Project Report No. 355

**November 2004**

**Price: £3.45**

# ‘Specific off-label approval’ trials of herbicides for use in UK soya

by

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This is the final report of a 27-month project that started in January 2002. The work was funded by a contract of £31,479 from the HGCA (project no. 2474).

**Contents**

## Abstract

Trials were carried out at Carbrooke, Norfolk (sandy loam), Preston St Mary, Suffolk (clay loam), Stixwould, Lincolnshire (sandy loam) and Bourne, Lincolnshire (silt clay loam) on commercial crops of soya during 2002 and 2003. The primary objective was to provide soya seed samples to generate residue data in support of an application for specific off-label approval (SOLA). Five herbicide treatments were evaluated; these were: untreated control (no herbicide); Aramo (Tepraloxydim) @ 1.5 litres product/ha @ GS V2; Alpha Linuron @ 0.8 litres product/ha at a light soil site (Carbrooke) or Alpha Linuron @ 1.4 litres product/ha at a heavy soil site (Preston) applied post-drilling, pre-emergence; Flex (Formesafen) @ 0.45 litres product/ha plus Silwet (@ 0.1% of total spray volume) @ GS V1 followed by a repeat dose 1 month after first application and Flex (Formesafen) @ 0.9 litres product/ha @ GS V2.

The field experiments were done to GLP in both years and provided soya seed for residue testing in support of a SOLA application for the most commercially important soya herbicides. Residues of Flex and Alpha Linuron were not detected in the harvested seed and a SOLA was approved for Flex. Residue analyses were not carried out for Aramo due to technical difficulties with the analysis method. A SOLA for Alpha linuron was not submitted, as the herbicide is not being used commercially. Additional information on weed control was gained from the experiment and a range of weeds were controlled by the herbicides, each product having specific strengths and weaknesses. Some herbicides caused crop scorch but this did not have an adverse effect on yield. Yield was increased by 0.71 t/ha (49%) where weeds were controlled.

# 1 Introduction

Weed competition is a major yield-limiting factor in soya, particularly under UK conditions, where spring temperatures limit early season growth and therefore affect the crop's competitive ability. This factor has been acknowledged by crop developers such as Robin Appel (Wilmott *et al*., 1999) and is also acknowledged in France, where over 85 000 ha of soya are now grown (CETIOM, 2004). Effective weed control is therefore essential to crop performance.

The period of early growth is critical in temperature sensitive, late sown crops such as soya, which under UK conditions are sown in early May. Additional delays or set-backs to early growth as a consequence of weed competition not only reduce crop yield, but reduce final crop height and can result in uneven crop maturity.

On a world scale there is a wide range of herbicides available for use on soya and many companies have developed herbicides specifically for soya and the market it provides. The control of pesticides legislation, introduced in 1986, strengthened the controls on the registration and use of pesticides. The use of pesticides was restricted to the crops for which 'label approval' had been sought by the chemical companies. Outside this label approval, users of agricultural pesticides can apply to have the approval of specific pesticides extended to cover uses additional to those approved and shown on the manufacturer's product label. These are known as Specific off label approvals or SOLA. Currently, no herbicides are fully approved for use on soya in the UK and obtaining these approvals is complicated by current rules. Soya is regarded as an oilseed rather than a pulse for pesticide registration purposes and this severely limits herbicide choice for UK farmers. SOLAs for soya herbicides are currently available for formesafen (SOLA expires Nov 2006), linuron (SOLA expires April 2004) and trifluralin (SOLA expires Dec 2008). Further residue data are required for both formesafen and linuron to renew the SOLA applications, a SOLA for tepraloxydim is also being sought as this will make available a grass weed herbicide to the soya grower

This experiment aims to provide seed for residue testing data which will then support SOLA applications for formesafen, linuron and tepraloxydim so that a herbicide choice is still available to soya growers.

# 2 Materials and Methods

## 2.1 *Field sites*

| Site | Name | Harvest year | Location | Soil type |
|---|---|---|---|---|
| 1 | Carbrooke | 2002 | Dawe Estates, Carbrooke, Norfolk | Sandy loam |
| 2 | Preston | 2002 | Priory Farm, Preston St Mary, Suffolk | Clay loam |
| 3 | Stixwould | 2003 | Newstead Farm, Stixwould, Lincolnshire | Sandy loam |
| 4 | Bourne | 2003 | Glen Farm, Bourne, Lincolnshire | Silt clay loam |

## 2.2 *Objectives*

To maintain legal approval for the use of the currently approved pesticides by

- Undertaking field experiments in soya to GLP standards in each of 2 years;
- To collate data from the trials to support off-label herbicide uses;
- To provide soya grain for residue analysis in the GLP compliant laboratories of the participating agrochemical companies.

## 3 Treatments

### 3.1 *Chemicals*

The herbicides and spreader/wetter adjuvant (Silwet) to be used in this study are all currently approved for use on soya in the UK and were purchased from local agrochemical merchants.

The chemicals used were as follows:

| | **Chemical** | **Active substance** | **Manufacturer** |
|---|---|---|---|
| a) | Aramo | Tepraloxydim 50 g/l EC | BASF |
| b) | Alpha Linuron | Linuron 500 g/l SC | Makhteshim-Agan |
| c) | Flex | Fomesafen 250g/l SL | Syngenta |
| d) | Silwet L-77 | Spreader/wetter containing 80% polyalkylene oxide modified heptamethyltrisiloxane and a maximum of 20% w/w allyloxypolyethylene glycol methyl ether | Loveland |

### 3.2 *Rates and timings*

| **Code** | **Description** |
|---|---|
| Untreated | Untreated control. No herbicide. |
| Aramo | Aramo @ 1.5 litres product/ha @ GS V2 |
| Alpha Linuron | Alpha Linuron @ 0.8 litres product/ha at light soil site (Carbrooke and Stixwould)<br>Alpha Linuron @ 1.4 litres product/ha at heavy soil site (Preston and Bourne)<br>All applied post-drilling, pre-emergence. |
| Flex + Silwet (split dose) | Flex @ 0.45 litres product/ha plus Silwet (@ 0.1% of total spray volume) @ GS V1 followed by repeat dose 1 month after first application. |
| Flex | Flex @ 0.9 litres product/ha @ GS V2. |

Growth stage descriptions are attached at Appendix 1.

### 3.3 *Site selection and location*

The experiment was conducted in farm-drilled crops of soya at the sites detailed in Section 2.1.

Farm crops received fungicides and insecticides as farm treatment. Herbicides applied to the crops by the host farmers were excluded from the study areas. Agronomic details are detailed in Appendix 2.

**3.4** *Treatment application methodology*

All treatments were applied with the following equipment:

- MDM $CO_2$-powered knapsack sprayer ID H10.
- Two-metre boom ID H13 fitted with four Lurmark LD02F110 nozzles* at 0.5 metre spacing at a pressure of 2.0 bar (200 k pascals) giving a medium spray quality.
  *Nozzles used for treatment 3 (Linuron) at Preston St Mary and Bourne (Sites 2 and 4) were BFS 02 Bubblejets at 2 bar pressure giving a coarse spray quality to reduce drift.
- Cornelius six-litre spray tanks colour coded for each treatment.

**3.5** *Treatment application dates*

| **Code** | Description | Carbrooke 2002 | Preston 2002 | Stixwould 2003 | Bourne 2003 |
|---|---|---|---|---|---|
| | | | | | |
| Untreated | Untreated control. No herbicide. | - | - | - | - |
| Aramo | Aramo @ 1.5 litres product/ha @ GS V2 | 12-Jun-02 | 12-Jun-02 | 20-Jun-03[b] | 20-Jun-03[b] |
| Alpha Linuron | Alpha Linuron @ 0.8 litres product/ha at light soil site (Carbrooke)<br>Alpha Linuron @ 1.4 litres product/ha at heavy soil site (Preston)<br>All applied post-drilling, pre-emergence. | 23-Apr-02 | 7-May-02 | -[c] | 25-Apr-03 |
| Flex + Silwet (split dose) | Flex @ 0.45 litres product/ha plus Silwet (@ 0.1% of total spray volume) @ GS V1 followed by repeat dose 1 month after first application.<br>NB Silwet added to tank first | 31-May-02<br>28-Jun-02 | 31-May-02<br>28-Jun-02 | 11-Jun-03[a]<br>9-Jul-03 | 11 Jun-03[a]<br>9-Jul-03 |
| Flex | Flex @ 0.9 litres product/ha @GS V2. | 12-Jun-02 | 12-Jun-02 | 20-Jun-03[b] | 20-Jun-03[b] |

a Applied late due to late arrival of Flex from suppliers (2003)

[b] Applied late due to knock on effect of delaying 1st application (2003).

[c]Treatment not applied – Site visited on 22 May and emergence was poor (20 plants/m²). Failure due to bean seed fly attack. Original site abandoned on 29 May and trial re-sited in an adjacent field. Alpha linuron not applied to new site as crop already at GS VC (10).

Details of weather conditions, crop growth stage, crop condition and soil information are attached at Appendix 4.

**3.6** *Experiment design and statistical analysis*

*3.6.1* **Experimental design**

The sites had 5 treatments on small plots and 4 replicates in a randomised block design. Plot size was a minimum of 2.25 m x 24 m, with untreated discard plots of the same size between each treated plot.

### *3.6.2* **Analysis**

Data were analysed by Analysis of Variance.

## **3.7** *Assessments and records*

Dates of assessment can be found in Appendix 3.

### *3.7.1* **Phytotoxicity**

Phytotoxic effects were recorded on each plot throughout the season at each site. Vigour scores were done using the scoring criteria 0-9, with 0 being the worst and 9 being least affected.

### *3.7.2* **Plant population**

Plant population was assessed in 5 x 0.25m² quadrats per plot.

### *3.7.3* **Weed counts**

Weed populations were assessed in 10 x 0.1m² quadrats per plot at two growth stages V5 and R7.

### *3.7.4* **Yield of soya seed**

Plots were harvested with a Sampo 2025 combine harvester, yield of seed per plot was recorded and samples were taken for determination of moisture content and residue testing.

### *3.7.5* **Soya seed samples for residue analysis**

Soya seed samples for residue analysis were collected by random sampling from the combine harvester output from each plot. For each individual plot, a main sample of at least 4 kg was removed from the grain hopper on the combine harvester. The samples were collected in heavy-duty plastic bags, which were labelled with details including study number, date of collection, site, plot number and treatment. All samples were returned to Boxworth on the day of harvest and placed in a freezer until called for by the analytical laboratories. One set of seed samples was retained in the freezer at Boxworth and the other set dispatched to the laboratories for analysis.

## 4 Results

### 4.1 *Plant population*

Plant numbers were unaffected by treatments applied at any site or in either year (Table 1).

Table 1. Plant counts (numbers/m²).

| Site | Carbrooke | Preston | Stixwould | Bourne |
|---|---|---|---|---|
| Date of assessment | 31-May-02 | 23-May-02 | 29-May-03 | 29-May-03 |
| **Treatment** | | | | |
| Untreated | 74.4 | 82.6 | 52.7 | 27.0 |
| Aramo | 73.0 | 91.4 | 49.2 | 21.3 |
| Alpha Linuron | 69.6 | 94.2 | - | 22.0 |
| Flex + Silwet (split dose) | 67.8 | 82.8 | 50.0 | 25.7 |
| Flex | 65.2 | 102.0 | 47.0 | 22.0 |
| Mean | 70.0 | 90.6 | 49.7 | 23.6 |
| SED | 5.44 | 6.85 | 6.34 | 2.31 |
| CV | 11.0 | 10.7 | 6.5 | 8.7 |
| F probability | NS | NS | NS | NS |

### 4.2 *Crop vigour*

At all sites and in both years, Flex + Silwet (split dose) had a visible effect on the crop causing scorch and retardation of growth this was visible from 4 days after application but the crop had recovered 16-21 days after treatment (Tables 2, 3, 4 and 5). The full rate of Flex alone had a similar effect. The second spray of split dose Flex + Silwet showed effects of scorch for a similar length of time (16-21 days after treatment). There were no other treatment effects.

Table 2. Vigour scores at Carbrooke 2002 (0 = worst, 9 = least affected).

| | Assessment date | 4 Jun | 12 Jun | 16 Jun | 21 Jun | 2 Jul | 9 Jul | 19 Jul |
|---|---|---|---|---|---|---|---|---|
| Treatment | Date applied | | | | | | | |
| Untreated | - | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 |
| Aramo | 12 Jun | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 |
| Alpha Linuron | 23 Apr | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 | 8.0 |
| Flex + Silwet (split dose) | 31 May 28 Jun | 7.0 | 6.0 | 7.0 | 8.0 | 6.0 | 6.0 | 8.0 |
| Flex | 12 Jun | 8.0 | 8.0 | 7.0 | 6.0 | 7.0 | 8.0 | 8.0 |
| Mean | | 7.8 | 7.6 | 7.6 | 7.6 | 7.4 | 7.6 | 8.0 |

Table 3. Vigour scores at Preston 2002 (0 = worst, 9 = least affected).

| | Assessment date | 4 Jun | 12 Jun | 16 Jun | 21 Jun | 2 Jul | 9 Jul | 19 Jul |
|---|---|---|---|---|---|---|---|---|
| Treatment | Date applied | | | | | | | |
| Untreated | - | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 |
| Aramo | 12 Jun | 9.0 | 9.0 | 9.0 | 8.0 | 9.0 | 9.0 | 9.0 |
| Alpha Linuron | 7 May | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 |
| Flex + Silwet (split dose) | 31 May 28 Jun | 6.0 | 7.5 | 8.0 | 8.0 | 7.8 | 8.0 | 9.0 |
| Flex | 12 Jun | 9.0 | 9.0 | 7.0 | 6.0 | 8.0 | 9.0 | 9.0 |
| mean | | 8.4 | 8.7 | 8.4 | 8.0 | 8.6 | 8.8 | 9.0 |

Table 4. Vigour scores at Stixwould 2003 (0 = worst, 9 = least affected).

| | Assessment date | 16 Jun | 20 Jun | 23 Jun | 4 Jul | 8 Jul | 14 Jul | 18 Jul | 30 Jul |
|---|---|---|---|---|---|---|---|---|---|
| Treatment | Date applied | | | | | | | | |
| Untreated | - | 8.0 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 |
| Aramo | 20 Jun | 8.0 | 9.0 | 8.8 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 |
| Flex + Silwet (split dose) | 11 Jun 9 Jul | 7.0 | 7.0 | 7.3 | 8.0 | 8.0 | 7.5 | 8.0 | 8.0 |
| Flex | 20 Jun | 8.0 | 9.0 | 7.0 | 7.0 | 7.0 | 9.0 | 9.0 | 9.0 |
| Mean | | 7.8 | 8.5 | 8.0 | 8.3 | 8.3 | 8.6 | 8.8 | 8.8 |

Table 5. Vigour scores at Bourne 2003 (0 = worst, 9 = least affected).

| | Assessment date | 16 Jun | 20 Jun | 23 Jun | 4 Jul | 8 Jul | 14 Jul | 18 Jul | 30 Jul |
|---|---|---|---|---|---|---|---|---|---|
| Treatment | Date applied | | | | | | | | |
| Untreated | - | 9.0 | 9.0 | 9.0 | 8.8 | 8.8 | 8.0 | 8.8 | 7.8 |
| Aramo | 20 Jun | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 | 8.0 | 8.8 | 7.8 |
| Alpha Linuron | 25 Apr | 9.0 | 9.0 | 9.0 | 8.8 | 8.8 | 8.0 | 8.8 | 7.8 |
| Flex + Silwet | 11 Jun | 7.0 | 8.0 | 8.0 | 8.8 | 8.8 | 7.0 | 8.0 | 8.0 |
| (split dose) | 9 Jul | | | | | | | | |
| Flex | 20 Jun | 9.0 | 9.0 | 7.0 | 7.8 | 7.8 | 7.5 | 8.8 | 7.8 |
| Mean | | 8.6 | 8.8 | 8.4 | 8.6 | 8.6 | 7.7 | 8.6 | 7.8 |

**4.3** *Weeds*

There was a wide range of broad-leaved weeds present at all sites but few grass weeds. Total weed numbers were greatest at Stixwould in 2003 in July but these had decreased naturally by 50% by the August count. Similarly, at Bourne in 2003 numbers decreased by 33%, reflecting the dry summer conditions. In 2002 weed populations doubled at Carbrooke between the two assessment dates but were static at Preston.
Herbicide applications generally had no effect on total weed numbers except at Preston in June 2002 where Alpha Linuron and Flex + Silwet (split dose) both significantly ($P$<0.05) decreased weed numbers (Table 6.).

Table 6. Total number of weeds at all sites – June/July (plants/m²).

| Site | Carbrooke | Preston | Stixwould | Bourne |
|---|---|---|---|---|
| Date of assessment | 28-Jun-02 | 28-Jun-02 | 8-Jul-03 | 9-Jul-03 |
| **Treatment** | | | | |
| Untreated | 51.7 | 80.7 | 210.0 | 61.2 |
| Aramo | 47.0 | 72.0 | 205.0 | 52.5 |
| Alpha Linuron | 44.2 | 56.2 | - | 51.2 |
| Flex + Silwet (split dose) | 37.2 | 27.5 | 233.0 | 47.2 |
| Flex | 42.5 | 22.8 | 188.0 | 56.7 |
| Mean | 44.5 | 51.8 | 209.0 | 53.8 |
| SED | 6.59 | 4.26 | 28.8 | 9.54 |
| CV % | 20.9 | 11.6 | 26.8 | 17.6 |
| F probability | NS | <0.001 | NS | NS |

In August total weed numbers were significantly ($P$<0.05) decreased by Flex + Silwet (split dose) at Carbrooke. The effects seen in June at Preston were still visible in August (Table 7). The highest level of

control was only 30% at any site, the highest level of control came from the Flex + Silwet (split dose) (Figure 1)

Table 7. Total number of weeds at all sites in August.

| | Carbrooke | Preston | Stixwould | Bourne |
|---|---|---|---|---|
| Date of assessment | 15-Aug-02 | 15-Aug-02 | 6-Aug-03 | 7-Aug-03 |
| **Treatment** | | | | |
| Untreated | 106.2 | 71.2 | 104.0 | 41.2 |
| Aramo | 100.7 | 69.7 | 108.0 | 41.7 |
| Alpha Linuron | 102.2 | 63.0 | - | 38.7 |
| Flex + Silwet (split dose) | 73.0 | 53.7 | 102.0 | 30.5 |
| Flex | 102.2 | 53.2 | 96.0 | 33.5 |
| Mean | 96.8 | 62.2 | 102.0 | 37.1 |
| SED | 7.35 | 3.21 | 7.5 | 5.98 |
| CV | 10.7 | 7.3 | 5.8 | 25.7 |
| F probability | 0.004 | 0.005 | NS | NS |

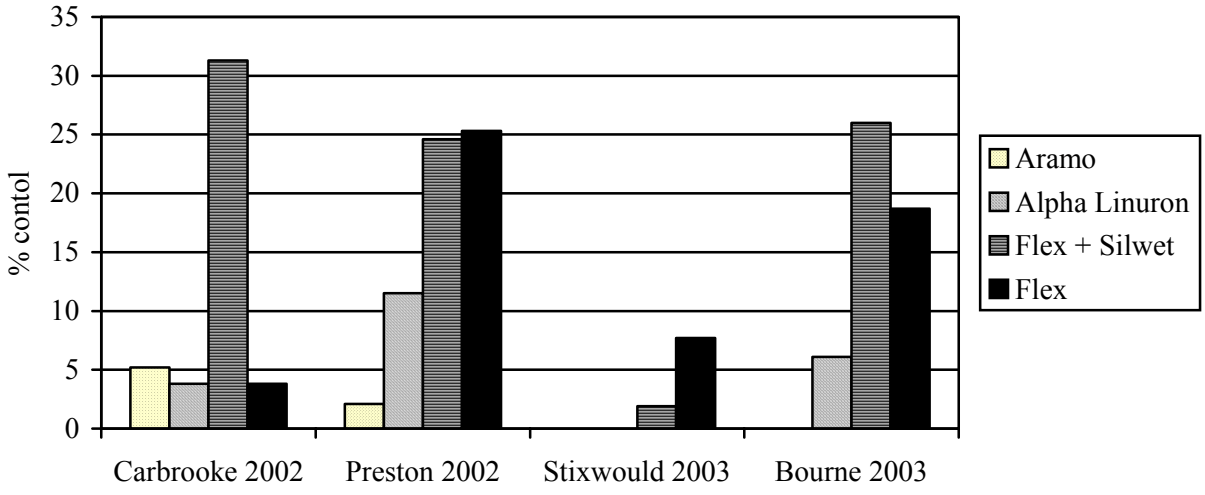


Figure. 1. Level of control of total weed numbers

### *4.3.1* **Individual weed species**

#### 4.3.1.1 Chickweed

Chickweed was present at all 4 sites and both assessment dates, populations were high at all sites ranging from 16-35/m² in the untreated. At Carbrooke and Preston in 2002 application of pre-emergence Alpha Linuron resulted in a significant ($p<0.05$) decrease in populations (Table 8), this was not seen at Bourne in 2003.

Table 8. Chickweed population at all four sites (plants/m²)

| Site | Carbrooke | Preston | Stixwould | Bourne |
|---|---|---|---|---|
| Date of assessment | 15-Aug-02 | 15-Aug-02 | 6-Aug-03 | 7-Aug-03 |
| **Treatment** | | | | |
| Untreated | 22.3 | 35.5 | 12.5 | 6.7 |
| Aramo | 19.8 | 34.8 | 16.0 | 10.3 |
| Alpha Linuron | 11.0 | 16.0 | - | 5.5 |
| Flex + Silwet (split dose) | 19.8 | 36.8 | 19.5 | 10.0 |
| Flex | 20.0 | 36.0 | 20.3 | 8.5 |
| Mean | 18.6 | 31.8 | 17.1 | 8.2 |
| SED | 3.21 | 2.992 | 4.33 | 4.05 |
| CV | 24.5 | 13.3 | 24.1 | 90.3 |
| F probability | 0.036 | <0.001 | NS | NS |

4.3.1.2 Black bindweed

Bindweed was controlled well by Flex + Silwet (split dose) ($p<0.05$) at both sites in 2002 but this was not seen in 2003 when bindweed numbers were low (Table 9).

Table 9. Black bindweed population at three sites (plants/m²)

| | Carbrooke | Preston | Bourne |
|---|---|---|---|
| Date of assessment | 15-Aug-02 | 15-Aug-02 | 7-Aug-03 |
| **Treatment** | | | |
| Untreated | 10.3 | 14.0 | 4.3 |
| Aramo | 7.5 | 13.5 | 4.3 |
| Alpha Linuron | 8.0 | 16.3 | 2.0 |
| Flex + Silwet (split dose) | 2.3 | 2.0 | 2.5 |
| Flex | 6.5 | 4.3 | 2.5 |
| Mean | 6.9 | 10.0 | 3.1 |
| SED | 1.112 | 2.153 | 1.34 |
| CV | 22.8 | 30.5 | 64.6 |
| F probability | <0.001 | <0.001 | NS |

#### 4.3.1.3 Orache

Orache was recorded at 2 sites, numbers were significantly decreased at Carbrooke by Flex + Silwet (split dose) but 20 plants were still present after treatment. At Stixwould in 2003 numbers were decreased by 50% but this was not statistically significant (Table 10).

Table 10. Orache population at two sites (plants/m²)

| | Carbrooke | Stixwould |
|---|---|---|
| Date of assessment | 15-Aug-02 | 6-Aug-03 |
| **Treatment** | | |
| Untreated | 31.3 | 11.3 |
| Aramo | 35.7 | 12.5 |
| Alpha Linuron | 32.5 | - |
| Flex + Silwet (split dose) | 20.3 | 5.6 |
| Flex | 34.2 | 6.3 |
| Mean | 30.8 | 8.9 |
| SED | 3.89 | 1.87 |
| CV | 17.8 | 28.6 |
| F probability | 0.013 | NS |

#### 4.3.1.4 Field Speedwell

Speedwell control was variable over the 2 years with numbers remaining high even after treatment (Table 11).

Table 11. Field speedwell population at three sites (plants/m²)

| | Preston | Stixwould | Bourne |
|---|---|---|---|
| Date of assessment | 28-Jun-02 | 8-Jul-03 | 9-Jul-03 |
| **Treatment** | | | |
| Untreated | 15.8 | 25.3 | 8.8 |
| Aramo | 15.5 | 27.0 | 11.3 |
| Alpha Linuron | 19.3 | - | 8.8 |
| Flex + Silwet (split dose) | 5.3 | 39.7 | 7.5 |
| Flex | 0.5 | 22.3 | 14.3 |
| Mean | 11.3 | 28.6 | 10.1 |
| SED | 1.82 | 11.64 | 2.89 |
| CV | 22.9 | 57.6 | 18.6 |
| F probability | <0.001 | NS | NS |

#### 4.3.1.5 Grass weeds

There were limited numbers of grass weeds and species seen during the experiments. Black-grass was controlled by Aramo at Preston but there were no effects on annual meadow grass (Table 12).

Table 12. Grass weed number by species (plants per m²).

| | Black-grass | Annual meadow grass | Annual meadow grass |
|---|---|---|---|
| Date of assessment | Preston | Stixwould | Stixwould |
| **Treatment** | 15-Aug-02 | 8-Jul-03 | 6-Aug-03 |
| Untreated | 3.3 | 4.7 | 3.3 |
| Aramo | 0 | 3.7 | 3.5 |
| Alpha Linuron | 1.3 | - | - |
| Flex + Silwet (split dose) | 4.5 | 13.5 | 8.5 |
| Flex | 3.3 | 8.5 | 5.0 |
| Mean | 2.5 | 7.9 | 5.1 |
| SED | 1.45 | 4.00 | 2.37 |
| CV | 83.6 | 24.9 | 10.9 |
| F probability | 0.058 | NS | NS |

### 4.4 *Yield*

Yield was increased by up to 0.71 t/ha (49%) ($P<0.05$) where weeds had been controlled by Flex + Silwet (split dose) (Table 13). Orache was the main weed at harvest with up to 30% contamination of harvested grain.

Table 13. Harvest grain yield (t/ha at 85% Dry Matter).

| Site | Carbrooke | Preston | Stixwould | Bourne |
|---|---|---|---|---|
| Harvest year | 2002 | 2002 | 2003 | 2003 |
| **Treatment** | | | | |
| Untreated | 1.29 | 1.97 | 0.78 | 1.44 |
| Aramo | 1.31 | 2.01 | 0.83 | 1.54 |
| Alpha Linuron | 1.20 | 2.17 | - | 1.55 |
| Flex + Silwet (split dose) | 1.64 | 2.33 | 1.01 | 2.15 |
| Flex | 1.39 | 2.33 | 0.85 | 1.71 |
| Mean | 1.37 | 2.16 | 0.87 | 1.68 |
| SED | 0.047 | 0.0946 | 0.04 | 0.128 |
| CV | 4.8 | 6.2 | 8.9 | 8.5 |
| F probability | <0.001 | 0.005 | 0.002 | 0.001 |

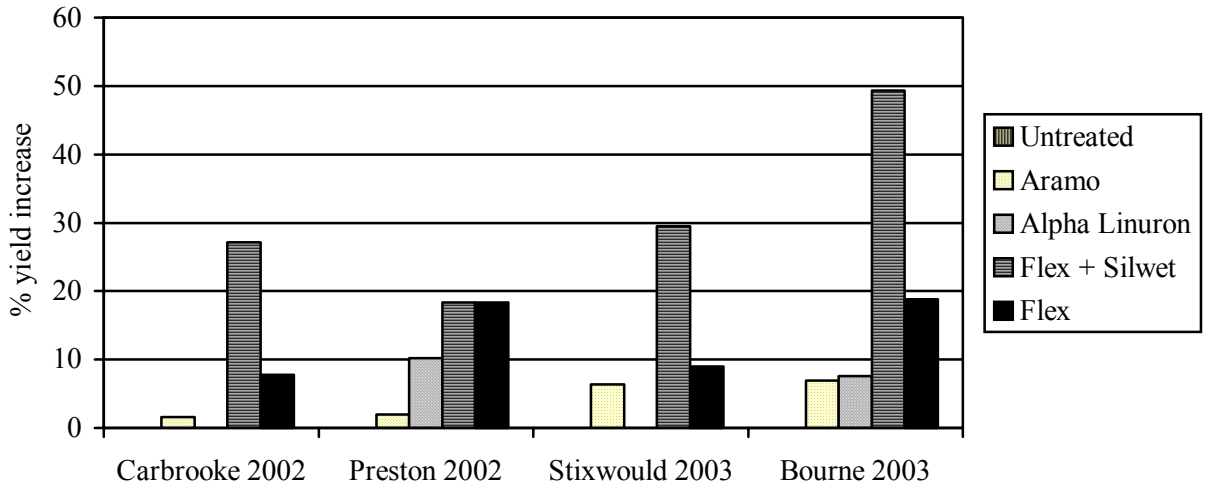


Figure 2. Percentage yield increase over the untreated.

### **4.5** *Residues*

No residues were detected of any of the chemicals used (Table 14).

Table 14. Residue data

| Site | Carbrooke | Preston | Stixwould | Bourne |
|---|---|---|---|---|
| Harvest year | 2002 | 2002 | 2003 | 2003 |
| **Treatment** | | | | |
| Aramo* | - | - | - | - |
| Alpha Linuron | ND | ND | - | ND |
| Flex + Silwet (split dose) | ND | ND | ND | ND |
| Flex | ND | ND | ND | ND |

ND = Non detectable <0.005mg/kg
*Analysis was not done due to technical difficulties

## 5 Discussion

Soya is a spring-sown crop that needs a soil temperature of 10°C at drilling. Drilling the crop into warm soil enables the crop to establish quickly, this is necessary as crop competition is an important part of weed control. The crop retains an open canopy from sowing through to late June and this can be extended due to poor establishment and low plant populations (Wilmott *et al*, 1999). Soya usually receives a 2 spray herbicide programme consisting of pre and post emergent sprays, this experiment confined itself to single treatments as its primary remit was to provide seed for residue analysis.

The target plant population for an UK soya crop is approximately 75 plants/m², this was achieved in 2002 but establishment was poor in 2003. The site at Bourne suffered from a bean seed fly attack which forced the repositioning of the first trial. The crop compensates for lower populations by branching to a greater extent (Wilmott *et al*, 1999) but the crop's competitive ability with weeds is reduced.

The stunting and scorching of the crop by Flex was extensive, this is a known transient effect of this chemical and is mentioned on the product label, there was no effect on the final yield of the crop that could be attributed to the scorching.

Weed control is a major issue to the soya grower, the open canopy of the crop allows extensive weed growth at a time when environmental conditions are optimal and crop competition is low. Weed populations changed between the two assessment dates, decreasing in 2003 probably due to the dry conditions, and increasing at Carbrooke in 2002 because of wetter conditions. The effectiveness of the chemicals over the two years was variable with Flex being the most consistent product. The critical time of removal for weeds in soya is before growth stage V3 (3$^{rd}$ vegetative node) (Knezevic *et al*., 2003). Before this growth stage losses are below 5%, but after this stage 2% of extra yield was lost for each growth stage passed up to R3 (beginning to pod).

The control of individual species was variable, chickweed is not susceptible to Flex but was controlled by Linuron in 2002 but not so well in 2003 although conditions were good at application. Bindweed was susceptible to both Flex and Linuron, control was better in 2002 with Flex having the greater effect. Orache and field speedwell control was variable over sites and years. Grass weeds were low in number and these experiments are not a true test for Aramo.

Harvested yields were on the low side probably due to not using a commercial herbicide programme. Weed numbers were decreased where Flex + Silwet were used leading to 18-49% yield increases, yield increases due to the use of Alpha linuron, Aramo and Flex alone were seen but were lower.

When yield was plotted against final weed population then a good linear relationship was seen (Figure 3). With $R^2$ values of 0.83 and 0.79, this indicated the importance of controlling weeds in the crop.

The control of pesticides legislation, introduced in 1986, strengthened the controls on the registration and use of pesticides. The use of pesticides was restricted to the crops for which 'label approval' had been sought by the chemical companies. Outside this label approval, users of agricultural pesticides can apply to have the approval of specific pesticides extended to cover uses additional to those approved and shown on the manufacturer's product label. These are known as Specific off label approvals or SOLA. The herbicides legally available to the grower are limited to Flex (SOLA expires Nov 2006), Alpha linuron (SOLA expires April 2004) and trifluralin (SOLA expires Dec 2008). Residue analyses for Alpha linuron and Flex showed no residues present in seed post harvest. A SOLA was successfully submitted for Flex and this herbicide is now available to the soya grower (SOLA expires Dec. 2007). An application was not made for Alpha linuron as this chemical is of limited use and is now not being used commercially.

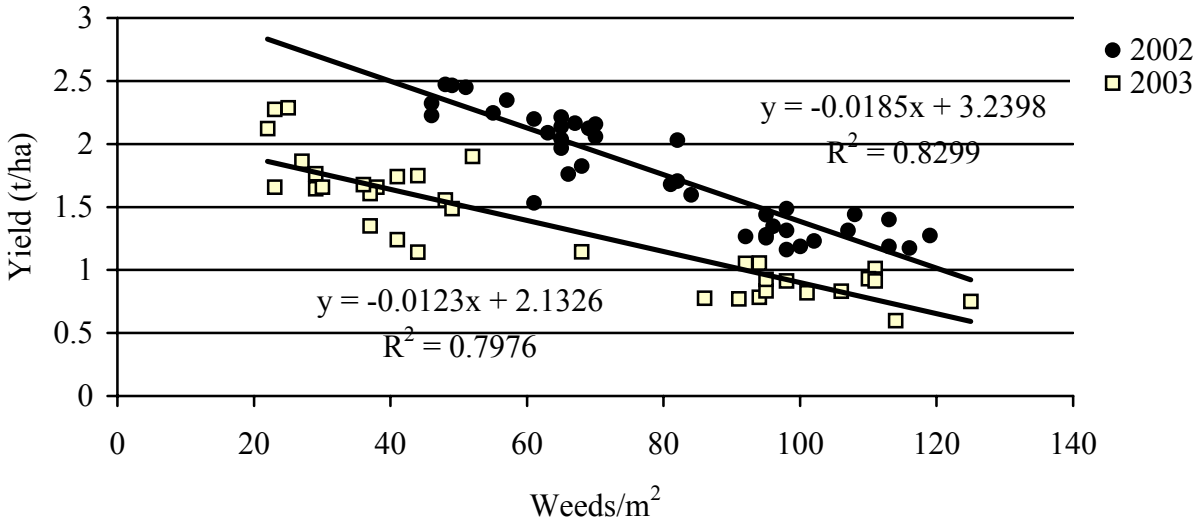


Figure 3. Relationships between yield and weed population

## 6 Conclusions

- The experiment provided seed for residue testing for the most commercially important herbicides.
- A range of weeds were controlled by the herbicides each product having specific strengths and weaknesses. Flex controlled field pansy; Flex plus Silwet controlled black bindweed, field pansy, mayweed and orache; Alpha Linuron controlled chickweed; Aramo controlled black-grass.
- Some herbicides caused crop scorch but this did not have an adverse effect on yield.
- Yield was increased by 0.71 t/ha (49%) where weeds were controlled.

- Residues were not detected in the harvested seed.
- Off-label approval now granted for Flex (expires 31 December 2007)

## 7 References

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**Appendix 1. Growth stage Key for Soya**

## LANDMARK STAGES IN SOYA
## (Varieties of an Indeterminate Type)

*A stage is identified when 50% of plants are at that stage.*
*The figures in brackets represent the codification on theBBCH scale.*

**(05)** Germination

**VC-(10)** The first unifoliate leaves appear between the cotyledons and have started to expand

**V1-(12)** Unifoliate leaves are completely expanded.

**V2-(32)** Second node. The first trifoliate leaf has started to expand.

**Vn-(39)** Internode extension ('n' node).

**R1-(60)** A flower in full bloom on any node on the main stem.

**R3-(65)** A pod of approximately 5 mm long is found on the highest of the last four nodes on the main stem with leaves fully expanded.

**R5-(69)** A seed measuring 3 mm in on e of the pods carried on the highest of the four nodes on the main stem.


**R6-(75)** A pod contains a green seed which fills the pod cavity on the highest of the four nodes on the main stem.
**R6+-(80)** Generally this stage marks the end of pod abortion. The green seed reaches 11 mm in length. Lower leaves start to senesce.

**R7-(81)** A pod on the main stem contains at least one seed which attains its mature chestnut colour. The seed fills out in the pod.

**R8-(99)** Maturity, 95% of the pods are at R7 (beyond that stage 5-10 days are necessary for the seed moisture to lower to 15%). The seed is released from the pod. All leaves are dropped.

**Appendix 2. Agronomic information**

| **Site:** | **Carbrooke** | | **Year: 2002** |
|---|---|---|---|
| Field name: | Little Oaks | | |
| Soil texture: | Sandy loam | | |
| Drainage: | Good | | |
| Previous cropping: | 2001 Winter barley | | |
| | 2000 Winter wheat | | |
| | 1999 Split peas/sugar beet | | |
| | 1998 Winter wheat | | |
| Previous cultivation: | 11/09/01 tramline subsoiled, 12/12/01 Plough, 03/04/02 Spring tine, 22/04/02 power harrow and drill | | |
| Crop: | Cultivar | : | Northern Conquest |
| | Sowing date | : | 22/04/02 |
| | Seedrate (kg/ha) | : | 165.4 |
| | Fertiliser (kg/ha) | : | 02/01/02 0:24:24 112 kg/ha |
| | 02/01/02 0:18:36 164 kg/ha | | |
| Herbicides: | None on trial area | | |
| Fungicides: | None | | |
| Insecticides: | None | | |
| Desiccant: | 24/9/02 Reglone 3.0 l/ha plus Neon 0.3 l/ha | | |
| Harvest date: | 7/10/02 | | |

| **Site:** | **Preston St Mary** | **Year: 2002** |
|---|---|---|
| Field name: | - | |
| Soil texture: | Clay loam | |
| Drainage: | Good | |
| Previous cropping: | 2001 Winter barley | |
| | 2000 Winter wheat | |
| | 1999 Winter wheat | |
| | 1998 Peas | |
| Previous cultivation: | December 2001 Plough, 1/03/02 Shallow cultivation, 15/04/02 Duck foot harrow, 28/04/02 Light harrow | |
| Crop: | Cultivar | : Northern Conquest |
| | Sowing date | : 29/04/02 |
| | Seedrate (kg/ha) | : 170.0 |
| | Fertiliser (kg/ha) | : 251 kg/ha Triple super phosphate |
| Herbicides: | 06/09/01 3.2 l/ha Roundup Ultra | |
| Fungicides: | None | |
| Insecticides: | None | |
| Desiccant: | 16/09/02 Reglone 3 l/ha plus Activator 90 0.3 l/ha | |
| Harvest date: | 30/09/02 | |

| **Site:** | **Stixwould** | **Year: 2003** |
|---|---|---|
| Field name: | 17 acre | |
| Soil texture: | Sandy loam | |
| Drainage: | Good | |
| Previous cropping: | 2002 Sugar beet | |
| | 2001 Winter wheat | |
| | 2000 Peas | |
| | 1999 Winter wheat | |
| Previous cultivation: | Plough and combination power harrow / drill on 25 April 2003 | |
| Crop: | Cultivar | : Northern Conquest |
| | Sowing date | : 25/04/03 |
| | Seedrate (kg/ha) | : 115 |
| | Fertiliser (kg/ha) | : None |
| Herbicides: | None on trial area | |
| Fungicides: | None | |
| Insecticides: | None | |
| Desiccant: | Roundup @ 3.5 l/ha on 25/09/03 | |
| Harvest date: | 13/10/03 | |

| **Site:** | **Bourne St Mary** | **Year: 2003** |
|---|---|---|
| Field name: | 6651 | |
| Soil texture: | Silt/clay loam | |
| Drainage: | Good | |
| Previous cropping: | 2002 Winter wheat | |
| | 2001 Set-aside | |
| | 2000 Sugar beet | |
| | 1999 Winter wheat | |
| Previous cultivation: | Plough and combination power harrow/drill on 24 April 2003 | |
| Crop: | Cultivar | : Northern Conquest |
| | Sowing date | : 24/04/03 |
| | Seedrate (kg/ha) | : 137 |
| | Fertiliser (kg/ha) | : None |
| Herbicides: | None on trial area | |
| Fungicides: | None | |
| Insecticides: | None | |
| Desiccant: | Reglone @ 3 l/ha on 07/09/03 | |
| Harvest date: | 18/09/2003 | |

**Appendix 3 Assessment dates**

**1. Vigour**

Carbrooke 2002

| Date done | Comments | Days After Treatment application | | | | |
|---|---|---|---|---|---|---|
| | | T2 | T3 | T4(1) | T4(2) | T5 |
| 04-Jun-02 | T4 symptoms of slightly retarded growth | - | 42 | 4 | - | - |
| 12-Jun-02 | T4 still showing symptoms of retarded growth | - | 50 | 12 | - | - |
| 16-Jun-02 | T5 now showing retarded growth, T4 recovering | 4 | 54 | 16 | - | 4 |
| 21-Jun-02 | T5 symptoms of retarded growth and scorch | 9 | 59 | 21 | - | 9 |
| 2-July-02 | T4 still scorched from second spray | 20 | 70 | 32 | 4 | 20 |
| 9-Jul-02 | T4 still scorched from second spray | 27 | 77 | 39 | 11 | 27 |
| 19-Jul-02 | Scorch effects on T4 almost gone | 37 | 87 | 49 | 21 | 37 |

Preston 2002

| Date done | Comments | Days After Treatment application | | | | |
|---|---|---|---|---|---|---|
| | | T2 | T3 | T4(1) | T4(2) | T5 |
| 04-Jun-02 | T4 symptoms of scorch and retarded growth | - | 28 | 4 | - | - |
| 12-Jun-02 | T4 still showing symptoms of retarded growth | - | 36 | 12 | - | - |
| 16-Jun-02 | T5 have scorch and retarded growth symptoms, T4 recovered | 4 | 40 | 16 | - | 4 |
| 21-Jun-02 | T5 shows most severe symptoms, T2 and T4 less severe | 9 | 45 | 21 | - | 9 |
| 2-July-02 | Score on newest leaves of T4, T5 still slightly retarded | 20 | 56 | 32 | 4 | 20 |
| 9-Jul-02 | T4 still scorched from second spray | 27 | 63 | 39 | 11 | 27 |
| 19-Jul-02 | T4 toxic effects almost gone, a few leaves curled | 37 | 73 | 49 | 21 | 37 |

Stixwould 2003

| Date done | Comments | Days After Treatment application | | | |
|---|---|---|---|---|---|
| | | T2 | T4(1) | T4(2) | T5 |
| 16 June 03 | T4 symptoms of slight scorch and leaf curl | - | 5 | - | - |
| 20 June 03 | Scorch still obvious on T4 | - | 9 | - | - |
| 23 June 03 | Scorch and leaf curl on T5, symptoms still visible on T4 | 3 | 12 | - | 3 |
| 4 July 03 | T4 and T5 symptoms still visible. T5 more severe | 14 | 23 | - | 14 |
| 8 July 03 | T4 and T5 symptoms still visible. T5 more severe. Weed control better than at Bourne | 18 | 27 | - | 18 |
| 14 July 03 | T5 nearly fully recovered, T4 showing scorch and slight stunting after 2nd spray | 24 | 33 | 5 | 24 |
| 18 July 03 | T4 still scorched and stunted | 28 | 37 | 9 | 28 |
| 30 July 03 | T4 still scorched and stunted. Symptoms greater at this site than at Bourne | 40 | 49 | 21 | 40 |

Bourne 2003

| Date done | Comments | Days After Treatment application | | | | |
|---|---|---|---|---|---|---|
| | | T2 | T3 | T4(1) | T4(2) | T5 |
| 16 June 03 | T4 symptoms of slight scorch and leaf curl | - | 52 | 5 | - | |
| 20 June 03 | Scorch on T4 not as obvious on 16 June | - | 56 | 9 | - | |
| 23 June 03 | Scorch and leaf curl on T5, symptoms still visible on T4 | 3 | 59 | 12 | - | 3 |
| 4 July 03 | T5 symptoms still visible | 14 | 70 | 23 | - | 14 |
| 9 July 03 | T4 and T5 almost fully recovered. | 18 | 74 | 27 | - | 18 |
| 14 July 03 | T5 nearly fully recovered, T4 showing scorch and slight stunting after 2nd spray | 24 | 80 | 33 | 5 | 24 |
| 18 July 03 | T4 still scorched and stunted | 28 | 84 | 37 | 9 | 28 |
| 30 July 03 | No symptoms visible on T4, Block 4 less vigorous | 40 | 96 | 49 | 21 | 40 |

## 2. Other assessments

| Assessment | Carbrooke | Preston | Stixwould | Bourne |
|---|---|---|---|---|
| Plant population | 31-May-02 | 23-May-02 | 29-May-03 | 29-May-03 |
| Weed count before GS V5 | 28-Jun-02 | 28-Jun-02 | 8-Jul-03 | 9-Jul-03 |
| Weed count before GS R7 | 15-Aug-02 | 15-Aug-02 | 6-Aug-03 | 7-Aug-03 |
| Harvest | 7-Oct-02 | 30-Sep-02 | 13-Oct-03 | 18-Sep-03 |

**Appendix 4**

Carbrooke 2002

| Date | Chemical and rate | Weather conditions | Crop growth stage | Crop condition | Weed, disease and pest | Soil information |
|---|---|---|---|---|---|---|
| 23-Apr-02 | Alpha Linuron 0.8 l/ha | Wind S 5 mph, slight drift, previous weather dry, weather at application sunny and warm (22°C) | Pre-emergence | - | none | Surface dry, sub soil dry |
| 31-May-02 | Flex 0.45 l/ha plus Silwet 0.1% v/v | Wind W 6-8 mph, moderate drift, previous weather wet and warm, weather at application sunny and warm (17°C) | V1 | dry | Weeds 1-2 pairs of leaves | Surface damp, sub soil damp |
| 12-Jun-02 | Aramo 1.5l/ha Flex 0.9 l/ha | Wind SW 3-6 mph, slight-moderate drift, previous weather showery and cool, weather at application sunny and warm (23°C) | V2 | dry | - | Surface dry, sub soil damp |
| 28-Jun-02 | Flex 0.45 l/ha plus Silwet 0.1% v/v | Wind NW 3-7 mph, slight drift, previous weather dry, weather at application overcast, dry and cool (15°C) | V5 | dry | - | Surface dry |

Preston 2002

| Date | Chemical and rate | Weather conditions | Crop growth stage | Crop condition | Disease and pest damage | Soil information |
|---|---|---|---|---|---|---|
| 7-May-02 | Alpha Linuron 0.8 l/ha | Wind SE 2-3 mph, slight drift, previous weather showery, weather at application dry and warm (15°C) | Pre-emergence | - | none | Surface damp, sub soil damp |
| 31-May-02 | Flex 0.45 l/ha plus Silwet 0.1% v/v | Wind W 3-6 mph, slight drift, previous weather showery and warm, weather at application sunny and dry (21°C) | V1 | dry | Weeds 1-2 pairs of leaves | Surface dry, sub soil damp |
| 12-Jun-02 | Aramo 1.5l/ha Flex 0.9 l/ha | Wind SW 3-6 mph, slight drift, previous weather dry and cool, weather at application overcast and cool (21°C) | V2 | dry | - | Surface dry, sub soil damp |
| 28-Jun-02 | Flex 0.45 l/ha plus Silwet 0.1% v/v | Wind calm, no drift, previous weather dry and cool, weather at application overcast, dry and warm (19°C) | V5 | dry | - | Surface dry |

Stixwould 2003

| Date | Chemical and rate | Weather conditions | Crop growth stage | Crop condition | Weed, disease and pest | Soil information |
|---|---|---|---|---|---|---|
| 11-Jun-03 | Flex 0.45 l/ha plus Silwet 0.1% v/v | Wind SW 5-9 mph, moderate drift, previous weather showery and warm, weather at application sunny, overcast and dry (22°C) | V1.5-V2 | dry | Very weedy, Weeds 1-2 pairs of leaves | Surface damp, sub soil damp |
| 20-jun-03 | Aramo 1.5l/ha Flex 0.9 l/ha | Wind W 5-15 mph, moderate drift, previous weather dry and warm, weather at application sunny and warm (18°C) | V3-V4 | dry | - | Surface dry, sub soil damp |
| 8-Jul-03 | Flex 0.45 l/ha plus Silwet 0.1% v/v | Wind WSW 2-4 mph, slight drift, previous weather dry and warm, weather at application sunny, overcast, dry and warm (22°C) | V5 R1 | dry | - | Surface damp, sub soil damp |

Bourne 2003

| Date | Chemical and rate | Weather conditions | Crop growth stage | Crop condition | Disease and pest damage | Soil information |
|---|---|---|---|---|---|---|
| 25-Apr-03 | Alpha Linuron 1.4 l/ha | Wind SE 4-6 mph, slight drift, previous weather showery, weather at application dry and overcast (16°C) | Pre-emergence | - | none | Surface damp, sub soil damp |
| 11-Jun-03 | Flex 0.45 l/ha plus Silwet 0.1% v/v | Wind SW 5-8 mph, moderate drift, previous weather showery and warm, weather at application sunny and dry (21°C) | V2 | dry | moderately weedy | Surface dry, sub soil damp |
| 20-Jun-03 | Aramo 1.5l/ha Flex 0.9 l/ha | Wind W 5-10 mph, moderate-severe drift, previous weather dry and warm, weather at application sunny and warm (18°C) | V3-V4 | dry | - | Surface dry, sub soil damp |
| 9-jul-03 | Flex 0.45 l/ha plus Silwet 0.1% v/v | Wind W, <2 mph, no drift, previous weather dry and hot, weather at application sunny, dry and hot (24°C) | V6 R1 | dry | - | Surface dry |

**Appendix 5. Weed data by species from all sites**

Table 1. Carbrooke 2002 - 28th June 2002 (number per m²).

| Treatment | Bindweed | Chickweed | Field Pansy | Orache |
|---|---|---|---|---|
| Untreated | 2.5 | 11.8 | 3.0 | 24.8 |
| Aramo | 3.5 | 9.5 | 2.5 | 22.0 |
| Alpha Linuron | 3.8 | 3.5 | 5.0 | 19.0 |
| Flex + Silwet (split dose) | 0.8 | 8.3 | 0.5 | 17.5 |
| Flex | 2.0 | 9.0 | 2.0 | 19.3 |
| Mean | 2.5 | 8.4 | 2.6 | 20.5 |
| SED | 1.25 | 2.49 | 1.5 | 3.81 |
| CV | 70.5 | 41.9 | 84.3 | 26.3 |
| F probability | 0.177 | 0.064 | 0.127 | 0.385 |

Table 2. Carbrooke 2002 -15th August 2002 (number per m²).

| Treatment | Bindweed | Chickweed | Fat hen | Field Pansy | Mayweed | Orache |
|---|---|---|---|---|---|---|
| Untreated | 10.3 | 22.3 | 4.3 | 4.3 | 2.5 | 31.3 |
| Aramo | 7.5 | 19.8 | 4.8 | 6.0 | 5.7 | 35.7 |
| Alpha Linuron | 8.0 | 11.0 | 6.0 | 5.0 | 14.30 | 32.5 |
| Flex + Silwet (split dose) | 2.3 | 19.8 | 3.8 | 1.0 | 0.8 | 20.3 |
| Flex | 6.5 | 20.0 | 4.8 | 3.3 | 6.7 | 34.2 |
| Mean | 6.9 | 18.6 | 4.7 | 3.9 | 6.0 | 30.8 |
| SED | 1.112 | 3.21 | 2.646 | 1.719 | 4.63 | 3.89 |
| CV | 22.8 | 24.5 | 79.6 | 62.3 | 109.2 | 17.8 |
| F probability | <0.001 | 0.036 | 0.934 | 0.101 | 0.096 | 0.013 |

Table 3. Preston 2002 - 28th June 2002 (number per m²).

| Treatment | Bindweed | Chickweed | Field Speedwell | Groundsel |
|---|---|---|---|---|
| Untreated | 6.8 | 13.3 | 15.8 | 45.0 |
| Aramo | 8.5 | 8.8 | 15.5 | 39.2 |
| Alpha Linuron | 11.5 | 5.0 | 19.3 | 20.5 |
| Flex + Silwet (split dose) | 1.0 | 7.3 | 5.3 | 14.0 |
| Flex | 0.5 | 8.8 | 0.5 | 13.0 |
| Mean | 5.7 | 8.6 | 11.3 | 26.4 |
| SED | 1.67 | 1.58 | 1.82 | 3.46 |
| CV | 41.8 | 26.0 | 22.9 | 18.6 |
| F probability | <0.001 | 0.003 | <0.001 | <0.001 |

Table 4. Preston 2002 - 15th August 2002 (number per m²).

| Treatment | Bindweed | Chickweed | Field Speedwell | Black-grass |
|---|---|---|---|---|
| Untreated | 14.0 | 35.5 | 10.8 | 3.3 |
| Aramo | 13.5 | 34.8 | 15.8 | 0 |
| Alpha Linuron | 16.3 | 16.0 | 25.5 | 1.3 |
| Flex + Silwet (split dose) | 2.0 | 36.8 | 10.3 | 4.5 |
| Flex | 4.3 | 36.0 | 7.0 | 3.3 |
| Mean | 10.0 | 31.8 | 13.9 | 2.5 |
| SED | 2.153 | 2.992 | 3.44 | 1.45 |
| CV | 30.5 | 13.3 | 35.2 | 83.6 |
| F probability | <0.001 | <0.001 | 0.001 | 0.058 |

Table 5. Stixwould 2003 - 8th July 2003 (number per m²).

| Treatment | Field pansy | Field speedwell | Chickweed | Shepherds purse | Orache | Annual meadow grass |
|---|---|---|---|---|---|---|
| Untreated | 107.0 | 25.3 | 22.0 | 21.5 | 13.3 | 4.7 |
| Aramo | 91.7 | 27.0 | 32.7 | 19.3 | 12.0 | 3.7 |
| Flex + Silwet (split dose) | 91.2 | 39.7 | 51.5 | 6.0 | 9.5 | 13.5 |
| Flex | 86.0 | 22.3 | 36.0 | 7.7 | 8.5 | 8.5 |
| Mean | 94.0 | 28.6 | 35.6 | 13.6 | 10.8 | 7.9 |
| SED | 8.69 | 11.64 | 13.40 | 5.74 | 2.48 | 4.00 |
| CV | 13.1 | 57.6 | 42.9 | 39.7 | 18.8 | 24.9 |
| F probability | NS | NS | NS | 0.05 | NS | NS |

Table 6. Stixwould 2003 - 6th August 2003 (number per m²).

| Treatment | Field pansy | Field speedwell | Chickweed | Cranesbill | Orache | Annual meadow grass |
|---|---|---|---|---|---|---|
| Untreated | 63.7 | 3.3 | 12.5 | 3.8 | 11.3 | 3.3 |
| Aramo | 57.7 | 4.3 | 16.0 | 5.8 | 12.5 | 3.5 |
| Flex + Silwet (split dose) | 52.7 | 3.5 | 19.5 | 9.8 | 5.6 | 8.5 |
| Flex | 50.0 | 2.5 | 20.3 | 8.0 | 6.3 | 5.0 |
| Mean | 56.1 | 3.4 | 17.1 | 6.8 | 8.9 | 5.1 |
| SED | 8.6 | 1.74 | 4.33 | 2.63 | 1.87 | 2.37 |
| CV | 16.5 | 35.0 | 24.1 | 46.8 | 28.6 | 10.9 |
| F probability | NS | NS | NS | NS | NS | NS |

Table 7. Bourne 2003 - 9 July 2003 (number per m²).

| Treatment | Bindweed | Chickweed | Field Speedwell | Mayweed | Cleavers | Knotgrass |
|---|---|---|---|---|---|---|
| Untreated | 4.8 | 9.8 | 8.8 | 10.0 | 5.0 | 4.5 |
| Aramo | 4.3 | 9.8 | 11.3 | 7.3 | 1.8 | 4.2 |
| Alpha Linuron | 4.0 | 7.0 | 8.8 | 6.5 | 1.8 | 7.7 |
| Flex + Silwet (split dose) | 2.8 | 8.8 | 7.5 | 5.5 | 4.5 | 5.0 |
| Flex | 2.5 | 12.0 | 14.3 | 8.8 | 5.3 | 3.2 |
| Mean | 3.7 | 9.5 | 10.1 | 7.6 | 3.7 | 5.0 |
| SED | 1.69 | 3.75 | 2.89 | 1.50 | 2.11 | 3.39 |
| CV | 119.3 | 76.9 | 18.6 | 22.3 | 42.8 | 80.1 |
| F probability | NS | NS | NS | NS | NS | NS |

Table 8. Bourne 2003 - 7th August 2003 (number per m²).

| Treatment | Bindweed | Chickweed | Field Speedwell | Mayweed | Cleavers | Knotgrass |
|---|---|---|---|---|---|---|
| Untreated | 4.3 | 6.7 | 5.0 | 8.3 | 4.0 | 2.5 |
| Aramo | 4.3 | 10.3 | 6.0 | 8.0 | 3.5 | 3.8 |
| Alpha Linuron | 2.0 | 5.5 | 8.8 | 6.5 | 3.3 | 4.3 |
| Flex + Silwet (split dose) | 2.5 | 10.0 | 2.8 | 1.5 | 5.5 | 4.3 |
| Flex | 2.5 | 8.5 | 4.5 | 6.3 | 3.8 | 2.0 |
| Mean | 3.1 | 8.2 | 5.4 | 6.1 | 4.0 | 3.4 |
| SED | 1.34 | 4.05 | 2.09 | 1.46 | 1.54 | 1.42 |
| CV | 64.6 | 90.3 | 35.7 | 12.1 | 42.4 | 73.3 |
| F probability | NS | NS | NS | 0.004 | NS | NS |