Final report:

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Project 03/20

Synchronised Granule Application

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SUMMARY

This project examined the efficacy of synchronised application of a nematicide granule compared to a continuous band application at drilling for the control of nematodes, the soil pest complex and virus yellows, and whether this application technique presented any crop phyto-toxicity effects. These treatments were benchmarked against an untreated control. The project was conducted over three years, with four replicated experiments carried out in each year. Each trial was of 6 or 8 replications, however randomisation was partially restricted, due to mechanical, and health and safety restrictions. Sites with a previous history of Docking Disorder, were selected and these were situated in North Yorkshire and North Norfolk, on predominately sandy soils. In year 1 and 2 Temik was used as the granule nematicide, however with its withdrawal from the market Vydate was introduced in year 2 to run alongside Temik and to replace Temik in 2005. The nematicide granules were applied continuously and synchronised through a Kuhn applicator mounted on a 12 or 18 row Kuhn precision drill and compared with an untreated control. In addition block strips of each treatment were drilled adjacent to each replicated trial and observed throughout the season for virus infection. Over the three years Docking Disorder was only visually observed at three of the twelve sites, two sites in 2004 and one in 2005, all at Docking. The low levels of Docking Disorder could be a result of either the weather or the crop rotation. There was only average May rainfall in each test year; and Docking Disorder is associated with wet Mays. At Thornton, potatoes, which were treated with Telon were included within the rotation, and this treatment may have depleted the natural nematode numbers; at the other sites the continuous use of a nematicide over the last 30 years on each beet crop, may have had a similar effect.

Plant numbers were reduced at four sites with the use of both synchronised and continuous Temik, however, there was a trend for fewer plants in the synchronised application treatment. It is possible that the synchronised mechanism placed more granules over the seed than each side as the shutter opened and closed, resulting in a higher chemical loading around the seed. The use of Vydate produced no reduction in plant number, and at one site plant numbers were increased, due to soil pest control from both application methods.

The three sites that exhibited Docking Disorder symptoms produced a significant positive yield response to a nematicide application with no significant difference between either application method. At the remaining nine sites, the overall trend was for a small yield improvement from the use of a granule at drilling regardless of application technique.

No significant level of virus yellows was recorded at any site in any year, therefore no conclusions can be drawn on the effectiveness of the synchronisation application technique to control aphid movement and virus, compared with continuous application.

INTRODUCTION

Docking Disorder is believed to be prevalent on approximately 15% of soils within the UK beet growing area. The control method is to apply a down-row continuous band of a granular nematicide at drilling via a drill-mounted granule applicator. Vydate is now the main insecticide used, as approval for the use of Temik in sugar beet was withdrawn in 2004. The cost and environmental impact of using this type of carbamate nematicide is high, therefore a synchronised, placed application around the seed, and not a continuous band, could reduce cost and environmental impact. This project examines whether a synchronised application of a nematicide granule is as effective as a continuous application, for nematode and other pest control. It also evaluated any plant phyto-toxicity effects that may result from the different granular application pattern produced by synchronisation application.

OBJECTIVES

To evaluate the effects on the sugar beet crop from a synchronised (placed) or continuous, band of a nematicide, applied at drilling.
To assess the level of control of, Docking Disorder, soil pests and virus yellows achieved by such treatments.

MATERIALS & METHOD

In each year four sites were located on fields with a previous history of Docking Disorder, sites details and design are set out in table 1. Randomisation was restricted due to drill mechanical restraints, and health and safety restrictions. Treatments are shown in table 2.

Table 1 *Trial Design: – All Sites*

	2003	2004	2005
Plot size	6 rows x 12m	6 rows x 12m	9 rows x 24m
Assessment and harvest size	3 rows x 9m	3 rows x 9m	3 rows x 9m
Number of treatments	4	4	4
Replicates	8	6	6
Total number of plots	24	24	24
Experimental design	Randomised Block Design	Randomised Block Design	Randomised Block Design
Site Location	Gayton Thorpe	Ash Beck	Stanhoe Hill
	Bircham 1	Merry Thistle	Honeyhills
	Bircham 2	Low Fringe	Choplands
	Thornton	Thornton	Stubbets

Table 2 *Treatments*:

	2003	2004	2005
Treatment	Rate kg/ha	Rate kg/ha	Rate kg/ha
Untreated	-	-	-
Continuous Temik	5.0	N/A	N/A
Synchronised Temik	2.5	2.5	N/A
Continuous Vydate	N/A	6.0	6.0
Synchronised Vydate	N/A	3.0	3.0
Synchronised Vydate	N/A	N/A	4.5

All treatments were applied as a granular nematicide application at drilling using a Kuhn granular applicator. Data collected as table 3, to British Sugar Standard Operating Procedures.

Table 3 *Data collected*

Plant count	Final emergence
Plant count	At Establishment
Crop Biomass	At Establishment
Virus Yellows	If present in August
Root Yield	At Harvest
Sugar Content	At Harvest
Sugar Yield	At Harvest
Amino-nitrogen impurities	At Harvest
Potassium impurities	At Harvest
Sodium Impurities	At Harvest

RESULTS

All figures marked * in the tables 4 to 11, are significantly different from the untreated control

Crop Biomass

Crop biomass was assessed at plant establishment, table 4.

Table 4 - *Percentage crop biomass (%) at plant establishment*

2003

	Gayton	Bircham 1	Bircham 2	Thornton
Treatment				
Untreated	98	98	N/A	91
Continuous Temik	93	91	N/A	81
Synchronised Temik	95	83	N/A	80
			N/A	
Mean	96	91	N/A	84
LSD *P*= 0.05	N.S	N.S	N/A	N.S

2004

	Ash Beck	Merry Thistle	Low Fringe	Thornton
Treatment				
Untreated	100	60	100	85
Continuous Vydate	100	88*	100	93*
Synchronised Vydate	100	93*	100	98*
Synchronised Temik	100	67	100	93*
Mean	100	77	100	92
LSD *P*= 0.05	N.S	15	N.S	6.6

2005

	Honeyhills	Stanhoe Hill	Choplands	Stubbets
Treatment				
Untreated	89	85	97	97
Continuous Vydate	97	95	100	97
Synchronised Vydate	92	87	100	100
Synchronised Vydate (high rate)	97	88	100	97
Mean	94	89	99	98
LSD *P*= 0.05	N.S	N.S	N.S	N.S

Plant biomass at establishment, was significantly affected at two sites, in 2004 at Thornton where all treatments were significantly better than the untreated and at Merry Thistle were both Vydate treatments were significantly better than the untreated control. At the remaining ten sites there was no significant differences between any treatment.

Plant Population

Table 5 – *Plant number(plants/ha) at plant establishment*.

2003

	Gayton	Bircham 1	Bircham 2	Thornton
Treatment				
Untreated	84191	71100	76192	73703
Continuous Temik	77147*	67326	80169	55083*
Synchronised Temik	75681*	47106*	76281	49150*
Mean	79014	61990	77547	59305
LSD *P*= 0.05	5555	13110	N/S	5110

2004

	Ash Beck	Merry Thistle	Low Fringe	Thornton
Treatment				
Untreated	80370	86543	79877	58642
Continuous Vydate	85802	85185	80864	56296
Synchronised Vydate	79877	85432	89259	59877
Synchronised Temik	81111	81975	82346	50988*
Mean	81790	84784	83086	56451
LSD *P*= 0.05	N.S	N.S	N.S	6600

2005

	Honeyhills	Stanhoe Hill	Choplands	Stubbets
Treatment				
Untreated	54595	38035	70800	69160
Continuous Vydate	56555	59042*	70515	64955
Synchronised Vydate	55440	50265*	76830	62000
Synchronised Vydate (high rate)	51260	56555*	70515	66200
Mean	54465	50975	72160	65580
LSD *P*= 0.05	N.S	9780	N.S	N.S

In 2003 use of continuous Temik resulted in a reduced plant population at two sites and synchronised Temik resulted in a reduced plant population at three sites. In 2004 synchronised Temik reduced plant population at one site. No plant population effects were recorded with the use of Vydate either applied continuously or synchronised. In 2005 at one site, Stanhoe Hill, all treatments gave a significant increase in plant numbers at establishment compared to the untreated control.

Table 6 – *Root yield at harvest (t/ha).*

2003

	Gayton	Bircham 1	Bircham 2	Thornton
Treatment				
Untreated	66.0	76.4	61.7	60.9
Continuous Temik	71.3	78.0	55.4	58.4
Synchronised Temik	66.2	76.4	59.7	56.3
Mean	67.8	77.0	58.9	58.5
LSD *P*= 0.05	N.S	N.S	N.S	N.S

2004

	Ash Beck	Merry Thistle	Low Fringe	Thornton
Treatment				
Untreated	79.8	65.0	72.0	59.9
Continuous Vydate	82.4	76.3*	78.3	61.3
Synchronised Vydate	81.4	74.7*	88.1*	63.0
Synchronised Temik	77.2	69.3	71.9	60.9
Mean	80.2	71.3	77.6	61.3
LSD *P*= 0.05	N.S	8.0	9.2	N.S

2005

	Honeyhills	Stanhoe Hill	Choplands	Stubbets
Treatment				
Untreated	50.8	62.0	69.2	77.3
Continuous Vydate	62.3	73.9*	73.2	80.3
Synchronised Vydate	61.1	69.5*	73.7	75.28
Synchronised Vydate (high rate)	56.6	73.7*	75.8	79.14
Mean	57.7	69.8	73.0	78.02
LSD *P*= 0.05	N.S	5.2	N.S	N.S

In 2003 no significant root yield differences between treatments were recorded. In 2004 synchronised Vydate produced a root yield increase at two sites and continuous Vydate at one site. In 2005 at Honeyhills all treatments significantly improved root yield compared to the untreated control. At the remaining nine sites there was no significant differences between treatments.

Table 7 – *Root sugar percentage (%) at harvest*.

2003

	Gayton	Bircham 1	Bircham 2	Thornton
Treatment				
Untreated	18.83	18.09	18.24	20.33
Continuous Temik	18.96	18.07	18.21	20.16
Synchronised Temik	18.99	18.04	17.99	20.16
Mean	18.93	18.07	18.15	20.21
LSD *P*= 0.05	N.S	N.S	N.S	N.S

2004

	Ash Beck	Merry Thistle	Low Fringe	Thornton
Treatment				
Untreated	17.51	17.87	18.22	18.16
Continuous Vydate	17.79	17.86	18.47	18.28
Synchronised Vydate	17.75	17.93	18.14	18.27
Synchronised Temik	17.38	17.95	18.14	18.27
Mean	17.61	17.91	18.24	18.25
LSD *P*= 0.05	N.S	N.S	N.S	N.S

2005

	Honeyhills	Stanhoe Hill	Choplands	Stubbets
Treatment				
Untreated	18.33	17.60	18.13	17.82
Continuous Vydate	18.41	17.79	18.06	18.02
Synchronised Vydate	18.38	17.72	18.05	18.04
Synchronised Vydate (high Rate)	18.27	17.75	18.15	17.91
Mean	18.35	17.71	18.10	17.95
LSD *P*= 0.05	N.S	N.S	N.S	N.S

No differences in sugar content were recorded at any site.

Table 8 – *Sugar yield at harvest (t/ha).*

2003

	Gayton	Bircham 1	Bircham 2	Thornton
Treatment				
Untreated	12.44	13.85	11.27	12.38
Continuous Temik	13.52*	14.13	10.09	11.78
Synchronised Temik	12.57	13.81	10.74	11.33
Mean	12.84	13.93	10.70	11.83
LSD *P*= 0.05	0.80	N.S	N.S	N.S

2004

	Ash Beck	Merry Thistle	Low Fringe	Thornton
Treatment				
Untreated	13.98	11.64	13.13	10.86
Continuous Vydate	14.67	13.63*	14.46	11.20
Synchronised Vydate	14.46	13.40*	15.98*	11.51
Synchronised Temik	13.46	12.48	13.07	11.13
Mean	14.14	12.79	14.16	11.17
LSD *P*= 0.05	N.S	1.51	1.90	N.S

2005

	Honeyhills	Stanhoe Hill	Choplands	Stubbets
Treatment				
Untreated	9.32	10.95	12.54	13.78
Continuous Vydate	11.47*	13.15	13.22	14.47
Synchronised Vydate	11.23*	12.34	13.30	13.58
Synchronised Vydate (high rate)	10.34*	13.10	13.76	14.18
Mean	10.59	12.38	13.21	14.00
LSD *P*= 0.05	0.95	N.S	N.S	N.S

In 2003 at Gayton the continuous Temik significantly increased sugar yield over the untreated and synchronised application. In 2004 synchronised Vydate applications significantly increased sugar yield at two sites and continuous Vydate at one site. In 2005 both continuous and synchronised Vydate increased sugar yield at one site compared to the untreated control, however the high rate Vydate produced a significantly smaller yield than continuous Vydate. At the remaining eight sites no significant differences between treatments were recorded.

Table 9 – *Root amino nitrogen (mg/100gS) impurities at harvest*.
2003

	Gayton	Bircham 1	Bircham 2	Thornton
Treatment				
Untreated	57	53	40	51
Continuous Temik	56	52	38	60*
Synchronised Temik	55	59	42	63*
Mean	56	55	40	58
LSD *P*= 0.05	N.S	N.S	N.S	8.1

2004

	Ash Beck	Merry Thistle	Low Fringe	Thornton
Treatment				
Untreated	70	63	83	71
Continuous Vydate	66	60	74	66
Synchronised Vydate	64	60	91	71
Synchronised Temik	71	60	86	70
Mean	68	60	84	69
LSD *P*= 0.05	N.S	N.S	N.S	N.S

2005

	Honeyhills	Stanhoe Hill	Choplands	Stubbets
Treatment				
Untreated	45	57	42	33
Continuous Vydate	47	48	38	33
Synchronised Vydate	45	47	39	32
Synchronised Vydate (high rate)	44	49	39	34
Mean	45	50	40	33
LSD *P*= 0.05	N.S	N.S	N.S	N.S

At Thornton in 2003 the untreated control had lower amino nitrogen root impurities. At all other sites no differences in amino nitrogen were recorded between any treatment.

Table 10 – *Root potassium impurities (mg/100gS) at harvest.*

2003

	Gayton	Bircham 1	Bircham 2	Thornton
Treatment				
Untreated	692	747	728	1009
Continuous Temik	704	753	757	(1092)
Synchronised Temik	695	772	752	(1106)
Mean	697	757	746	1069
LSD *P*= 0.05	N.S	N.S	N.S	65

2004

	Ash Beck	Merry Thistle	Low Fringe	Thornton
Treatment				
Untreated	711	782	714	813
Continuous Vydate	665	686	687	822
Synchronised Vydate	699	733	665	751
Synchronised Temik	745	725	707	772
Mean	705	732	693	789
LSD *P*= 0.05	N.S	N.S	N.S	N.S

2005

	Honeyhills	Stanhoe Hill	Choplands	Stubbets
Treatment				
Untreated	1017	1120	990	1066
Continuous Vydate	997	1045	970	1015
Synchronised Vydate	1035	1092	990	1047
Synchronised Vydate (high rate)	1065	1054	990	1076
Mean	1028	1078	985	1051
LSD *P*= 0.05	N.S	N.S	N.S	N.S

At Thornton in 2003 the untreated control had a lower potassium root impurity levels than the treated treatments. At all other sites no differences in root potassium impurity levels were recorded between any treatments.

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Table 11 – *Root sodium impurities (mg/100gS) at harvest*.

2003

	Gayton	Bircham 1	Bircham 2	Thornton
Treatment				
Untreated	37	58	60	47
Continuous Temik	38	54	58	51
Synchronised Temik	40	60	62	53
Mean	38	57	60	50
LSD *P*= 0.05	N.S	N.S	N.S	N.S

2004

	Ash Beck	Merry Thistle	Low Fringe	Thornton
Treatment				
Untreated	67	71	65	70
Continuous Vydate	65	65	60	71
Synchronised Vydate	69	67	63	61
Synchronised Temik	78	61	72	74
Mean	70	66	65	69
LSD *P*= 0.05	N.S	N.S	N.S	N.S

2005

	Honeyhills	Stanhoe Hill	Choplands	Stubbets
Treatment				
Untreated	72	92	60	74
Continuous Vydate	68	73	60	69
Synchronised Vydate	74	74	60	75
Synchronised Vydate (high rate)	77	73	58	68
Mean	73	78	60	71
LSD *P*= 0.05	N.S	N.S	N.S	N.S

No differences in root sodium impurity levels were recorded at any site.

DISCUSSION OF ANNUAL RESULTS

2003

Plant establishment was reduced by synchronised application at 3 sites and by continuous Temik at 2 sites. The reason for this is not clear, however these sites did suffer from stress during the emergence period, caused by some wind blow and surface organic matter. It was also observed that the granule application treatments were slower to emerge, possibly because of a higher chemical loading on the seed, than the untreated control. At one site, Thornton amino nitrogen and potassium root impurities were increased with the use of Temik. This may have been the result of the lower plant stand on these treatments. Therefore phyto-toxicity effects from Temik must be considered.

At Gayton the sugar yield was increased with the use of continuous Temik, compared to the untreated control. At the three other sites no differences in sugar yield was recorded between any treatment. Docking Disorder and virus yellows were not observed at any site.

2004

At Thornton synchronised Temik reduced plant population compared to the untreated control and to the continuous Temik. Capping was observed at Thornton and this may of contributed to the Temik treatment having a lower plant stand. The treatment was again slower to emerge than the other treatments (similar to that observed the previous year).

Docking Disorder was seen at Merry Thistle, where there was a significant increase in crop biomass and sugar yield from using Vydate, continuously or synchronised. A sugar yield benefit was also seen at Low Fringe from synchronised Vydate.

Vydate performed at least as well as Temik in terms of sugar yield with a trend at two sites of producing more yield. Indeed the synchronised Vydate performed as well as continuous Vydate application.

2005

Soil pest activity was seen at the Stanhoe Hill site and this significantly reduced plant numbers on the untreated control. All three Vydate treatments gave a significant control of the pest activity, however it was observed that some plants were still lost between full emergence and establishment. Docking Disorder was only seen on one site, Honeyhills, in June there was a significant increase in root and sugar yield from using Vydate either continuously or synchronised.

Synchronised high rate Vydate performed no better than the standard rate, both in controlling soil pest activity and Docking Disorder. There was also no difference in yield response between the two rates.

At Honeyhills, all three Vydate treatments gave an average sugar yield increase of 1.69t/ha of sugar compared to the untreated control with no difference between the application methods.

CONCLUSION

The Kuhn applicator allowed granules to be applied either continuously or as a synchronised application and was easy to calibrate. No problems were experienced with blockage during application.

The withdrawal of Temik from the marketplace in the middle of the project, forced a change of nematicide granule and Vydate was selected due to its popularity. A lowering in plant population was seen with the use of Temik, used both continuously or as a synchronised application, however the synchronised application gave a slightly greater effect in 2003 and 2004. This could possibly result from a greater granular loading around the emerging seedling, than occurs with the continuous application. It is possible that more granules are distributed over the seed than either side as the applicators distribution shutter opens and closes. However when Vydate was used, plant establishment was not detrimentally affected by this possible increased chemical loading and at one site in 2005 the plant stand was improved as soil pests were controlled.

Virus Yellows was not observed at any site in any year, so no conclusions can be drawn on the synchronised application's ability to control it, compared with a continuous application.

Even though severe Docking Disorder had been seen and recorded in the past by the host growers on all the fields selected, Docking Disorder was observed at only three of the twelve sites. At these three sites a significant yield response was obtained with the use of granules, applied either continuously or synchronised with no significant difference between the two application methods. The low level of Docking Disorder experienced could be due to one of several factors. High May rainfall, that greatly increases nematode activity, was not experienced. The crop growth stage may be important, more Docking Disorder was recorded in 2004 when drilling was later, i.e. mid April, when nematodes are more active. The trial fields were (in the main) weed beet free, so no host plants were available for the nematodes through the rest of the rotation. These may all impact on nematode numbers, however the extent cannot be quantified within the scope of the project. The crop rotation was different at each site, At Thornton, potatoes, which were treated with Telon, were included within the rotation, and this may also have depleted nematode numbers. At the other sites the continuous use of a nematicide over the last 30 years on each beet crop, may have had a similar effect. On the remaining nine trials where Docking Disorder was not observed a small non-significant overall yield increase was recorded with the use of a granule, by both application methods.

The higher rate of synchronised Vydate (4.5kg/ha) used in 2005 gave no benefit over the standard rate (3.0kg/ha) in Docking Disorder and soil pest control. The synchronised application has proved as effective as a continuous application in controlling Docking Disorder and soil pests, although on a limited number of sites. It has allowed application rates to be cut by 50%.

Where pest activity was significant the use of granules provided an acceptable level of control using both application methods. And so where possible the synchronised application should be advised as it presents a better economic and environmental

position. It offers substantial cost savings and produces health and safety benefits to the operator and the field environment. Drill operation output will also be increased, as there will be less downtime filling granule hoppers with product. However three questions remain, can lower application rates be used and obtain the same level of control, with the possible granule distribution profile created by synchronised applicator? And can we predict where and at what level will Docking Disorder will occur each year to reduce the granular treated area without putting sugar yield at jeopardy?. Finally could synchronised granules be used in-conjunction with an insecticide seed treatment economically to help control aphids and greatly reduce the need for foliar spray applications to control aphids?