# MODELLING THE FATE OF BROME GRASS IN THE LUPIN/WHEAT ROTATION

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*Summary*. This paper describes a simulation model for brome grass that gives an indication of the seed bank dynamics under different weed control regimes in both the lupin phase and the wheat phase. The model shows that simazine and a grass selective herbicides are essential to reduce the weed seed bank during the lupin phase so that the yield potential of the following wheat crop is not reduced. Brome grass seed bank is, however, replenished in the wheat phase and delayed seeding did not reduce the weed seed bank significantly. At present there is little information on the impact of the seeding operations on the seed bank and validation of the seed decay curve is necessary.

## INTRODUCTION

The lupin-wheat rotation is a very productive cropping system on the sand plain soils of Western Australia. With the adoption of minimum tillage for wheat production and early seeding, brome grass has become a dominant weed, as there are no selective herbicides registered for its control in wheat. At present farmers are relying on grass selective herbicides in the lupin phase to reduce brome grass seed carry-over into the wheat phase. However, it is important to incorporate control options into an integrated program for the long term sustainability of the lupin-wheat rotation. Modelling the impact of control techniques on weed seed production and carry-over will be valuable for the development of an integrated weed control program.

A simulation model of the life cycle of brome grass was used to study the effect of varying the degree of kill through the use of chemicals and delayed seeding on the long term seed population trends in the lupin-wheat cropping rotation.

## MODEL

The simplified life cycle model for brome grass was adapted from a model for wild oats (3). This includes a proportion of the seed bank which produced mature plants in the crop , the number of seeds produced and the mortality of seeds in the seed bank. The model was programmed in Microsoft Excel and runs on a PC.

We have assumed that the seed decay curve is sigmoidal (Fig. 1). The depletion of the majority of the seed bank occurs within 12 months following seed production (1). Seed decay was assumed to be minimal immediately following production in December due to innate and enforced dormancy. The innate dormancy of *Bromus* sp is short and generally does not extend into the winter months (2).

Brome grass seed production was described by a hyperbolic, non-linear function of weed density (pers comm. Cheam). Seed production approached an upper limit of 6500 seeds/$m^2$ as weed density increased to 1000 plants/$m^2$ (Fig. 2).

Assumptions were also made about efficacy of the herbicides used in the model; simazine (75%), grass selective herbicide in lupin phase (95%) and herbicides in wheat (70%).

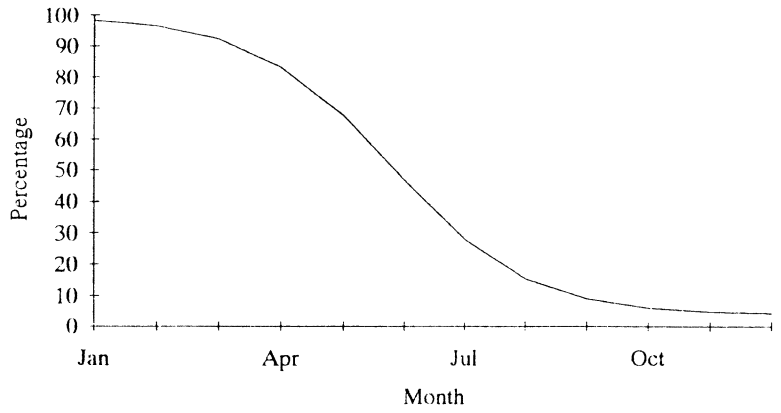



Figure 1. Relative decay of brome grass seed following production in December.

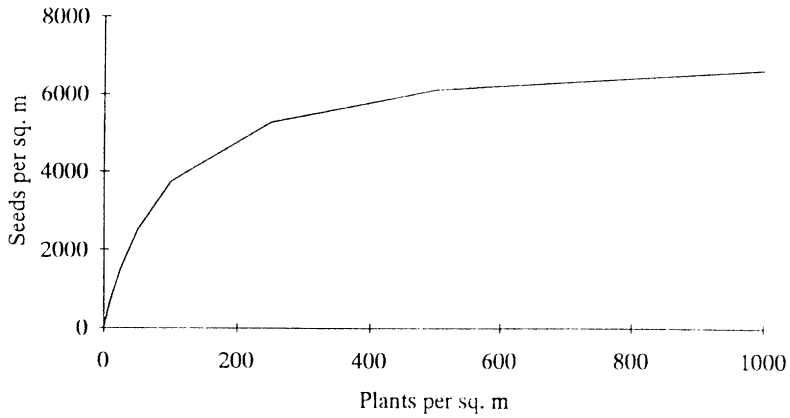
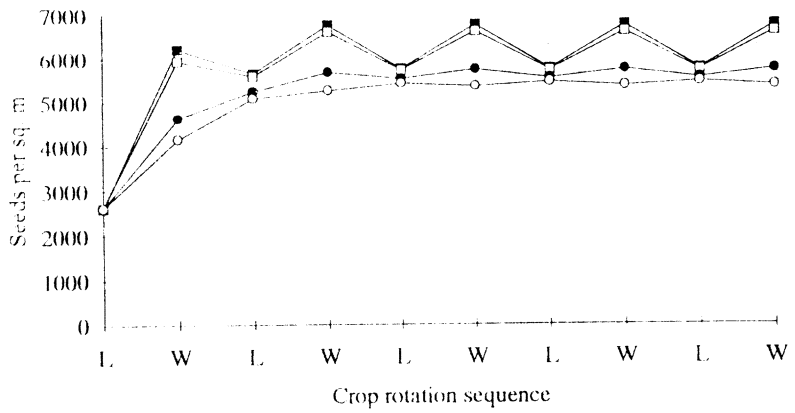



Figure 2. Relationship between brome grass seed production and weed density

## RESULTS AND DISCUSSION

The main effect of not applying a grass selective herbicide in the lupin phase was a rapid increase in the brome grass seed bank in the first two years of the rotation. The initial seed bank was set at 1000 seeds/$m^2$. At the end of the first lupin crop in which simazine only was applied, the seed bank had increased to 3000 seeds/$m^2$. In contrast, the seed bank was reduced to 300 seeds/$m^2$ at the end of the first lupin crop when both simazine and a grass selective herbicide were applied.

a) simazine in lupin




b) simazine plus grass selective herbicide in lupin.

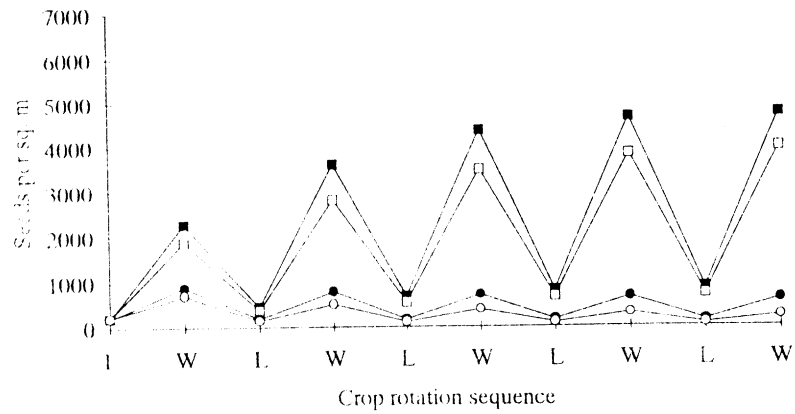



Figure 3. Effect of herbicides in wheat and delayed seeding of wheat on brome grass seed bank in the lupin (L)-wheat(W) rotation.
(■ :early sown wheat, no herbicide; □ :late sown wheat, no herbicide; ● :early sown wheat, plus herbicide; O :late sown wheat, plus herbicide).

Replenishment of the seed bank occurred in the wheat phase. Following the depletion of the seed bank during the lupin crop where simazine and a grass selective herbicide were used, the seed bank was replenished in the following wheat phase to greater than 2000 seeds/$m^2$. However, adopting the use of a herbicide with 70% efficacy in the wheat phase maintained the

weed seed bank at about 500 seeds/$m^2$ in the following wheat year. The impact of delayed seeding of wheat was a slight reduction in the weed seed bank relative to early sowing.

The model indicates that the best management practice to ensure that the brome grass seed bank does not increase to the maximum level and impact on wheat production is the use of grass selective herbicides in the lupin phase. The use of chemicals or cultural practices in the wheat phase were not essential. However, the grass selective herbicides used in lupins are effective on both brome grass and annual ryegrass. While targeting control of brome grass, annual ryegrass populations resistant to the grass selective herbicides could develop and the model does not incorporate the impact of the continuous herbicide usage on the altering weed spectrum. Hence we need to reduce the reliance on grass selective herbicides for brome grass control and develop an integrated approach to weed control which is economically sustainable. The brome grass seed bank model will be valuable for the development of an integrated weed control program. Validation of the model is not complete. At present there is little information on the impact of the seeding operations on the seed bank and weed establishment. Validation of the seed decay curve is also necessary.

## ACKNOWLEDGEMENTS

We would like to thank Dr Cheam for providing the data on seed production of brome grass and gratefully acknowledge the support given by the Grains Research and Development Corporation-WA Committee.

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