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Summer survival of seedling phalaris

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Phalaris based pastures are traditionally established in autumn. With late seasonal breaks many producers consider establishing phalaris pastures in late winter/spring. While this may present an opportunity for additional weed control, there are some risks associated with late sowing of phalaris. To better quantify these risks, an understanding of the key factors that determine plant survival over the critical first summer is needed.

The plant

The south-west slopes is a typical summer dry environment. That is, seasonal rainfall is biased towards the winter period and summer temperatures are high. For perennial plants to survive under these conditions they need to have either a very deep root system with access to sufficient soil moisture or have some form of summer dormancy.

Dormancy in phalaris is centred around a tuber with associated dormant buds (hence its original scientific name of Phalaris tuberosa) which form at the base of flowering tillers during seed set. The tuber stores food reserves to initiate shoot development which occurs once dormancy has lifted after the season breaks.

Exposure to winter cold also seems to be necessary for full dormancy. Plants sown in spring that flower do not express dormancy as intensely as those which have experienced a winter. It is thought that this occurs because winter cold enhances the production of dormancy, inducing hormones.

The tuber allows the plant to dramatically reduce green leaf area and subsequent water use over the hot dry months. Plants that do not have tubers and remain vegetative must have sufficient available soil moisture to maintain green leaf area over summer in order to survive. Tillers only form tubers and resting buds if they become reproductive. Allowing the plant to flower and set seed will maximise the size of tubers and the number of dormant buds.

Soil moisture

Soil moisture over summer is the main determining factor for summer survival of phalaris plants. Hoen (1966) compared two varieties of phalaris at two densities and subjected these plants to two watering regimes. Spaced plants were established in large pots and placed in the field at Wagga Wagga.

Rain was excluded from the trial after mid-December using clear sheeting suspended over the trial site. Un-watered plants received no additional moisture from mid-December until early April when the first autumn rains fell. Watered plants received supplementary soil moisture approximately equalling normal rainfall until the end of February and half of the normal rainfall during March. The results are shown in Table 1.

At the lower plant population the unwatered treatment suffered a significant loss of plants due to drought. The early maturing line CPI 19331 (from which Sirocco was developed) experienced much less plant loss than the variety Australian.

Competition from adjacent plants at the high plant density resulted in a significant loss of plants under both of the watering regimes. Again, the earlier maturing variety that enters dormancy sooner exhibited better survival than Australian.

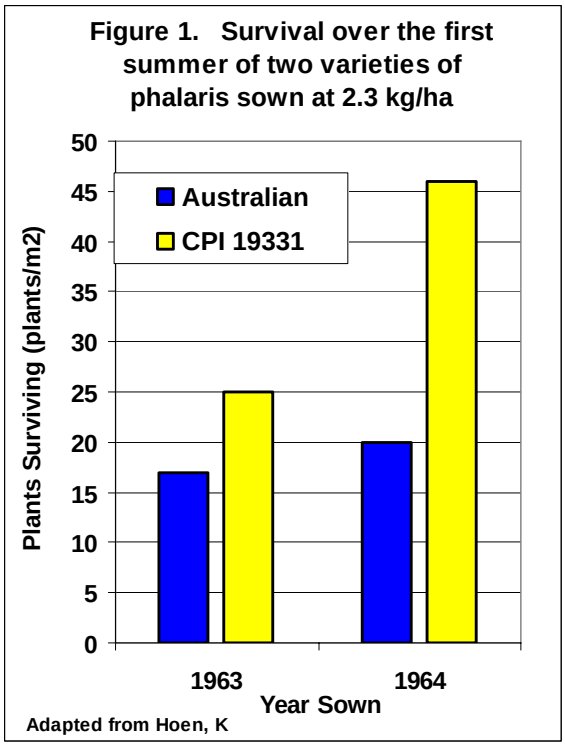
Table 1. Effect of water, variety and plant density over summer on survival

Number of surviving phalaris plants/m2
(% plant survival)

	Initial population = 50/m^2		Initial population = 300/m^2	
Variety	Watered	Not watered	Watered	Not watered
Australian	46 (92%)	21 (42%)	136 (45%)	97 (32%)
CPI 19331	50 (100%)	38 (76%)	210 (70%)	147 (49%)

Adapted from Hoen, K. (1966)
CPI 19331 is a strongly summer dormant type

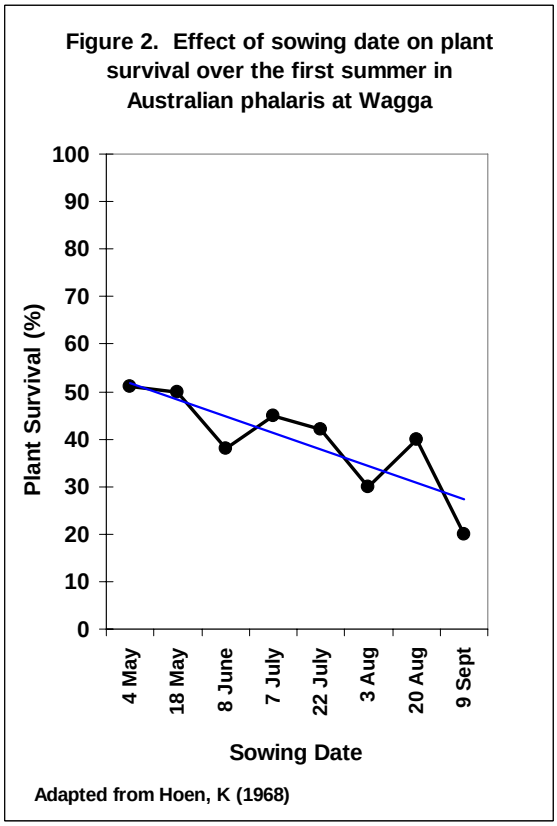
Sward trials over two years (Figure 1) also reflected the ability of the more summer dormant CPI 19331 to survive better than Australian phalaris in conditions of low soil moisture over summer.



After considering the original sown population, only around 15% of the Australian phalaris seed sown managed to establish and then survive over summer. These survival rates are comparable to those observed in commercially sown pastures in the Wagga Wagga district. The higher survival of CPI 19331 (between 18% and 33% of seed sown) is a reflection of earlier maturity, greater dormancy and stronger seedling vigour.

Sowing date

In another experiment, the effect of sowing date on summer survival of phalaris demonstrated reduced survival with later sowing (Figure 2). It should be noted that initial establishment losses have been accounted for. The survival percentage is the number of plants found after the autumn break (April 1965) compared to the number at the start of summer (December 1964).



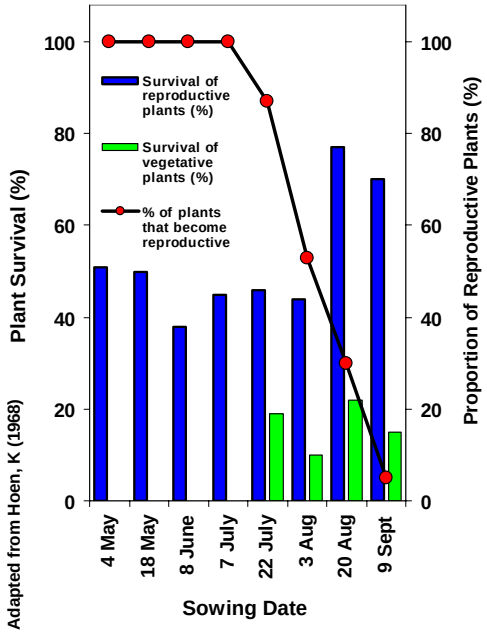
Over the course of this experiment there was good seasonal rain until September. August rainfall was less than a third of average, followed by above average spring rain. Almost no rain fell during January to March.

Strong dormancy will enhance survival by stopping the plant from responding to false breaks because many of the plants which do respond die off when dry conditions return before the true seasonal break arrives.

Because dormant buds and tubers only form at the base of reproductive tillers, sowing early enough to ensure that they experience some winter cold and become reproductive will have a positive influence on summer survival.

Sowing up until early July resulted in all plants turning reproductive (Figure 3). The proportion of reproductive plants declines sharply the later they are sown after mid July. The poor survival of vegetative plants compared to reproductive plants is shown in Figure 3.

Figure 3. Effect of sowing date on per cent of reproductive plants, percent survival of reproductive and vegetative plants of Australian phalaris at Wagga



The increased survival of reproductive plants in the last two sowings is attributed to a reduction in germination and reduced plant density from dry conditions during August. However, they only represent 30% and 5% of all plants respectively.

Plant size

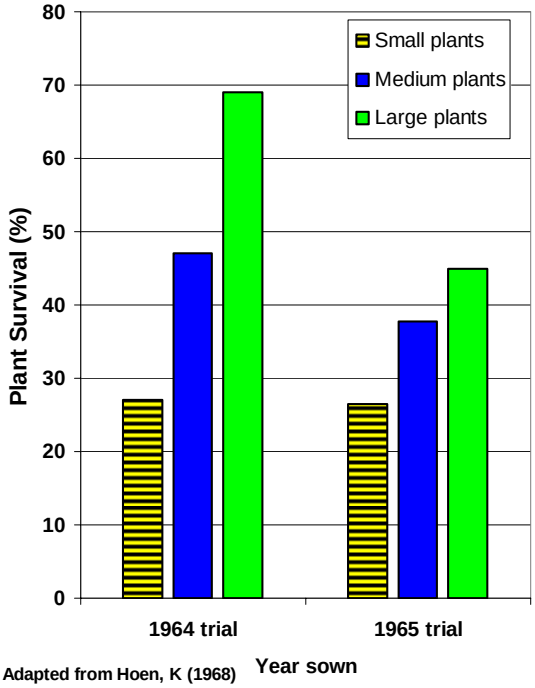
There is also a strong relationship between plant size and survival in phalaris pastures (Figure 4). Larger plants have a larger root system, thereby enabling them to access more soil moisture and nutrients and out-compete smaller plants. This relationship holds true for both reproductive and vegetative plants, though it should be remembered that survival of vegetative plants is compromised and still lower overall.

While there will be some genetic differences between varieties for producing larger plants, plant age and plant density would most likely have a greater impact on plant size. The most practical way to achieve larger plant size is by sowing as early as possible and limiting plant density through sowing rate.

Sowing method (e.g. direct drill or broadcast) will also have a strong influence on establishment and must be considered when calculating sowing rates.

Cover crops will compete with the establishing phalaris for soil moisture and should be avoided.

Figure 4. Effect of plant size on phalaris survival over the first summer at Wagga



Conclusions

- The biggest risk factor when establishing phalaris is the amount of available soil moisture in spring and summer. While it may not be possible to predict rainfall and subsequent soil moisture, you can help to minimise risk with a better understanding of plant physiology.
- Control weeds that compete for soil moisture. This may not only include a knock-down spray just before sowing, but weed control in the years prior to sowing. This is especially important for grass weeds as there are very few herbicide options for use in establishing phalaris.
- Sow early enough to ensure that plants become reproductive in the year of sowing. Allow these heads to set seed, thereby producing dormant buds and tubers to maximise summer dormancy. At Wagga Wagga, this means sowing before mid-July.
- Varieties with high summer dormancy, such as Atlas PG, more readily enter the reproductive

phase and are therefore more likely to tolerate later sowing and dry summers.

- Do not cut for hay or graze heavily in the year of establishment.
- Size influences the plants' ability to survive over summer. Large plants have higher survival rates.
- Don't establish an excessively high plant population which will result in smaller plants that are less able to cope with dry conditions over summer.
- A productive phalaris stand will have about 20–30 plants per square metre. A sowing rate of 1.5 kg/ha will distribute about 90 seeds per square metre. Under good conditions, approximately 20 plants per square metre will remain after the first summer.
- Sow seed with a high germination capacity. Regularly measure the establishment attained when establishing pasture with your machinery. Use this information to refine sowing rates.
- To be profitable, phalaris based pastures will need to last at least five years or preferably longer. Select the variety that has the correct maturity length for your environment as well as sufficient dormancy to resist false breaks in summer dry environments.

Acknowledgements

Mark Norton, NSW Department of Primary Industries, Canberra

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References

Hoen, K. (1966) The effect of temperature and soil moisture on summer survival of two varieties of Phalaris tuberosa. *Australian Journal of Experimental Agriculture and Animal Husbandry* 6:280.

Hoen, K. (1968) The effect of plant size and development stage on summer survival of some perennial grasses. *Australian Journal of Experimental Agriculture and Animal Husbandry* 8:190.

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PASTURE IMPROVEMENT CAUTIONS
Pasture improvement may be associated with an increase in the incidence of certain livestock health disorders. Livestock and production losses from some disorders are possible. Management may need to be modified to minimise risk. Consult your veterinarian or adviser when planning pasture improvement.

The *Native Vegetation Act 2003* restricts some pasture improvement practices where existing pasture contains native species. Inquire through your office of the Department of Natural Resources for further details.

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