1-1-1989

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Recommended Citation
Perry, M W.; Anderson, Wal; and Delane, Rob (1989) "Early sowing : one key to improved yields of cereal crops," Journal of the Department of Agriculture, Western Australia, Series 4: Vol. 30 : No. 1 , Article 8. Available at: https://researchlibrary.agric.wa.gov.au/journal_agriculture4/vol30/iss1/8

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EARLY SOWING - one key to improved yields of cereal crops

In the following six articles, officers of the Department of Agriculture's Division of Plant Industry discuss the potential for increasing yield through early sowing, particularly of wheat, some of the results of recent research and their implications for the management of cereal crops.

In the northern and central wheatbelt, early sowing of cereal crops will improve yields.

By Mike Perry, Principal Officer, Wal Anderson, Research Officer, South Perth and Rob Delane, Research Officer, Geraldton

Influences on crop yield

Cereal crop yield is a function of the complex interaction between the plants, the weather, soil and management. In dryland farming systems, water supply, largely determined by the low and erratic rainfall, is the most important constraint to crop yield.

Where the water supply is limiting, a plant's water use efficiency has a large bearing on yield. All management practices which improve yield increase a crop's water use efficiency. For example, correcting nutrient deficiencies may increase growth without changing water use, hence increasing efficiency; and by controlling weeds, water otherwise lost is made available to the crop.

Early sowing is another important management technique that can improve the efficient water use and thus increase grain yield. How efficiently a cereal crop uses water depends on the dryness of the atmosphere and, within reason, the earlier crops are sown in autumn, the more of their growth occurs when the humidity is high, allowing a highly efficient water use. This is particularly important during grain filling because 70 to 80 per cent of the material which forms the grains is made from atmospheric carbon assimilated after flowering.

Water use efficiency deteriorates rapidly in spring as temperatures rise and humidity falls. In general, the later in the season that crops are sown, the later in spring it flowers, and the more detrimental are the conditions during grain filling.

Lower temperatures in mid-winter also have a bearing on why early sown crops have the potential to produce higher yields. For example, in the central wheatbelt, each week by which sowing is delayed after May 1, delays maturity by three days. Thus a crop sown in the first week of May has a life cycle two to three weeks longer that that of a crop sown in the first week of June.

It is the combination of these two processes - the longer life cycle allowing greater growth, and the more efficient water use particularly during grain filling in spring - that gives early sown crops a greater yield potential. Figure 1 shows these two processes schematically. Early sowing, however, also has some associated risks and any decision to start a sowing programme earlier than usual must take these into account.
Risks associated with early sowing of cereals

False breaks

Cereal crops sown on an early 'false break' without follow-up rain may germinate and 'malt', giving patchy, poor establishment. The risk of a false break increases as sowing dates are brought forward, but cereal crops are very drought tolerant in the seedling stage and usually survive provided that there is enough moisture to permit germination and shoot development.

Weeds

Weeds are the biggest threat to successful early sowing especially where there are grasses which cannot be controlled effectively with in-crop herbicides. Brome grass on sandplain soils in the northern wheatbelt and barley grass on heavy soils are the two most common problem grasses.

Careful paddock selection and preparation are essential if grass weed problems are to be minimized in early sown cereal crops. Increased use of cereal-legume (crop or pasture) rotations with control of grass weeds has greatly improved farmers' ability to successfully exploit early sowing.

Frost risk

Frost damage in cereals, in particular wheat, in Western Australia occurs in spring when crops are flowering or filling grain. Early sown crops are at more risk than crops sown late because they flower earlier when the risk of damaging low temperatures is greater. The risk of damage is greatest in the western portion of the Great Southern from Pingelly to Kojonup, although frosts do occur and do cause some damage throughout the wheatbelt in an average year. See "Frost injury to wheat" on page 32 of this Journal.

Leaf diseases

The incidence of the leaf diseases septoria and yellow spot are often greater in early sown crops than in crops sown late. These pathogens spread through the canopy of the crop by rain splash, and infection of the flag leaf and head is more likely when these emerge early when the weather is cool and wet.

Apart from exceptionally early sowing or very high rainfall sites, the advantages of early sowing will outweigh the effects of leaf diseases. See "Leaf diseases of wheat and time of sowing" on page 37 of this journal.

Variety adaptation

Choice of the correct variety is also important for early sowing.

Some short season (early maturing) wheat varieties which may be the correct choice when sown in mid to late May or June, may be entirely the wrong choice for sowing earlier. This is because these varieties (Gutha, Aroona, Wilgoyne and Kulin) go through their life cycle quickly if sown when the weather is warm. This has been the cause of farmers' experiences of crops 'running up into head' in July or early August. Because these crops have developed quickly, they produce few heads, have a low yield potential and are susceptible to septoria diseases and weather damage.

Figure 1. Crops sown in May generally have a longer life cycle and fill grain under more favourable conditions than crops sown in June.
Other varieties such as Halberd, Gamenya, Spear and Dagger have a requirement for exposure to low temperature before development proceeds and these are safer for very early sowings. Similar considerations apply to the other cereal crops.

This very early flowering ('precocious') development was seldom a problem in wheat in the past because very early sowings were uncommon. Or, where they did occur on early sown or dry sown fallow land, farmers used old varieties such as Bencubbin specifically because they did not head too early in the season. However, with the use of herbicides and direct drilling, farmers now have the ability to sow quickly following an opening rain. If this opening rain comes in late April or early May, farmers face a difficult choice between sowing with a variety which may develop too rapidly or waiting for an uncertain follow-up rain.

Farmers should hold seed stocks of more than one variety so that some choice of variety is possible, depending upon the seasonal opening. Costs of holding additional seed are considered further in the accompanying article on early sowing in the northern wheatbelt.

**Grain yield depends on flowering date**

Cereal growers need to balance the potential benefits of early sowing with the risks of yield loss from the detrimental influences discussed previously. Taken together, these define a 'best' flowering time or flowering 'window' when grain yields will be maximized. Crops that flower too early will be lower yielding because of frost or disease, or because development has been too rapid; whilst crops flowering later than the 'window' are lower yielding as temperature stresses and lack of water limit grain filling. This results in a relationship between flowering date and grain yield such as that in Figure 2.

The flowering 'window' will differ from one location to another and from one season to another depending on temperature, disease incidence and timing of the last effective rainfall. Since none of these events is entirely predictable at sowing time, the best way to determine the approximate starting and finishing dates of the 'window' is from experiments over several seasons.

As an example, Figure 3 shows the relationship between flowering date and yield from experiments at Wongan Hills. Work is going on to determine the flowering 'window' for other locations throughout the wheatbelt, but where exact information is not available, local knowledge of farmers and advisers will provide a guide to the most appropriate flowering time. For most locations, the 'window' is about 30 days long, but it is shorter in frost prone environments and probably also on the low rainfall eastern margins of the wheatbelt.

**Matching wheat variety and sowing date**

This concept of a flowering 'window' is critical to the exploitation of the advantages of early sowing. The producer's objective must be to choose a high yielding variety which flowers...
within the flowering 'window' from a given sowing time. In other words, producers must match variety and sowing date. Longer season (late maturing) varieties should be sown, in general, earlier than usual and short season (early maturing) varieties should be sown later to match their flowering dates to the flowering 'window'. Variety and sowing time for a particular location can be matched by using the FLOWER model described in "FLOWER: Predicting flowering times of cereal crops" on page 35 of this Journal.

Figure 4 shows the suggested general sequence of sowing times for wheat, barley and oat varieties. The sequence is based on a combination of trial information and observations of variety development and should be used as a general guide in the selection of varieties. The sequence may change a little from site-to-site and the actual sowing date will vary according to the timing of the 'break' in a particular season.

Many trials in the northern and central parts of the wheatbelt have confirmed the increased yields possible through early sowing provided that variety is matched to sowing date. These results are discussed in the two following articles. For other areas of the wheatbelt, less specific information is available, but the principles discussed in this article should also apply. On the south coast and in the Great Southern region, the State Wheat Research Committee is funding wheat agronomy projects with the aim of defining the best variety and management combinations for improving grain yield.