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## **Collection and dormancy testing of black-grass seed**

by

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## **ABSTRACT**

The aim of this three month project was to provide continuation of information on black-grass dormancy for the 2006 season. The project followed on from the LINK project 'Improving profitability by using minimum cultivations and exploiting grass weed ecology' (LK0923/HGCA 2469) which finished in August 2005 (Project Report No. 381). Seed was collected from 37 sites and assessed for dormancy level during summer 2006. Results were issued as a press release during mid-August 2006 to coincide with cereal harvest and cultivation planning. This information included the dormancy status and guidelines on the implications of this on black-grass management for the following season.

The data from 2006 fitted the pattern seen in the previous years of 2001, 2003 and 2005. In these years, as in 2006, mean maximum and minimum temperatures were hotter than average, hours of sunshine were above average and dormancy low. Dormancy levels in 2006, measured in the seed samples, covered a wide range (16-87%, mean 56% germination). Advice was communicated to the industry via several routes.

## **1 INTRODUCTION**

The LINK project 'Improving profitability by using minimum cultivations and exploiting grass weed ecology' (LK0923/HGCA 2469 – Project Report No. 381) finished in August 2005. Within this project a test for assessing dormancy level in black-grass (*Alopecurus myosuroides*) was developed. Results from the dormancy test indicated that temperature had a significant part to play in determining seed dormancy. Increased temperatures during seed maturation lead to reduced dormancy in the seed produced. Soil moisture had a lesser effect. Excellent results, with a high degree of consistency, were obtained for seed samples collected from 20 fields, over a wide geographical area each year. Seed dormancy was higher in summer 2002 and 2004 than in 2001, 2003, and 2005 and this related well to weather patterns. With this information on the dormancy status of black-grass, strategic cultivation and drilling decisions could be made to maximise seed losses pre-drilling. This has generated a lot of demand for this type of information on an ongoing basis.

The aim of this three month project was to provide continuation of information on black-grass dormancy for the 2006 season. Seed was to be collected and assessed for dormancy level during summer 2006 and results issued as a press release during mid-August 2006 to coincide with cereal harvest and cultivation planning. This information aimed to include the dormancy status and guidelines on the implications of this on black-grass management for the following season.

## **1.1 Objectives**

- To assess whether black-grass dormancy follows the patterns identified in the previous project (2469).
- To provide a forecast of black-grass dormancy to the farming industry.
- To make recommendations on how to utilise the dormancy information to greatest effect in arable situations.

## **2 MATERIALS AND METHODS**

### **2.1 Sample collection**

Black-grass seeds were collected from 37 winter wheat fields in July when about 10-30% of seeds had already been shed. Initially it was planned to collect seed from 20 sites but due to the high level of interest from the industry, we were sent seed from 37 sites. Details of the collection method used are attached at Appendix 7-1. Collectors were asked to place the seed in the paper envelope provided and leave to dry for 24 hours before sending to ADAS Boxworth. In the laboratory, before conducting viability and germination tests, samples were cleaned in an air column separator to remove most of the empty seeds and debris. A minimum airflow was used and checks were made to minimise loss of seeds. Viability was estimated by dissecting 50 random seeds per sample and recording the total number of caryopses present. The testing was identical to that used in the SA LINK project.

### **2.2 Germination tests**

All germination tests were initiated within seven days of seed collection, and results were corrected to account for differences between samples in the proportion of seeds containing a caryopsis. Germination was determined by placing 50 seeds in 9 cm Petri-dishes containing three cellulose filter papers (Whatman Number 1) covered by one glass-fibre filter paper (Whatman GF/A) and adding 7 ml  $\text{KNO}_3$  (2 g/l in deionised water) per dish. For each sample tested, four replicate dishes were used. They were placed in sealed transparent polythene bags in an incubator with a light (17°C, 14 h) and a dark (11°C, 10 h) phase. The number of seeds that had germinated within two weeks were recorded and used as a measure of the proportion of non-dormant seeds in the sample. All germination data were corrected before analysis to account for differences between samples in the proportion of seeds containing a caryopsis. Summary statistics were done using GENSTAT.

A population is more dormant or has high dormancy when a lower number of non-dormant seeds are present. When tested in a Petri-dish few seeds grow. A population is less-dormant or has low dormancy when a large number of seeds grow in the Petri-dish test.

## 2.3 Meteorological records

Meteorological records were collated for eight recording centres across England, representative of the 37 seed-sample collection sites. The recording centres were Rothamsted Research, Harpenden (Hertfordshire), Marham, Norfolk and six ADAS sites; Boxworth (Cambridgeshire), Drayton (Warwickshire), Gleadthorpe (Nottinghamshire), High Mowthorpe (North Yorkshire), Rosemaund (Herefordshire), and Terrington (Norfolk). The meteorological parameters used were maximum and minimum daily temperatures (°C), daily rainfall (mm), and where available, daily sunshine (h). For comparative purposes, 30 year means (1975-2004) have been used for all recording centres.

## 3 RESULTS

### 3.1 Dormancy

Samples were collected from 37 sites and the individual count data for each is detailed in Appendix 7-2.

Table 3-1. Dormancy sampling results for 2006

Parameter	
Number of samples	37
	(% germination or non-dormant)
Mean	56
Median	56
Minimum	16
Maximum	87
Lower quartile	46
Upper quartile	71
Standard deviation	19.3

### 3.2 Meteorological data

Maximum and minimum temperatures and rainfall were recorded at all eight sites. Hours of sunshine were recorded at four of the sites (High Mowthorpe, Rosemaund, Rothamsted, Terrington and Marham). Weather conditions were similar at all sites for the period of interest, 15 June to 12 July; Mean maximum temperatures are shown in Figure 3-1.

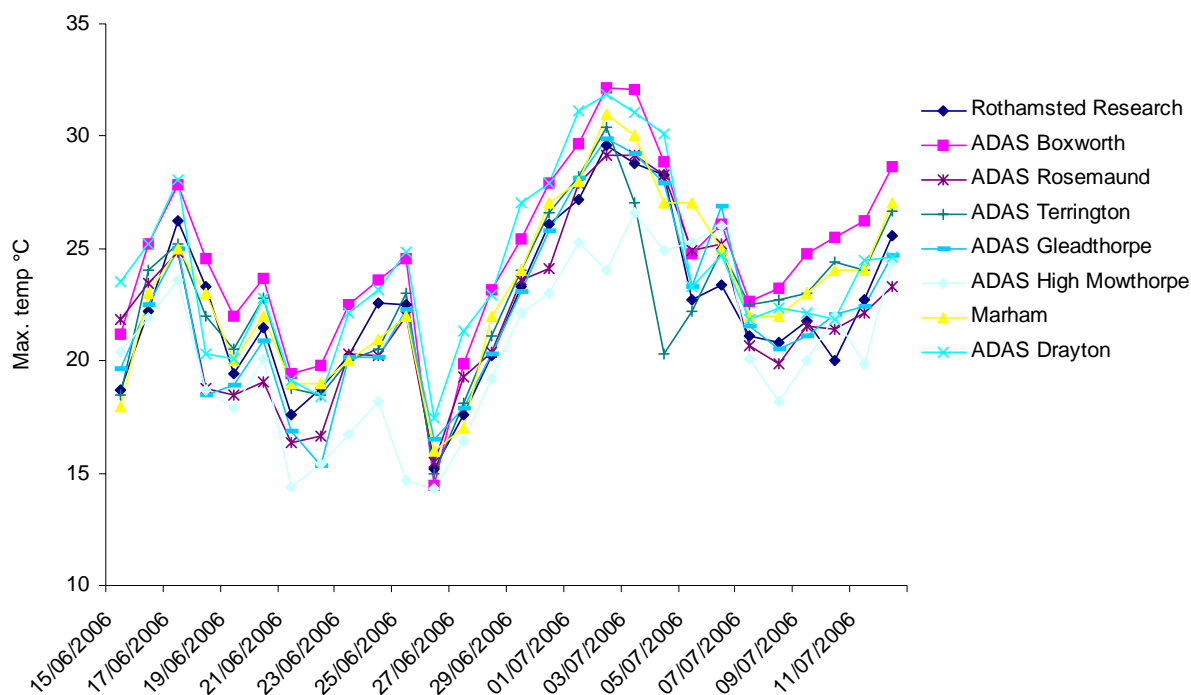


Figure 3-1. Mean maximum temperatures recorded at eight sites throughout the UK, between 15 June and 12 July.

### 3.3 Publicity

The 2006 testing was completed and information was released to the press on 17 August, well before the end of harvest. This information was rapidly published on the Internet by Farmers Weekly Interactive, Seedquest, Farming Online, first4farming and Farming Views. The print media magazines Arable Farmer, Farmers Weekly and Farmers Guardian all carried the story. Information was also sent directly by ADAS to all major agrochemical companies, distributors and advisory groups and was published in Crop Action by ADAS. HGCA emailed out the press release to their contacts and included a report in Crop Research News Issue 15 on 29 August. The text of the press release circulated is included as Appendix 7-3.

## 4 DISCUSSION

Black-grass dormancy has been assessed using the same methodology since 2001 (Cook *et al*, 2006). The previous work showed that temperature had a greater effect on dormancy than moisture during the latter stages of seed maturation, which occurs from mid-June to mid-July. Hotter conditions than average during this period resulted in black-grass seed with low dormancy; conversely cooler than average conditions resulted in seed with higher dormancy. The data from 2006 fits the pattern seen in previous years. In 2001, 2003, 2005 and 2006 mean maximum and minimum temperatures were hotter than average, hours of sunshine were above average and dormancy low (Figure 4-1).

Looking at the weather data in greater detail, in the cooler years of 2002 and 2004 the mean maximum temperature was lower than average by 0.6°C and 1.1°C and, mean minimum temperatures were 0.3°C and 0.8°C lower respectively. The warmer years were in 2001, 2003, 2005 and 2006, during these years, mean maximum temperatures were on average 2.1°C (range 1.2 - 2.8°C) higher than the long-term average. Mean minimum temperatures were also higher by 1.5°C (range 0.6-2.0°C).

Seed collected in 2001, 2003, 2005 and 2006 showed a much higher percent germination than that collected in 2002 and 2004 (Figure 4-2), with average germination of 62%, 57%, 59% and 56% compared to 19% and 28% respectively. The mean proportions of non-dormant seeds for the samples collected in each of the five years, with their standard errors, were respectively: 2001 62% ± 4.4; 2002 19% ± 2.2; 2003 57% ± 4.6; 2004 28% ± 3.0; 2005 59% ± 3.9; 2006 56% ± 3.2. In 2001, 2003, 2005 and 2006 where the average percent-germinated seed was higher, the range also increased when compared to the lower average non-dormancy and tight ranges seen in 2002 and 2004.

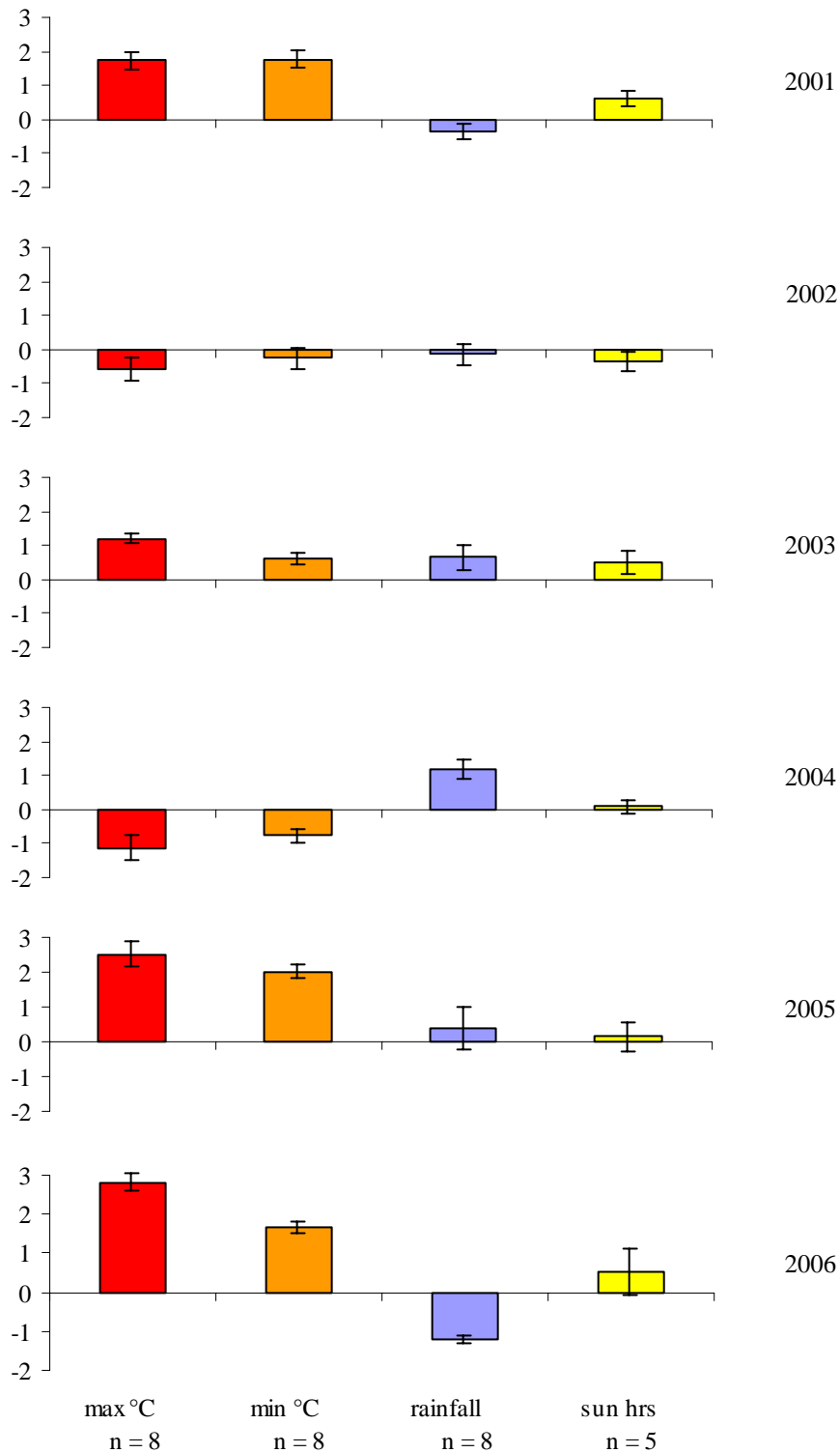


Figure 4-1. Average weather parameters from eight sites across England, for four weeks from 15 June to 12 July, 2001-2006. The y-axis scale shows difference from the long-term mean and the units are dependent on the parameter; temperature (°C), daily rainfall (mm) and sunshine (h). Standard Deviation (I).

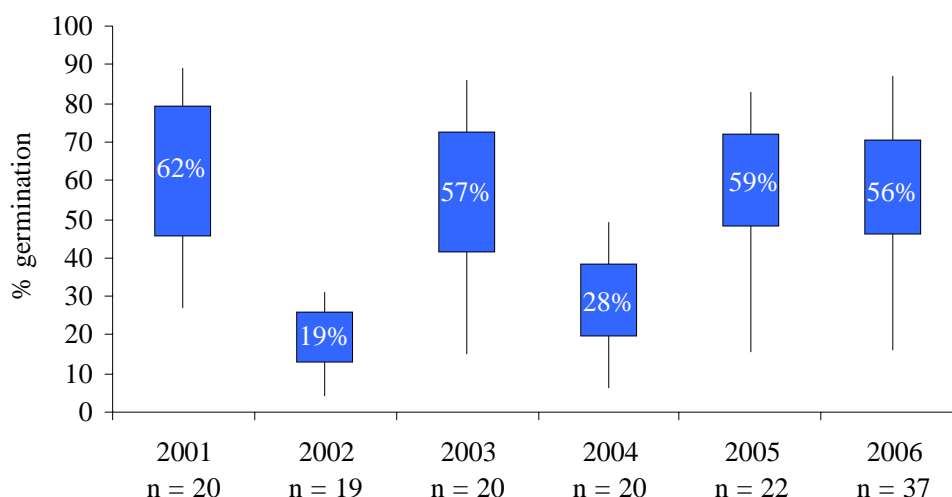


Figure 4-2. Percent germination (non-dormancy) of black-grass seed collected from 19 to 37 geographical sites each year from 2001-2006. This is a box plot. For each year, the graph shows the most extreme values in the data set (maximum and minimum values), the lower and upper quartiles, and the mean (written in). The darkened boxes indicate the quartiles, the first quartile of a group of values is where 25% of the values fall at or below this value. The third quartile of a group of values is where 75% of the values fall at or below this value.

As in previous years' data, dormancy levels in 2006, measured in the seed samples, covered a wide range (16-87%, mean 56%). Repeat samples taken from the same field on farms have recorded consistent results in relation to the mean, for example, the same farm consistently records the highest level of dormancy within the year (Figure 4-3). So far, there has been no link found between the range of figures with specific factors although there is a good general link with temperatures in June and July. It was interesting to note that 2006 was the warmest of the years during which seed was tested but the dormancy level recorded was not the lowest. There can be variation between dormancy levels measured in different fields at the same site (Figure 4-4). There is a need to investigate the effect of other factors on dormancy level to give a greater degree of interpretation to the results and the factors that affect them. There is also a need to identify a closer relationship between black-grass dormancy and weather data to bring us closer to a greater dependence on weather data with a few seed samples as confirmation. This would allow even earlier prediction of dormancy and enable an earlier start to optimum management.

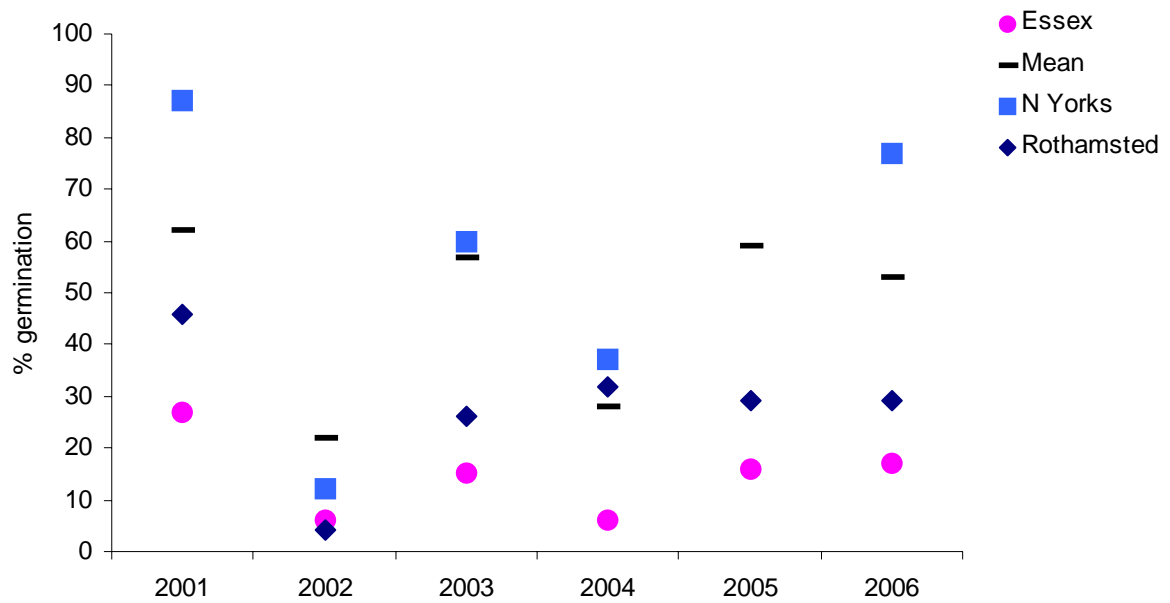


Figure 4-3. Variation in the level of dormancy between sites, compared to the annual mean, 2001-2006.

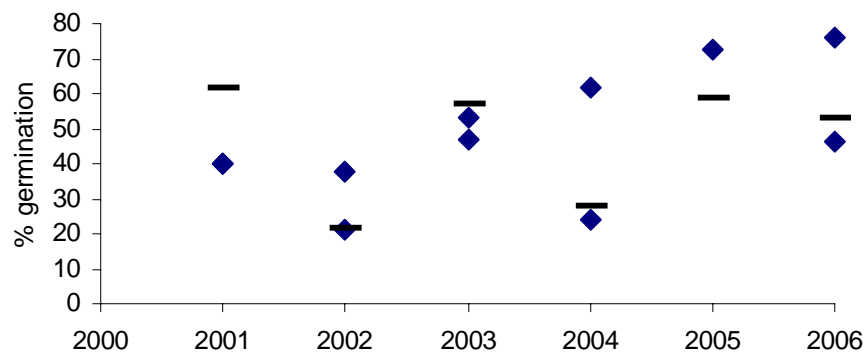


Figure 4-4. Variation in the level of dormancy at a single site, ADAS Boxworth, compared to the annual mean, 2001-2006.

## 5 REFERENCES

S. K. Cook, A.J. Swain, J. Clarke, S. Moss, Z. Hughes, J. Orson, L. Powell, A. Creasey, K. Norman and J. Alford (2006) Improving crop profitability by using minimum cultivation and exploiting grass weed ecology. Project report No. 381, HGCA, London. 90p.

## 6 ACKNOWLEDGEMENTS

The authors would like to thank everyone at ADAS, Rothamsted Research and AICC who had an input to the experiment and for collecting and sending samples.

## 7 APPENDICES

### Appendix 7-1. Method of seed sampling for dormancy status.

It is essential that we receive the seed samples within 7 days of collection.

- Collect seeds from *winter wheat* fields in the *second or third week of July* when about 10-30% seeds have already been shed. Collect when seeds are dry.
- Collect ripe seeds by gently rubbing heads over a polythene bag, tray or envelope so only ripe seeds are detached. Do not collect heads from the field or strip seeds as this will result in a poor quality sample – good samples should contain mostly seed with no stalks, chaff or other debris. Do not store in a polythene bag.
- Aim to collect over an area of about 100m by 2-3 tramlines.
- Aim to collect the equivalent of at least a mug full.
- Store seeds in this envelope with the end flap open for a day to dry. Samples should be sent off within a couple of days of collection.

## Appendix 7-2. Location, date of sampling, viability and adjusted germination for 2006

County	Town	Date sampled	Viability	Adjusted germination
Bedfordshire	Woburn	17-Jul-06	92	53
Berkshire	Maidenhead	11-Jul-06	94	16
Buckinghamshire	St. Kenchurch	12-Jul-06	100	49
Cambridgeshire	Alconbury	7-Jul-06	92	49
Cambridgeshire	Boxworth	8-Jul-06	94	76
Cambridgeshire	Keyston	12-Jul-06	96	86
Cambridgeshire	Boxworth	18-Jul-06	80	46
Essex	Bishop's Stortford	7-Jul-06	94	57
Essex	Peldon	11-Jul-06	90	17
Essex	Widdington	14-Jul-06	82	56
Essex	Gt Waltham	17-Jul-06	92	86
Essex	Farnham	18-Jul-06	92	61
Gloucestershire	Ruardean	11-Jul-06	96	45
Gloustershire	Cirencester	17-Jul-06	100	72
Hampshire	Hook	13-Jul-06	92	70
Hampshire	Hook	14-Jul-06	84	37
Herefordshire	Hereford	12-Jul-06	92	68
Hertfordshire	Harpden	12-Jul-06	84	29
Hertfordshire	Hadham	14-Jul-06	98	30
Hertfordshire	Gt Hormead	14-Jul-06	98	53
Kent	Ashford	18-Jul-06	100	66
Kent	Dover	24-Jul-06	90	62
Lincolnshire	-	17-Jul-06	100	74
Norfolk	King's Lynn	12-Jul-06	96	50
Northants		21-Jul-06	98	74
Northants	Maidwell	21-Jul-06	100	87
Nottinghamshire	-	17-Jul-06	98	55
Nottinghamshire	Kneesall	17-Jul-06	98	70
Oxfordshire	Chalgrove	12-Jul-06	100	18
Oxfordshire	Little Milton	12-Jul-06	94	43
Oxfordshire	Great Milton	12-Jul-06	94	54
Suffolk	-	17-Jul-06	100	64
Suffolk	-	17-Jul-06	98	74
Warwickshire	Rugby	18-Jul-06	92	71
Warwickshire	Stratford-Upon-Avon	19-Jul-06	86	31
Yorkshire (East)	Seaton	7-Jul-06	72	50
Yorkshire (North)	Malton	21-Jul-06	100	77

### Appendix 7-3. Press release

Black-grass seeds have a low dormancy this autumn – allow maximum germination and spray off prior to drilling

Final results from HGCA funded research has shown that dormancy in black-grass seed samples this autumn is **low**. Seeds for the project were collected by ADAS, AICC and Rothamsted Research. Weather data from ADAS and Rothamsted Research indicated a particularly hot year, with temperatures 2-4 °C above than the 40 year mean, but also much drier than average.

The actual figure is 53% germination based on 37 geographical samples taken in 2006. We also have results for 20 samples tested in each of the last six years as part of a LINK project (LK 0923) and the results below summarise the findings. 2006 results are similar to those in 2001, 2003 and 2005, all after warmer summers. In all years samples were collected from across the country and we have not identified any consistent regional patterns.

Year	Mean % black-grass seed germinating	Conditions during black-grass seed maturation
2001	62	Hot and dry
2002	22	Cool and damp
2003	57	Hot and dry
2004	28	Cool and damp
2005	59	Warm and damp
2006	53	Hot and dry

As in previous years, despite an average low dormancy, a few samples did show higher levels of dormancy indicating that local conditions are still important.

These test results are borne out by field observations of black-grass beginning to germinate within the crop before harvest. Low dormancy is likely to mean a less protracted germination period for black-grass.

#### What do these results mean?

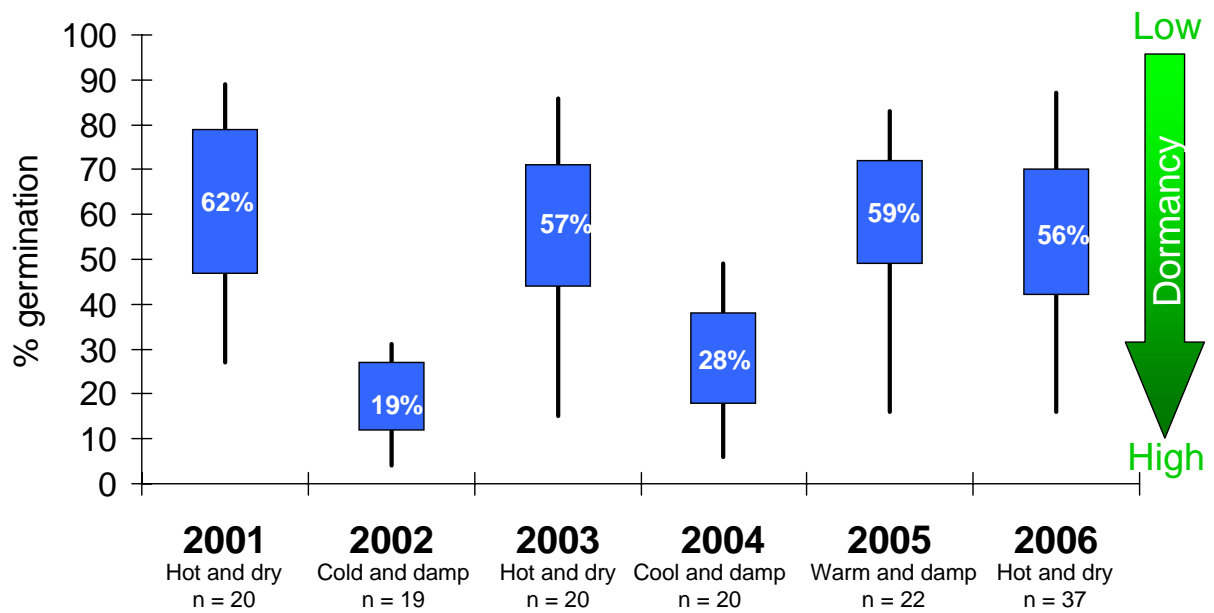
2006 is similar to last year. 2005 and 2006 were typified by ‘non-dormant’ seeds, which are likely to germinate readily with adequate seedbed moisture, unlike 2002 and 2004 when seeds were more dormant and unwilling to germinate even with adequate seedbed moisture.

Black-grass seeds this year have a similar level of dormancy to 2001, 2003 and 2005. Observations made in 2001 saw seeds germinating within the crop before harvest due to adequate moisture. In 2003 a high proportion of seeds were ‘non-dormant’ but failed to germinate in September due to an absence of available moisture in the late summer/early autumn. However, in 2003 when the rain did arrive, we saw a rapid emergence of black-grass. This year some black-grass has already begun to germinate prior to harvest and with unsettled weather forecast for the next two weeks more are predicted to emerge.

The prediction this year is that germination should be rapid as long as there is adequate seedbed moisture. Maximising black-grass germination and spraying off prior to drilling is crucially important. This year looks like providing a good opportunity to reduce numbers before drilling, an essential part of any strategy and especially important to reduce implications of resistance. Keeping the black-grass seed in the top 5 cm of the soil and retaining moisture to encourage germination makes shallow cultivations a suitable option for this season.

This project was sponsored by HGCA (Project Number 3275). For further information please contact Sarah Cook, ADAS Boxworth (e-mail [sarah.cook@adas.co.uk](mailto:sarah.cook@adas.co.uk); Tel. 01954 268215).

**Appendix to press release: Dormancy patterns in black-grass (2001-2006)**



**Notes on graph for editors**

This is a box plot. For each year the graph shows the most extreme values in the data set (maximum and minimum values), the lower and upper quartiles, and the mean (written in).

The darkened boxes indicate the quartiles, the first quartile of a group of values is where 25% of the values fall at or below this value. The third quartile of a group of values is where 75% of the values fall at or below this value.

17 August 2006