IMPROVING THE ESTABLISHMENT OF OILSEED RAPE

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ABSTRACT

About half the cost of growing oilseed rape in the UK is associated with establishment; a process which is prone to failure and consequently can lead to loss of revenue. This paper presents the progress towards improving establishment by examining the potential for improving seed quality. Following extensive studies of the seedbed environment, the obstacles that the seed and seedling have to overcome to produce a viable plant capable of contributing to yield have been identified. During examination of commercial lots of seed, we have found that there is scope to improve the quality of the seed to overcome some of these obstacles in the seedbed and hence reduce the risk of failure. Specifically, it was identified that there is considerable variation between seedlots in terms of speed and uniformity of germination as well as total germination under field temperatures. Advancement (seed priming) proved to be a valuable tool to synchronise and hasten germination. Selecting larger seed (>2mm diameter) improved emergence from depths greater than 3cm, compared to smaller seed. More importantly, there is mounting evidence that improvements in seed quality can be achieved directly through manipulation of the ripening environment on the mother crop. Seed produced from crops with more open canopies with a more uniform ripening environment germinated more rapidly and produced larger seedlings than seed produced from more dense canopies.

KEYWORDS
Oilseed rape, establishment, seed quality

INTRODUCTION
About half the cost of growing oilseed rape in the UK is associated with establishment (McWilliam, 1998). Establishment is taken here to encompass the period from September to March during which there is great uncertainty about the outcome, especially for the 60% of the UK crop sown into heavy clay soils where cereal residues have been incorporated (McWilliam *et al.*, 1995). Minimising the number of crops which have to be 'patched' or totally redrilled will bring major savings in labour, machinery, fuel and the use of additional fungicide and insecticide treated seed. Reducing patchiness not only minimises the need to manage the crop according to its most backward and poorest areas, thus enabling better precision but it also reduces costs directly: full crop cover presents less opportunity for weeds and pigeons, ripening is more uniform, thus there is reduced need for pre-harvest desiccants.

RESULTS

Our work to improve establishment began with detailed examinations of germination, emergence and seedling survival in a wide range of contrasting seedbeds created on heavy clay soils using various cultivation strategies to incorporate straw. The aim was to provide a better understanding of the influence of cultivation on the physical structure of the seedbed, and to examine the implications for seed and seedling performance. This work, reported previously (Scott *et al*., 1994; Bullard *et al*., 1996; McWilliam, 1998) has shown that better choice of cultivation based on the condition of the soil, can make small but important improvements in establishment across almost all soils.

The work, reported in full by McWilliam (1998), demonstrated that greater understanding of the establishment process can be achieved by analysing three key phases, namely germination, emergence and post emergence survival (Figure 1). In the majority of the experiments, the events which had the greatest impact on final establishment were those operating between germination and emergence. Furthermore, McWilliam (1998) also suggested that the quality of the seed itself can have a far greater impact on success or failure than was hitherto thought to be the case.

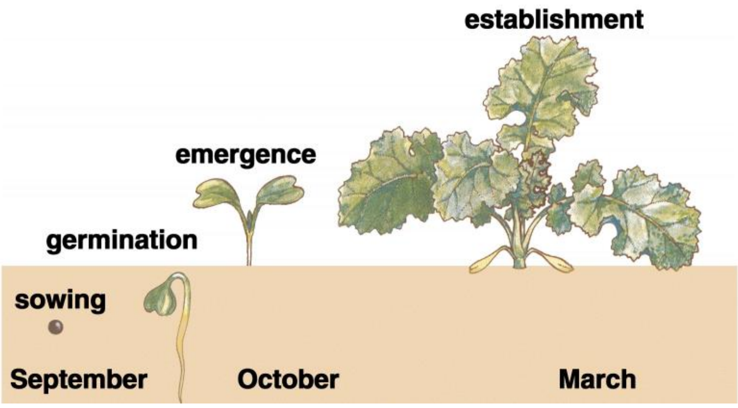

Figure 1: The phases of establishment

It appears that in most seedbeds, the difference between success and failure is very finely balanced. For example, as well as water potential stress resulting directly from dry soil, the size of the soil aggregates, presence of straw, osmotic stress from fertiliser N and depth of sowing can all affect water supply at the location of the seed /seedling. Desiccation of the seedling often caused failure and this is one of the major concerns for growers where water supply is marginal. In these conditions, rapid germination and fast growth of the young root is crucial if the seedling is to penetrate to moisture at depth, in advance of the soil's drying front (Figure 2). In addition, rapid emergence results in earlier growth to a point where the seedling is better able to tolerate the stresses experienced later during growth. Our attention has therefore turned to examine the potential benefits which might be achieved from improving seed quality.

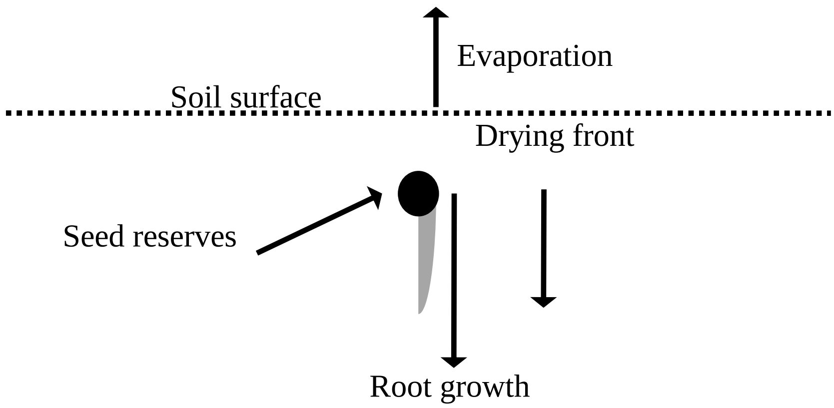

Figure 2: Diagrammatic representation of the 'race' between root growth and the progress of the drying front through the soil profile.

This next section reviews the evidence we have found to enable us to suggest that seed improvement is a worthwhile avenue for improving establishment. The work has been reported fully elsewhere (Stokes *et al.*, 1997) and here, the more important findings are presented. The seed used in these experiments was taken from 16 lots sampled from batches sown in the autumn 1996 sourced from commercial farms and ADAS Research Centres and are therefore considered to be representative of the seed sown commercially.

Germination

The ability of the seed to germinate is a fundamental requirement for successful establishment. To investigate whether or not failure during germination might be directly related to poor establishment, the germination characteristics of the 16 seedlots were measured in the laboratory by germinating at 20, 15 and 10°C. 20°C was close to the optimum temperature for maximum germination of all 16 seedlots, and there was little difference in maximum germination between varieties and seedlots of a variety. However, at temperatures closer to those operating in the field during autumn drilling in September in the UK, (10-15°C), the speed and uniformity of germination varied significantly between seedlots with some taking twice as long for 90% of seeds to germinate. Furthermore, the final germination in some seedlots was markedly reduced with between 25- 50% of seeds failing to germinate (Table 1).

Table 1: The effect of temperature on final germination in the laboratory of three seedlots of the same variety.

~~**preliminary evidence using 16 commercial seedlots suggests that the germination patterns of oilseed rape under a range of temperatures is not consistent between seedlots of the same variety.**~~

~~**in some seedlots, germination was markedly poorer at the lower end of the temperature range experienced in the field during September.**~~

Seedlot	Germination temperature (°C)		
	10	***15***	***20***
S 1	76	94	93
S 6	57	94	100
S 13	32	87	98

Seed advancement

Hastening the onset of germination leads to earlier root growth. This reduces the potential for evaporative loss of water from the seedbed before the seedling reaches the sensitive stage of radicle emergence. In these conditions, the seed can be improved by completing part of its pre-germination events in ideal conditions in the laboratory. A simple seed 'priming' technique consisting of imbibing seed in water for 18 hours at 15°C, followed by drying at 20°C to constant weight, has been used to advance seed close to the point of germination. We have shown that seed advancement is a valuable tool for hastening and synchronising germination leading to earlier, more uniform and more complete emergence (Figure 3).

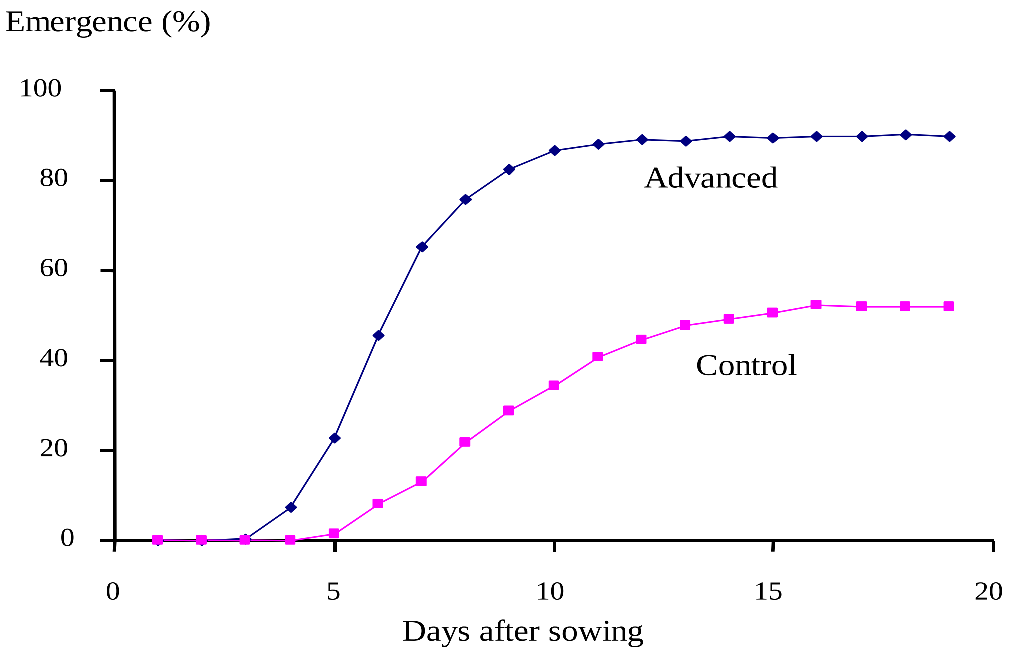

Figure 3: Effect of advancement on emergence of seedlings from seeds down 3cm deep into a sandy loam.

Seed reserves

If seed is sown deeper, or it 'trickles' to depth in dry seedbeds, it is less vulnerable to desiccation. However, McWilliam *et al*. (1995) demonstrated that seed sown deeper than 2-3cm often failed because the seed ran out of reserves before the cotyledons reached the surface. This effect was exacerbated when the surface layers of the soil slumped and were more consolidated or when many large aggregates were at the soil surface. We have shown that selection of larger seed with greater reserves is possible. From commercial seedlots sown by growers in 1996, selection of the seed >2mm diameter increased individual seed weight by 30%. This resulted in a 40% improvement in emergence when seeds were sown 3cm deep into soil.

DISCUSSION

Improving the quality of the seed is an approach which is likely to produce significant benefits in almost all circumstances without any significant increase in risk. It therefore appears that the most valuable gains in establishment are likely to come from improving seed quality and then integrating these benefits with the improvements that can be gained from better seedbed preparation. For the rape crop though, t~~It is clear that the production of a suitable seedbed is only part of the requirement for ensuring a high level of establishment. Increasingly, there is more need to consider the quality~~

~~of the seed. The current approach adopted by farmers in the absence of any suitable alternatives is to drill seed at a rate much higher that the target plant population required. Notwithstanding the inherent risks of this approach, the move towards more expensive hybrid seed which require lower densities for optimal performance demands that a new approach is taken.~~

~~X~~he majority ~~X%~~ is sown from seed from the recent harvest, whilst a smaller (about 20%), but increasing, proportion ~~xx%~~of largely hybrid seed ~~-~~has been carried forward from one year's harvest to sowing 12 months later. Thus, for the majority of the rape crop, ~~These provide different opportunities and risks for the seed producer and grower. {LIZ WILLIAMS TO PROVIDE DETAILS} T~~there is ~~usually~~ little or no time between harvesting seed from the mother crop and drilling. ~~—This~~ However, there is mounting evidence that improvements in seed quality can be achieved directly through manipulation of the ripening environment on the mother crop. Seed produced from crops with more open canopies with a more uniform ripening environment (from our experiments on Canopy Management) ~~may show better~~ germinat~~ion~~ed more rapidly and produced larger seedlings than seed produced from more dense canopies~~and emergence and early growth~~
~~seed from low N fertiliser treatments produce poorer establishment~~
~~large seed remain more vigorous regardless of the condition of the mother cr~~. The explanation for this appears to be linked with more uniform maturity of the seedlot. From commercial seedlots sown by growers in 1996, separation of seedlots into seeds with contrasting maturity (darkness of the seed coat) showed that the more mature (more dark) seed germinated faster resulting in earlier root growth.

Improving the quality of the seed for resowing must therefore begin with an examination of precisely how the management of the mother crop can be improved to produce larger and more mature seed. Then, the potential for further improvement should be examined through selection and pre-treatment especially for the increasing proportion of seed which is overwintered. The full value to the grower will then derive from sowing better quality seed into improved seedbeds resulting from better choice of cultivation (Bullard *et al*., 1996).

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CONCLUSIONS

This on-going work to improve returns from oilseed rape is showing that there are potentially large benefits to growers from improving the quality of the seed for resowing. Improving seed quality is likely to come from two complimentary pathways. First, from a better understanding of how to manage crop growth so that the ripening environment is optimised for the production of fully mature seed and second, by implementing appropriate seed selections and treatments.

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