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| Project Title: | Vining Peas: Reducing risk of slug contamination |
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CONTENTS

## GROWER SUMMARY

### Headline

Reduce the risk of slug contamination in vining peas by trapping in the spring from March to mid May to identify of high risk fields, especially where oilseed rape is part of the rotation. Pellet in high risk fields at the early bud stage and when possible avoid vining during wet periods.

### Background

Slug contamination of mechanically vined vining peas causes problems both in the factory and with the consumer. Peas are delivered to the factory in 20t loads usually within 90 minutes of vining. Contaminated loads result in rejection by the factory, costing around £4800 per load. Much work has been done studying biology and control of slugs in autumn sown cereals, but the problem in peas during the summer, has identified several areas needing research. The present study is aimed at identifying the species of slug likely to cause contamination and to examine the value of monitoring to identify high risk fields.

The influence of previous cropping and crop rotations is not fully understood and if chemical means for control are required, the optimum time for treatment needs to be identified.

The results from such a study should provide a better understanding and awareness of the means to reduce the risk of slug contamination in vined peas, both culturally and by chemical means if required.

### Summary of the project

### The project objectives are:-

To identify the species composition within pea fields.

Slug monitoring using refuge traps baited with dry poultry mash was used to identify the principal slug species present in vining pea fields during the summer. Two species were found in crops, the most frequently found was the grey field slug, *Deroceras reticulatum* and less frequently, the black garden slug *Arion hortensis.* However, at the end of the season, *Deroceras reticulatum* was the only significant species found in peas prior to harvest.

2. The effect of cropping rotations on slug populations.

A limited amount of data suggested that slug numbers were high where oilseed rape had been grown as part of the cropping rotation. There was no evidence to show that other vegetables increased slug numbers.

3. Identification of high risk fields.

Trapping was effective in showing differences in population between fields, but slugs were only recorded in traps when the soil surface was moist.

4 Slug activity during the season.

Some limited data showed that slugs were only present on the foliage of peas when the crop was wet. Where numbers were high, around 25% of the total population were on wet foliage with the remainder on the soil surface. Even where slugs were on the soil, there was a risk of contamination when the peas were being harvested by the viner.

5. Optimum timing of molluscide application.

Measurements of plant damage following treatment with metaldehyde pellets indicated that an application made at the cream bud stage (gs 202) reduced damage to the upper parts of the plants indicating that this would reduce the risk of slugs being present on the foliage before harvest.

**Financial benefits**

Current value of vined peas is £240 per tonne. Loads of peas are delivered to the factory in 20t loads. Rejection of a load due to slug contamination costs £4800. Therefore reducing the risk of load rejection will prevent significant financial loss.

**Action points for growers**

- Use refuge traps from the time of drilling up to early flower to give an indication of slug populations.
- Limited information suggests that fields with a cropping rotation which includes oilseed rape may be at a higher risk and therefore trapping is especially important in such fields.
- The risk of slug contamination in dry periods i.e 14 days with little measurable rainfall, is very low therefore chemical treatment is not worthwhile.
- Where slug populations are high, an application of slug pellets should be applied before flowering has started.
- Avoid harvesting crops with high slug numbers during periods where the crop and soil surface is moist.

## SCIENCE SECTION

### Introduction

Contamination of vined peas by slugs, cause a major problem both in the factory and for the consumers. Dense crops, which can often remain in a wet condition throughout the day, allow slugs to migrate to the foliage, where they become contaminated with the crop during harvesting. Although the most serious infestations occurred during the wet summer of 1998, there has been a gradual increase in the slug related problems over the recent years. Population changes may also be due to the recent sequences of mild winters and wetter periods in July and August.

It is unclear whether wet foliage encourages slug contamination, where slug are present on the leaves, or whether they are being collected from the soil surface by the action of harvesters. Nor is it clear whether differences in diurnal activity are significant and the relative dominance of slug species in vining peas at that time is also not known.

Experience of slugs in arable crops has identified several husbandry factors which can influence slug populations. The presence of crop residues, cropping with oilseed rape and the condition of the seed bed, have an effect, however, most research has been examining behaviour in the autumn sown cereal crops, where as the problem is peas, occurs in the middle of the summer.

Chemical control based on the use of slug pellets may be important in reducing slug numbers at critical times although there is a risk of contamination of vined peas by the pellets themselves.

The project is aimed at identifying the main slug species present in pea fields, to examine the relationship of cropping practises in slug population and to examine the usefulness of chemical control. The results will provide information to growers and consultants, of the best practices which can be employed in an integrated approach to reduce the risk of slug contamination in the harvested produce.

### Methods

#### Species composition within pea fields.

Refuge traps consisting of 40 x 40cm hardboard squares were placed on the soil surface of pea fields. Traps were baited with approximately 50g of dry poultry mash. Baits were replenished at each visit, or the traps were moved to a different position if predation of the bait had been high. Five traps were deployed in each field with a distance of 20m between traps.

In 1999, trapping was carried out five crops in South Lincolnshire. Trapping began on 25$^{th}$ May as the peas were just emerging and traps were examined on 5 occasions until 5$^{th}$ July by which time the peas were at the beginning of flowering (gs 202).

In 2000, trapping was again conducted in 6 pea fields in South Lincolnshire. Traps were deployed as before and commenced on 25$^{th}$ May although the peas were at a later growth stages, i.e. from late vegetative stage (gs 106) to early flower (gs 203). Traps were examined on three occasions until 5$^{th}$ June by which time the peas had finished flowering.

**Effects of previous cropping on slug populations**

In 2000, the fields chosen for slug monitoring had a range of non-cereal crops in the rotation. These included oilseed rape, potatoes and carrots. The cropping details were collated with the slug catch data.

**Identification of high risk fields**

Slug trapping in 1999 and 2000 gave an indication of those fields where slugs were present although the dry weather during June in both seasons was not conducive to soil surface activity. In 2000 crops in the monitoring sites were examined close to harvesting to determine slug activity in the foliage. Each crop was inspected by examining the foliage and soil surface in an area of $0.5m^2$ at 20m intervals along a 120m transect across the field. The number of slugs, and their identity were recorded together with their position in the crop or soil together with the moisture condition of the foliage and soil surface.

**Activity patterns**

During 1999 and 2000, four crops were inspected during the harvesting operation. Inspections were made as described in the previous section, but in addition, samples of vined peas were collected from the viner tank or trailer and were examined for contamination. In both years, the crops and soil surface was dry and no slugs detected.

In 2001, two crops of Waverex vining peas in South Lincolnshire were also inspected during harvesting. There had been recent heavy rain and the foliage and soil surface were wet. The crop was inspected at 25 positions along a transect as before. The numbers, identity and position on the foliage or soil was recorded. During the vining operation in one of the fields samples of vined peas were taken as before and examined for slugs.

**Application timing of slug pellets**

In 2002, two field trials were carried out in vining pea crops in South Lincolnshire. Slugs were monitored in both fields and plots marked out as the peas reached the 5-$6^{th}$ node (gs 105-106). Each plot was 10m x 4m and metaldehyde slugs pellets applied at a rate of 15kg/ha to the plots at different crop growth stages, pre-flowering, (gs106-7) cream bud (gs 202) and first flower (gs 204). An untreated area was left for comparison. Each treatment was replicated four times in a Latin Square design. Prior to harvest, the plots were examined for slugs and plants were examined for damage. Slug feeding damage was assessed as a percentage on the bottom, middle and top thirds of 20 plants taken at random from each plot. The damage was an indication of slug activity over the trial period.

**Results**

**Species composition within pea fields**

In 1999, very few slugs were recorded in the traps over the period as there was very little rain recorded during the period. The soil surface was dry and the foliage only moist in the early morning as a result of dew. The data shown in Table 1. The rainfall is shown in Appendix 1.

Table 1. Slug recording in vining pea fields 1999

| | recording date | 27/5 | 4/6 | 9/6 | 25/6 | 5/7 |
|---|---|---|---|---|---|---|
| field reference | crop growth stage | 103 | 104 | 105 | 111 | 201-202 |
| Rhoon P1B | | 0 | 0 | 0 | 0 | 0 |
| Rhoon P2A | | 3 A.h. | 3 A.h | 14 A.h | 0 | 0 |
| Rhoon P3B (light) | | 0 | 0 | 0 | 0 | 0 |
| Rhoon P3B (heavy) | | 3 A.h | 4 A.h | 1 A.h<br>1 D.r | 0 | 0 |
| Lighthouse | | 0 | 0 | 0 | 0 | 0 |

A.h *Arion hortensis* D.r. *Deroceras reticulatum*

In 2000, rainfall occurred on several occasions during the period, (Appendix 2) but again slug numbers were low, but catches corresponded with recent rain and a wet soil surface.

Table 2. Slug recording in vining pea fields 2000

| | recording date: | 30/5 | 1/6 | 5/6 |
|---|---|---|---|---|
| field reference | crop growth stages | | | |
| M 3B | 203 - 205 | 0 | 0 | 0 |
| M 3D | 202 - 205 | 1 D. r | 9 D. r | 0 |
| M4 | 203 - 205 | 1 D. r | 5 D. r<br>7 A. h | 0 |
| S 1A | 201 - 204 | 5 D. r | 22 D. r<br>5 A. h | 1 D. r<br>1 A. h |
| WX4 | 107 - 201 | 0 | 8 D. r | 0 |
| WX1F | 106 - 201 | 0 | 1 D. r | 0 |

A. h *Arion hortensis* D. r *Deroceras reticulatum*

**Effect of previous cropping on slug population**

The cropping history since the current years pea crop was related to the total number of slugs recorded over the period 25th May until 25th June. The data are shown in Table 3.

Table 3. Slug numbers and cropping history

| Field | cropping history | | | | | slug numbers | |
|---|---|---|---|---|---|---|---|
| | 1995 | 1996 | 1997 | 1998 | 1999 | A. h | D. r |
| M3B | peas | wheat | potatoes | wheat | s. beet | 1 | 0 |
| M3D | peas | wheat | s. beet | wheat | carrots | 0 | 10 |
| M4 | wheat | s. beet | wheat | onions | wheat | 7 | 6 |
| S1A | wheat | wheat | o.s. r | wheat | wheat | 2 | 27 |
| WX4 | wheat | cauliflower | wheat | potatoes | wheat | 0 | 6 |
| WX1F | peas | wheat | potatoes | wheat | cauliflower | 0 | 1 |

A. h *Arion hortensis* D. r. *Deroceras reticulatum*

**Identification of high risk fields**

In 1999 slugs were found in a significant number in only one of the fields where the foliage was moist with dew. All slugs were found on the soil surface. Table 4 shows the details of the crop and soil condition.

Table 4. 1999 trap catches compared with crop infestation

| field | variety | total trapped | inspection date | soil | foliage | slug numbers |
|---|---|---|---|---|---|---|
| WX4 | Waverex | 8 | 21.7 | dry | dry | 1 D. r |
| P3B | Puget | 18 | 28.7 | dry | moist | 12 D.r |

A further inspection in 4 other pea crops, was made prior to harvest to determine the presence of slugs in the crops. The data are shown in Table 5. All slugs were found on the soil surface.

Table 5. Crop inspections prior to harvest in 1999

| field | variety | inspection date | soil | foliage | slug numbers |
|---|---|---|---|---|---|
| WX15E | Waverex | 23.7 | dry | dry | 1 D. r (soil) |
| WX15D | Waverex | 23.7 | dry | dry | 2 D. r (soil) |
| Octon | Bikini | 27.7 | dry | dry | 5 D. r (soil) |
| Arras | Tristar | 27.7 | dry | dry | 3 D. r (soil) |

D.r. *Deroceras reticulatum*

**Activity patterns**

The rainfall occurring during the 2001 season allowed inspections of two vining pea crops and harvested peas from field WX2B. The results are shown in Table 6.

Table 6. Crop inspection

| field | variety | recording date | slugs/ $m^2$ foliage | | vined peas soil surface (slugs/kg) | |
|---|---|---|---|---|---|---|
| WX2C | Waverex | 17.7 01 | 1.08 | 3.4 | - WX2B | Waverex 17.7.01 |
| 0 | 0.4 | 0.06 | | | | |

All slugs were *Deroceras reticulatum*

**Application of timing of slug pellets**

Appreciable damage on the upper parts of the plants was only recorded from one the two trials. Damage assessments were made on two occasions, 15 days after the final application and again 25 days after just prior to vining. The results are shown in Table 7.

Table 7. Pelleting trial. Fleet Coy 2001

| | | % botto | tr | % middle | tr bottom | | % middle | tr top m | % | tr | % | tr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 15 $DAT_3$ 19/7/02 | | | | | 25 $DAT_3$ 29/07/02 | | | | | |
| 1 untreated | 1.87 | 7.71 | 0.25 | 1.96 | 1.20 | 6.09 | 0.21 | 1.86 | 0.13 | 1.01 | | |
| 2 $T_1$= pre-flower | | 1.37 | 6.68 | 0.06 | 0.72 | 0.94 | 5.3 | 0.19 | 1.24 | 0.01 | 0.32 | |
| 3 $T_2$= cream bud | | 1.81 | 7.37 | 0.44 | 3.16 | 0.33 | 2.79 | 0.01 | 0.32 | 0 | 0 | |
| 4 $T_3$= open flower | | 1.0 | 5.62 | 0 | 0 | 0.94 | 5.32 | 0.25 | 2.45 | 0.13 | 1.43 | |
| LSD | | 1.19 | 2.63 | 0.46 | 2.90 | 0.98 | | 3.33 | 0.44 | 3.26 | 0.20 | 1.73 |
| Probability | | 0.36 | 0.35 | 0.20 | 0.14 | 0.31 | | 0.20 | 0.63 | 0.53 | 0.37 | 0.29 |
| CV% | | 49.2 | 24.0 | 154.0 | 124.0 | 71.2 | | 42.7 | 164.8 | 139.0 | 193.5 | 156.6 |

tr = angular transformation
At the second site, a single assessment was made 16 days after $T_3$. Table 8

Table 8. Pelleting trial. Sutton Bridge 2002

| | % bottom | tr | % middle | tr |
|---|---|---|---|---|
| | | 16 $DAT_3$ 31/7/02 | | |
| 1. untreated | 0.38 | 3.04 | 0.03 | 0.45 |
| 2. $T_1$ = pre-flower | 0.28 | 2.12 | 0 | 0 |
| 3. $T_2$ = cream bud | 0.73 | 4.80 | 0.03 | 0.45 |
| 4. $T_3$ =open flower | 0.28 | 2.12 | 0 | 0 |
| LSD | 0.25 | 1.93 | 0.06 | 1.08 |
| Probability | 0.01 | 0.04 | 0.63 | 0.63 |
| CV% | 38.5 | 40.0 | 298.1 | 298.1 |

tr = angular transformation
Damage was only recorded on the lower parts of the plants. This was at a very low level and the results from treatments were not consistently significant.

**Discussion**

The weather conditions during the four seasons of the study were mainly of dry spells with occasional wetter days.

Slug activity in the vining pea crop from early crop emergence to harvest, was related to wet periods both on the soil surface and on the foliage. This was the largest single factor affecting the results of all sections of the study.

However, the principal findings were that the dominant species of slug in peas during the summer was *Deroceras reticulatum.* The occurrence of *Arion hortensis* was noted during the growing season, but not at harvest. In that field, a relatively low slug population on the soil surface still posed a risk for vining contamination, and it is likely that this would be increased where slugs were active within the crop canopy. The identification of *Deroceras reticulatum* as the main species will focus future research work on this pest.

There appeared to be a relationship of slug population density with previous cropping. Surprisingly, the inclusion of other vegetable crops in a pea rotation did not seem to increase slug numbers compared with a situation where oilseed rape had been included. Using traps to identify high risk fields was useful, but trapping early in the growing season when soil conditions were dry failed to provide any indication of slug presence. Techniques in identifying slug presence in soil samples are being examined in a current LINK project and could have a value in these situation.

Slug activity within the crop was closely related to foliage and soil surface moisture. High numbers of slugs could be found on the soil when the crop is wet immediately following heavy rain. It was not possible to relate slug positions within the crop canopy with risk of vining contamination as there was only one opportunity to observe this, although even where slugs were mainly on the soil. The risk of contamination was present.

Chemical control of slugs by pelleting may reduce the activity of slugs in the foliage if applied at a time where the risk of pellet contamination is low. The results of the trials gave only an indication of usefulness of pelleting although the application made at cream bud stage (gs202) did appear to reduce damage to the upper parts of the plants indicating that slug activity had been affected by the application.

Earlier or later applications were perhaps not so effective and the later applications run the risk of contaminating the vined peas.

**Conclusion**

The main species of slug present in vining pea crops during the summer was *Deroceras reticulatum.* Activity was confined to periods when foliage or the soil surface is wet. Trapping was a useful means of identifying high risk fields although this should only be carried out when the soil surface is moist. Rotations which include oilseed rape may result is high slug populations and there is a risk of slug contamination even when slugs are on the soil surface when vining in wet conditions.

Slug pelleting may be useful in reducing slug activity and feeding on the foliage, but the application should coincide with the cream bud stage.

Appendices

Table 1. Daily rainfall 1999

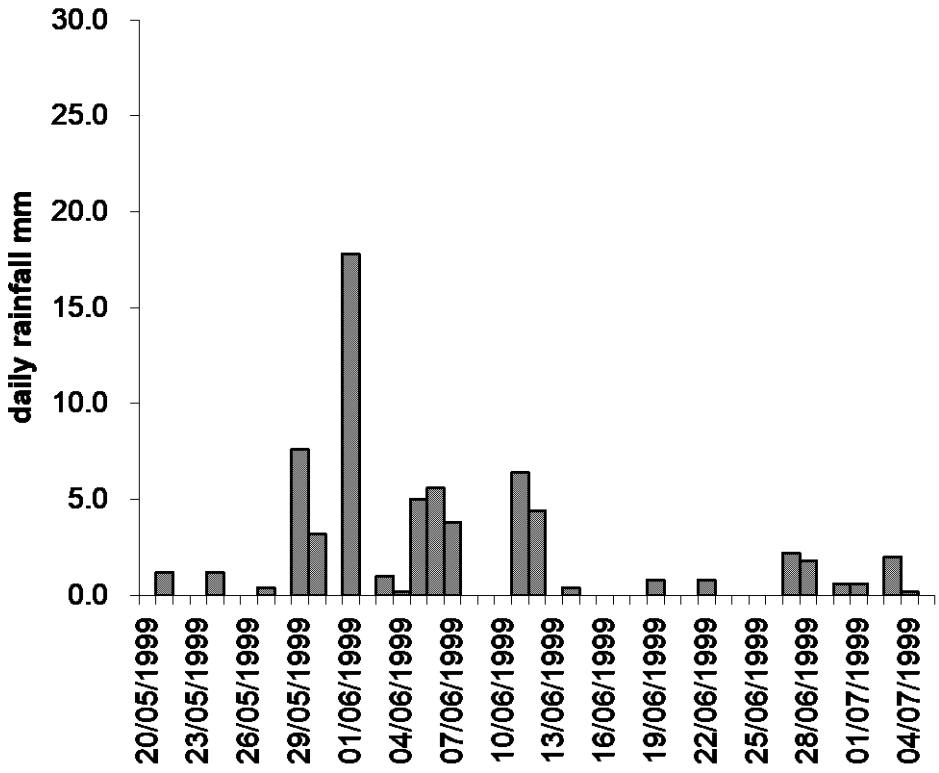

Table 2. Daily rainfall 2000.