during the 2001 growing season from farms at three locations (Wubin, Yandanooka and Mingenew) in the northern wheatbelt region of Western Australia. There were two objectives of this study the first of which was to collect valuable data on wild radish emergence from 'real' crop production situations. Secondly the WEEDEM program was evaluated by the farmers involved in the collection of emergence counts with the aim of using the feedback from these evaluations to refine and further develop WEEDEM.

MATERIALS AND METHODS

At five locations (Yandanooka, Mingenew, Mullewa Tenindewa and Wubin) across the northern Western Australian wheatbelt farmers were involved in the collection of wild radish emergence data over the 2001 growing season. At each location, prior to the commencement of the growing season five 1.0 m^2 quadrats were established in paddocks to be sown to wheat and in sections of these paddocks with wild radish populations. Following the commencement of the growing season wild radish emergence was recorded by farmers on a weekly basis throughout the season until harvest. Wild radish seedlings and other weeds were carefully removed avoiding soil disturbance from the quadrat areas at the time of counting. The areas were maintained in the same manner as the rest of paddock in the preparation, seeding and management of the wheat crop. The only exception was that the quadrats were covered when any herbicides that would affect the emergence of wild radish were applied. Due to the dry conditions experienced in some regions of the northern wheatbelt only three (Wubin, Yandanooka and Mingenew) of the five counting sites yielded valuable emergence data.

Data loggers were used to record daily maximum and minimum soil temperature data at the 2 cm depth throughout the season at each counting site. Rainfall gauges were placed at each counting site and daily rainfall data was collected. At the end of the growing season the temperature and rainfall data were used to derive predictive wild radish emergence curves for each counting site. These data were then compared with the actual recorded emergence data collected from each site.

In early 2002 a series of workshops were conducted with the five farmers involved in collecting wild radish emergence data the previous season. As part of this workshop the farmer collected emergence data was compared with the wild radish emergence model derived data. In doing this farmers were required to use WEEDEM to derive the wild radish emergence curves from the on-site rainfall and temperature data. Following this farmers were requested to provide feedback on the program by filling in evaluation sheets.

RESULTS

The pattern of wild radish emergence at three locations across the northern Western Australian wheatbelt was predicted with some accuracy by the emergence model contained within the WEEDEM program. Cumulative emergence of wild radish was calculated from the data collected by the weekly counting of seedling emergence in permanent quadrats established within wheat crops at three locations across the northern region of Western Australian wheatbelt during the 2001 growing season. The reduced and erratic rainfall of the 2001 growing season resulted in significant emergence occurring at only the three of the counting sites (Yandanooka, Mingenew and Wubin). Temperature and rainfall data collected from these sites was used to develop predictive cumulative emergence curves using the wild radish emergence model contained within WEEDEM. These emergence curves are plotted against the recorded emergence curves in Figure 1.

There were some discrepancies in the initial emergence patterns between the actual emergence data and the emergence of wild radish as predicted by WEEDEM (Figure 1). There was an over estimation of emergence by WEEDEM at the Mingenew and Wubin sites while emergence was under estimated at the Yandanooka site. In each instance the variation was by a factor of about two and lasted for at least the first two weeks of the counting period. At Mingenew and Wubin the predicted emergence was more than double the actual emergence for the first two and four weeks respectively. In contrast the predicted emergence was less than half the actual emergence at the Yandanooka site for the first two weeks of the season. The predicted emergence of wild radish closely resembled that of the actual emergence for the remainder of the growing season at Wubin. In contrast, predicted emergence at the Yandanooka and Mingenew sites continued to be

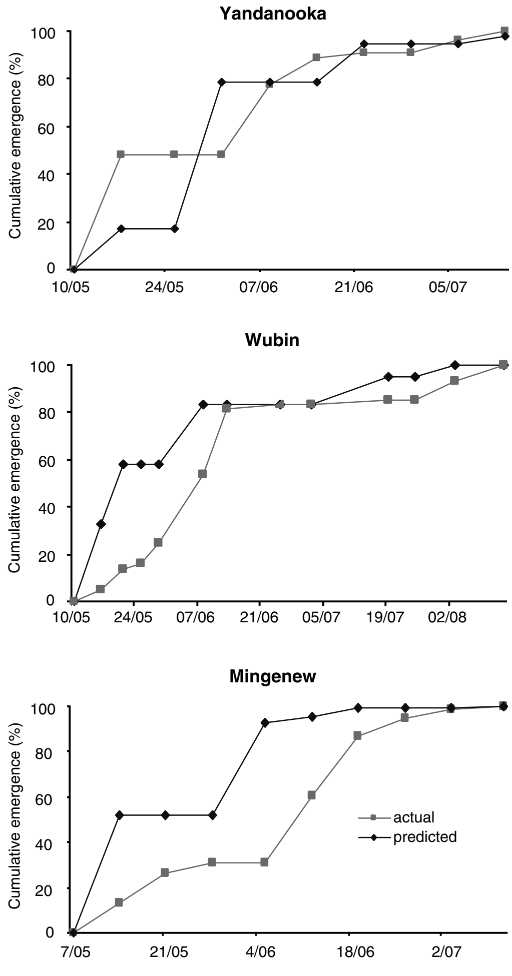

Figure 1. Actual and predicted cumulative emergence of wild radish at three locations in the Western Australian wheatbelt during the 2001 growing season.

higher and lower respectively for these two locations for the remainder of the growing season.

Feedback received from farmers who evaluated the WEEDEM program was extremely positive on the potential use of this program in managing weed control practices. Valuable information was gained from farmers who used this program for the first time to develop predictive wild radish and annual ryegrass cumulative emergence curves (Table 1). As expected given the lack of development of the program most responses indicated the short-comings of the program for first time users. All users found that the output although a little difficult to view would be extremely valuable in planning weed control strategies if the predictions were accurate. There were some concerns expressed by farmers on the lack of close correlation between the predicted and observed wild radish emergence patterns. The evaluation data will be used in the future development of the WEEDEM program.

DISCUSSION

The WEEDEM program has the potential to improve the management and delivery of weed control practices in the dryland crop production systems of Western Australia. Despite the simplistic nature of the emergence model and the lack of data used to develop it reasonably accurate predictive data were derived for three locations, Wubin, Yandannooka and Mingenew for the 2001 growing season. The shape of the predicted emergence curves mirrored those of the actual cumulative emergence curves determined from emergence counts conducted in farmers wheat crops over this season (Figure 1). These results indicate that the wild radish emergence model within WEEDEM was able to predict with some accuracy the emergence of wild radish in three separate environments.

The evaluation of this software by Western Australian crop producers provided positive feedback on the potential value of this program in the development of weed management programs. In particular, the surveyed farmers felt that the greatest potential benefit from deriving predictive emergence curves was the possibility of more effective early season weed control. All users felt that a refined version of the software would be a valuable asset for their production system. Of particular interest was the need to include additional weed species and an expansion of the tillage techniques to suit the current farming systems.

The discrepancies between actual and predicted cumulative wild radish emergence observed at all sites indicated that further validation of this emergence model is required before it can be released for general use. It is envisaged that this model would be most valuable in estimating the proportion of emergence that has occurred following the season commencing rainfall. Unfortunately there was not a high degree of accuracy in the prediction of the wild radish emergence during the initial stages of the growing season (Figure 1). This is the critical period for the implementation of strategic weed control practices. The feedback from the farmer users clearly indicated that the greatest use for the WEEDEM program would be in assisting farmers to plan weed control procedures over this period. Therefore the variation between predicted and actual emergence that was observed at all three counting sites indicates that the model currently could not be used to accurately estimate early season emergence. There is a clear need to refine the wild radish emergence model using recently collected data to improve early season predictions.

Table 1. Summary of responses to questions asked on the use and properties of the WEEDEM program.

Feedback requested	Summary of responses
Ease of use	Not obvious what input is needed Need explanation of variable requirements Easy to use once instructed on use
Tillage systems/ Soil types	Need more variety e.g. Deep ripping, ‘Medium till’, fallow, tickle Broader range of soil types e.g. Acid sands, non-wetting soils
Weeds included	Common and scientific names Additional weeds e.g. Doublegees, cape weed, brome grass, wild oats
Weather data	Requested readily accessible weather data from internet Difficult to manually input weather data
Output	‘Fantastic’ for planning weed control if accurate Needs more detailed explanation Plot rainfall with emergence Plot emergence months not entire year

ACKNOWLEDGMENTS

The authors wish to thank the five farmers Ros Duane, Jan Michael, Helen Freeman, Blayn Carlshausen and Mick Desmond who diligently counted wild radish emergence on a weekly basis and recorded daily rainfall throughout the 2001 growing season.

REFERENCES

Archer, D., Eklund, J., Walsh, M. and Forcella, F. (2002). WEEDEM: A user-friendly software package for predicting annual ryegrass and wild radish emergence. Proceedings of the 13th Australian Weeds Conference, Perth.

Cheam, A.H. (1986). Seed production and seed dormancy in wild radish (*Raphanus raphanistrum* L.) and some possibilities for improving control. *Weed Research* 26, 405-413.

Panetta, F.D., Gilbey, D.J. and D'Antuono, M.F. (1988). Survival and fecundity of wild radish (*Raphanus raphanistrum* L.) plants in relation to cropping, time of emergence and chemical control. *Australian Journal of Agricultural Research* 39, 385-97.

Reeves, T.G., Code, G.R. and Piggin, C.M. (1981). Seed production and longevity, seasonal emergence and phenology of wild radish (*Raphanus raphanistrum* L.). *Australian Journal of Experimental Agriculture and Animal Husbandry* 21, 524-530.