SCEPTREPLUS

Final Trial Report

Trial code:	SP06.2019
Title:	**AHDB SCEPTREplus sweetcorn post-emergence herbicide screen – grown under covers**
Crop	**Group: Field Vegetables** **Sweetcorn** – *Zea mays*
Target	**General Broadleaf Weeds and Grasses**, 3WEEDT EPPO1/50(3) Weeds in Maize
Lead researcher:	Angela Huckle
Organisation:	RSK ADAS
Period:	27th March 2019 – 31st March 2020
Report date:	12th August 2020
Report author:	**Angela Huckle** Oliver Thomas
ORETO Number: (certificate should be attached)	409

I the undersigned, hereby declare that the work was performed according to the procedures herein described and that this report is an accurate and faithful record of the results obtained

……12th Aug 2020…… …….A. Huckle……
Date Authors signature

……12th Aug 2020…… ……B. Mulholland……
Date Managers signature

Trial Summary

Introduction

The limited range of herbicides available for use on sweetcorn (*Zea mays*) has left gaps in the weed control spectrum. Post-emergence weed control relies on very few active ingredients, such as mesotrione, bromoxynil, clopyralid and fluroxypyr for broad leaf weed control, and nicosulfuron for grass weed control. Coverage of the weed spectrum is therefore incomplete and furthermore there is a risk of resistance development so alternatives and additions to the current armory are required. In addition, bromoxynil is also under threat of revocation.

Particularly problematic broad leaf weeds which remain elusive targets for growers even after pre-emergence applications are; knotgrass (*Polygonum)*, red shank (*Persicaria maculosa)*, pale persicaria *(Polygonum lapathifolium)*, marestail *(Equisetum arvense)*, and volunteer OSR *(Brassica napus)*, as well as blackgrass *(Alopecurus myosuroides)*, brome (*Bromus)*, common millet *(Panicum miliaceum)*, wild oats *(Avena fatua)*, and cereal volunteers. Furthermore, *Amaranthus retroflexus* is an emerging issue (AHDB Gap Analysis 2019).

The trials in 2017 were carried out on an uncovered main season crop of sweetcorn. More information was desired by growers to test the newly approved products and promising products on earlier drilled crops which are more susceptible to any phytotoxic effects of herbicide application. Early drilling is understood to increase sensitivity to herbicides, as conditions are cooler and the crop is growing slower. The sweetcorn was also grown under a biodegradable mulch, which provides a robust test for herbicides because weeds species exhibit particularly vigorous growth under crop covers.

The aim of the work was to screen post-emergence residual herbicides in order to increase the weed control options available to sweetcorn growers for early season and main crops,

Methods

The screen of contact herbicide products was carried out at two separate sites on a grower holding in Sussex on silty loam soils. A randomised replicated design was used to test for treatment effects. The first site was drilled on 10th April 2019, while the second site was drilled on 16th April 2019; both sites were drilled with the cultivar “Early Bird”.

All treatments at both sites were applied at a post-emergence timing (V4 – V5 growth stage) with a 3 m boom, using an Oxford Precision Sprayer (knapsack), and a water rate of 200 L/ha. The randomised block design consisted of three replicates of 14 treatments, including two untreated controls. There were 42 plots in total at each site, each measuring 3.3 m x 5.0 m (16.5 m^2). Each plot consisted of two beds and four crop rows—two per bed.

The trial sites were assessed on three occasions, focussing on treatment efficacy and crop phytotoxicity (safety). Weed control was assessed using weed counts; a percentage of overall plot cover of all weeds, and a percentage cover of each weed species was measured. At the second site, a 0.25 m x 0.25 m quadrat was used, and the total number of weed plants was counted for each individual weed species. Site 1 had a much higher weed burden than the second site, so a quadrat assessment wasn’t used. Crop phytotoxicity (safety) was assessed at the same timings; crop affects were scored on a 0 - 10 scale, 0 = completely healthy crop, 10 = complete crop kill.

Site 1 assessment timings: **40**, **54** and **68** days after treatment application.
Site 2 assessment timings: **34, 48** and **63** days after treatment application.

A harvest assessment was carried out on 13th August (Site 1) and 6th August 2019 (Site 2) and yield and quality parameters were measured to determine the weight and number of marketable and unmarketable cobs, as well as total weight and numbers per plot.

Results and discussion

Five post-emergence treatments (Callisto + Fornet 6OD + AHDB 9856, AHDB 9858, Stomp Aqua applied pre-em followed by AHDB 9856, AHDB 9990 applied post-emergence or AHDB 9859 applied inter-row; **Table 1**) showed greater efficacy, as well as an increase in yield compared with the standard (Callisto + Fornet 6OD); these treatments were also of at least equivalent safety for use in sweetcorn grown under plastic covers.

At Site 1, a greater effect from post-emergence treatments was observed. It was a larger crop at a later growth stage when the herbicides were applied, and sweetcorn becomes intolerant of herbicides as it enters growth stages at 6 leaves or above. The post-emergence application at Site 1 was also applied as the buttress roots were growing, and selected treatments caused deformation of the growth of the roots. These effects were not seen at Site 2, as the crop was at an earlier growth stage and these roots were not yet being formed.

The buttress root deformation was a more severe effect and this persisted until harvest, but yield was not reduced by this effect where efficacy was good. Treatments which caused the deformation to occur were those which included AHDB 9866 and AHDB 9867. AHDB 9867 was one of the best performing products for weed control, and marketable yield was equivalent to or above that of the standard. The buttress root effects would have had a greater effect on yield if the crop had lodged, but this can be mitigated by timing application of the product before the roots are forming.

Despite these greater effects from many of the treatments, three caused very little effect on the crop. These were; Stomp Aqua followed by either AHDB 9990, AHDB 9856, or AHDB 9859 applied as an inter-row application. Effects caused by the remaining treatments included transient yellowing or chlorosis of foliage and an associated check to speed of growth, scorch and white spots on the leaves, or deformation of the buttress roots.

The commercial standard, Callisto + Fornet 6OD caused slight yellowing and check to the speed of growth of the crop, but it should be noted that growers expect this to happen at the growth stage it was applied at Site 1, and accept this effect. This effect was also observed on the treatments Callisto + Fornet 6OD + AHDB 9856, AHDB 9985 + AHDB 9857 and AHDB 9858 at four weeks after application. The crop had recovered from these effects by the time of harvest.

Moderate spotting and scorch was caused by AHDB 9859 applied over the crop at 1/3 rate, but the effect was transient and the crop was recovering by four weeks after application and had fully recovered by harvest.

No concerning effects were seen on the sweetcorn crop at Site 2 by one month after application, but earlier after application at two weeks post spraying there were slight effects on the crop from five of the treatments. This was exhibited as yellowing in plots treated with Callisto + Fornet 6OD, Callisto + Fornet 6OD + AHDB 9856 and AHDB 9867; and there was scorch and white spotting on the foliage from the two treatments where AHDB 9859 was applied. Although the product didn't kill any of the crop when applied over the foliage, less effect was seen from AHDB 9859 when it was applied as an inter-row application.

The weed species and levels at each of the sites differed, with a higher weed population at Site 1, but with a narrower range of species. The weed species at Site 1 consisted mainly of fat hen (*Chenopodium album*) and redshank (*Polygonum persicaria*) while the key weeds at Site 2 were fat hen, chickweed (*Stellaria media*), black nightshade (*Solanum nigrum*), groundsel (*Senecio vulgaris*), and fumitory (*Fumaria officinalis*).

All treatments significantly reduced the percentage of redshank at Site 1; Stomp Aqua 3.3 L/ha pre-emergence followed by AHDB 9867, AHDB 9867 alone and Callisto + Fornet 6OD + AHDB 9856 gave the greatest reduction in redshank. The percentage cover of fat hen was significantly reduced by all treatments at both sites with the exception of AHDB 9866 applied as a single post-emergence application at Site 1; at Site 2 the product did give significant control of fat hen, but it only reduced cover by 75.2% when compared to the control, which meant it was still one of the poorest performing treatments against this weed species in the trial. The standard Callisto + Fornet 6OD gave the greatest reduction in fat hen with 100% control of the weed.

At Site 2 population levels of individual weed species were lower but there were significant differences. For example, control of fat hen by the treatments followed a similar trend in performance to Site 1, and all products gave significant control of the weed at that site. Seven treatments significantly reduced the percentage cover of chickweed, there were the standard, Callisto + Fornet 6OD, Callisto + Fornet 6OD + AHDB 9856, AHDB 9986 + AHDB 9857, AHDB 9867 and Stomp Aqua pre-emergence followed by either AHDB 9856, AHDB 9867, or AHDB 9900. AHDB 9859 did not control chickweed as this is a particular weakness for this product. There were very low levels of black nightshade in the trial at 4.5% plot cover, but with the exception of AHDB 9866, and Stomp Aqua followed by AHDB 9900 or AHDB 9859 applied inter-row, all other treatments significantly reduced this weed.

Overall, eleven treatments significantly reduced the percentage of weed cover at both sites for four weeks after herbicide application, when compared to the untreated ($P < 0.001$). At the time of the post-emergence spray application, the plots treated with a pre-emergence herbicide had significantly lower weed at Site 1, though this did not always lead to them having the greatest reduction in weed population by the end of the assessment period. The post-emergence applications still had an influence on overall efficacy.

The best performing treatments by efficacy were the standard, Callisto + Fornet 6OD, Callisto + Fornet 6OD + AHDB 9856, AHDB 9867 and Stomp followed by AHDB 9867, all which reduced weed levels by greater than 85% at both trial sites. However, AHDB 9867 does cause buttress root deformation if applied when the roots are forming, and if authorised for use on sweetcorn, timing of application would need to be considered.

There were significant differences in yield at Site 1 when compared to the untreated control, and seven treatments had 4.4 to 14.3 % greater marketable yield than those treated with the current standard (Callisto + Fornet 6OD). Those treatments were Callisto + Fornet 6OD + AHDB 9856, AHDB 9858, Stomp Aqua pre-em followed by AHDB 9856, AHDB 9867, AHDB 9866, AHDB 9990 applied post-emergence or AHDB 9859 applied inter-row.

There are no significant differences in marketable yield between the treatments and the untreated control at Site 2 despite the appearance of differences in the percentage marketable yields, and a 20% lower marketable yield between the mean highest yield and the untreated control. This is likely due to the variability in the crop growth differences where the plastic came off selected rows in high winds.

Table 1. Assessments of crop damage (phytotoxicity) and weed efficacy (as percentage weed reduction) at 28 days after treatment (18th June), and marketable yield at harvest. Phytotoxicity scale of 0-10; 0 = no effect, 10 = complete crop death. Scores ≤2 deemed commercially acceptable damage, and those >2 are highlighted in red. Figures in **bold** are significantly different to the untreated. Negative (-) figures indicate an increase in weed.

Treatment	Phytotoxicity (0-10)		% weed reduction compared to untreated		% marketable yield	
	Site 1 28 DAA	Site 2 28 DAA	Site 1 28 DAA	Site 2 28 DAA	Site 1 13th Aug	Site 2 6th Aug
Untreated	0.0	0.0	-		3.6	71.1
Callisto 0.75 L/ha Fornet 6OD 0.75 L/ha	4.0	0.0	**93.2**	**98.1**	**79.2**	73.7
Callisto 0.75 L/ha Fornet 6OD 0.75 L/ha AHDB 9856	3.7	1.3	**96.6**	**98.1**	**88.1**	90.7
Stomp Aqua 3.3 L/ha fb AHDB 9856	1.0	0.8	**59.3**	**88.3**	**91.1**	77.3
AHDB 9986 + AHDB 9857	3.0	1.0	**61.4**	**96.7**	**64.6**	91.4

Treatment	Phytotoxicity (0-10)		% weed reduction compared to untreated		% marketable yield	
	Site 1 28 DAA	Site 2 28 DAA	Site 1 28 DAA	Site 2 28 DAA	Site 1 13th Aug	Site 2 6th Aug
AHDB 9858	3.0	2.0	**64.4**	**87.1**	**83.6**	71.8
AHDB 9867	4.7	0.5	**90.2**	**87.7**	**79.6**	85.6
Stomp Aqua 3.3 L/ha fb AHDB 9867	6.3	0.5	**93.2**	**96.4**	**93.5**	91.5
AHDB 9866	5.3	1.0	**37.3**	40.3	**26.3**	79.2
Stomp Aqua 3.3 L/ha fb AHDB 9866	6.0	1.0	**77.9**	**85.7**	**85.9**	85.6
Stomp Aqua 3.3 L/ha fb AHDB 9859 (1/3 rate)	3.0	0.0	**63.1**	**70.2**	**78.9**	79.0
Stomp Aqua 3.3 L/ha fb AHDB 9859 (Inter Row)	1.0	1.0	**70.5**	**70.8**	**86.7**	83.8
Stomp Aqua 3.3 L/ha fb AHDB 9990	1.7	0.0	**68.8**	**74.1**	**92.9**	80.3
F prob. value	**<0.001**	**<0.001**			**<0.001**	**NS**
d.f.	**27**	**27**			**27**	**27**
L.S.D.	**1.083**	**0.685**			**21.10**	**29.92**

Conclusions

- Five post-emergence treatments improved weed control and were also of at least equivalent crop safety to the current standard (Callisto + Fornet 6OD), in sweetcorn grown under plastic covers. Yield in these treatments was also greater or equivalent than in the plots where the standard was applied.
    - These are - Callisto + Fornet 6OD + AHDB 9856, AHDB 9858, Stomp Aqua applied pre-em followed by AHDB 9856, AHDB 9990 applied post-emergence or AHDB 9859 applied inter-row.
- AHDB 9867 was one of the best performing products for weed control, and marketable yield was equivalent to or above that of the standard, but care needs to be taken with application timing to avoid damage to buttress roots.

Take home message:

Authorisation for AHDB 9856, AHDB 9858, AHDB 9859 or AHDB 9867 would improve weed control in sweetcorn, and increase the actives available for use reducing the risk of resistance development if used in conjunction with existing products. AHDB 9900 is a sulfonylurea, and would increase the number of ALS inhibitors authorised for sweetcorn but does bring control of redshank, as would AHDB 9858, and AHDB 9867.

Objectives

To compare a number of herbicide products and tank-mixes with the current commercial standard (Callisto 0.75 L/ha + Fornet 0.75 L/ha) at one post-emergence application timing for selectivity (crop safety) and efficacy in sweetcorn grown under covers.

Trial conduct

This study will be conducted in compliance with the requirements of the UK Official Recognition of Efficacy Testing scheme.

Protocol conforms to **EPPO1/50(3)** for **Weeds in maize**, with the following deviations:

"Replicates: at least 4"
Current study to have only 3 replicates – the large number of treatments provides an acceptable number of residual degrees of freedom.

The following EPPO guidelines were followed:

Relevant EPPO guideline(s)		**Variation from EPPO**
EPPO PP1/135(4)	Phytotoxicity assessment	None
EPPO PP1/152(4)	Guideline on design and analysis of efficacy evaluation trials	None
EPPO PP1/225 (2)	Minimum effective dose	None
EPPO PP1/181 (4)	Conduct and reporting of efficacy evaluation trials including good experimental practice	None
EPPO PP1/214(3)	Principles of acceptable efficacy	None
EPPO PP1/224(2)	Principles of efficacy evaluation for minor uses	None

ADAS has Efficacy Testing Certificate No. ORETO 409.

Test site

Item	**Details**	
	Site 1	**Site 2**
Location address	**Broom Field** Honer Lane Chichester W. Sussex PO20 1LY	**Mile Pond Barn** Stockbridge Chichester W. Sussex PO19 8TD
Crop and cultivar	**Sweetcorn** – Early Bird	
Soil or substrate type	Silty clay loam	
Agronomic practice	See Appendix A	
Prior history of site	See Appendix A	

Trial design

Item	**Details**
Trial design:	Fully Randomized Block
Number of replicates:	3
Row spacing:	2 rows per 1.65 m bed
Plot size: (w x l)	3.3 m x 5.0 m
Plot size:	16.5 m^2
Number of plants per plot:	N/K

Treatment details

AHDB Code	Active substance	Product name/ manufacturers code	Formulation batch number	Content of active substance in product (g/L or g/kg)	Formulation type
N/A	mesotrione	Callisto	SAV5D15030	100	SC
N/A	nicosulfuron	Fornet 6OD	16FCC0179	60	OD
N/A	pendimethalin	Stomp Aqua	ST12600518	455	CS
AHDB 9856	N/D	N/D	N/D	N/D	N/D
AHDB 9986	N/D	N/D	N/D	N/D	N/D
AHDB 9857	N/D	N/D	N/D	N/D	N/D
AHDB 9858	N/D	N/D	N/D	N/D	N/D
AHDB 9867	N/D	N/D	N/D	N/D	N/D
AHDB 9866	N/D	N/D	N/D	N/D	N/D
AHDB 9859	N/D	N/D	N/D	N/D	N/D
AHDB 9990	N/D	N/D	N/D	N/D	N/D

Application schedule

Treatment number	Treatment: product name or AHDB code	Rate of active substance (ml or g a.s./ha)	Rate of product (l or kg/ha)	Application code
1	Untreated	-	-	-
2	Untreated	-	-	-
3	Callisto + Fornet 6OD	75 + 45	0.75 + 0.75	T2
4	Callisto + Fornet 6OD + AHDB 9856	75 + 45 + 450	0.75 + 0.75 + 0.75	T2
5	Stomp Aqua	1501.5	3.3	T1
	AHDB 9856	450	0.75	T2
6	AHDB 9986 + AHDB 9857	300.15 + 1.5 + ?	0.15 + 2.0 + 2.0	T2
7	AHDB 9858	150 + 37.5	0.25	T1
8	AHDB9867	350	0.5	T2
9	Stomp Aqua	1501.5	3.3	T1
	AHDB9867	350	0.5	T2
10	AHDB 9866	450	0.9	T2

Treatment number	Treatment: product name or AHDB code	Rate of active substance (ml or g a.s./ha)	Rate of product (l or kg/ha)	Application code
11	Stomp Aqua	1501.5	3.3	T1
	AHDB 9866	450	0.9	T2
12	Stomp Aqua	1501.5	3.3	T1
	AHDB 9859	6	0.1	T2
13	Stomp Aqua	1501.5	3.3	T1
	AHDB 9859 (Inter-row)	18	0.3	T2
14	Stomp Aqua	1501.5	3.3	T1
	AHDB 9990	12.5	0.05	T2

Application details

Site 1

	T1	T2
Application date	11/04/2019	21/05/2019
Time of day	10:30 - 11:10	14:30 - 16:05
Crop growth stage (Max, min average BBCH)	BBCH00 - Pre-Emergence	BBCH16 (5 Unfolded Leaves) – V5
Crop height (cm)	N/A	25
Crop coverage (%)	N/A	35
Application Method	Spray	Spray
Application Placement	Soil	Soil
Application equipment	Oxford Precision Sprayer (Knapsack)	Oxford Precision Sprayer (Knapsack)
Nozzle pressure	2-3Bar	2-3Bar
Nozzle type	Flat Fan	Flat Fan
Nozzle size	02F110	02F110
Application water volume/ha	200	200
Temperature of air - shade (°C)	9.2 - 9.3	22.2 - 21.4
Relative humidity (%)	69.4 - 66.3	34.2 - 46.0
Wind speed range (m/s)	0.17 - 0.67	0.89 - 1.56
Dew presence (Y/N)	N	N
Temperature of soil - 2-5 cm (°C)	N/K	N/K
Wetness of soil - 2-5 cm	Dry	Dry
Cloud cover (%)	0	0

Site 2

	T1	T2
Application date	17/04/2019	21/05/2019
Time of day	12:30 - 12:45	17:55 - 18:45
Crop growth stage (Max, min average BBCH)	BBCH00 - Pre-Emergence	BBCH15 (4 Unfolded Leaves) – V4
Crop height (cm)	N/A	27.5
Crop coverage (%)	N/A	35
Application Method	Spray	Spray
Application Placement	Soil	Soil
Application equipment	Oxford Precision Sprayer (Knapsack)	Oxford Precision Sprayer (Knapsack)
Nozzle pressure	2-3Bar	2-3Bar
Nozzle type	Flat Fan	Flat Fan
Nozzle size	02F110	02F110
Application water volume/ha	200	200
Temperature of air - shade (°C)	15.6 - 15.6	20.8 - 21.5
Relative humidity (%)	54.4 - 59.0	42.6 - 43.0
Wind speed range (m/s)	2.28 - 2.22	0.50 - 0.47
Dew presence (Y/N)	N	N
Temperature of soil - 2-5 cm (°C)	N/K	N/K
Wetness of soil - 2-5 cm	Dry	Dry
Cloud cover (%)	100	20

Untreated levels of broad-leaved weeds and grasses at through the assessment period - Site 1

Common name	Scientific Name	EPPO Code	Weed level early-assessment period (0 days)	Weed level mid-assessment period (14 days)	Weed level end-assessment period (28 days)
Broad leaved weeds and grasses	*N/A*	3WEEDT	64.2 *(untreated average % coverage)*	93.5 *(untreated average % coverage)*	98.3 *(untreated average % coverage)*

Untreated levels of broad-leaved weeds and grasses at through the assessment period - Site 2

Common name	Scientific Name	EPPO Code	Weed level early-assessment period (0 days)	Weed level mid-assessment period (14 days)	Weed level end-assessment period (28 days)
Broad leaved weeds and grasses	*N/A*	3WEEDT	0.92 *(untreated average % coverage)*	9.8 *(untreated average % coverage)*	51.3 *(untreated average % coverage)*

Assessment details - Site 1

Evaluation date	Evaluation Timing (DA)*	Crop Growth Stage (BBCH)	Evaluation type	What was assessed and how (e.g. dead or live pest; disease incidence and severity; yield, marketable quality)
21/05/2019	0	16 (V5)	Phytotox Efficacy	Crop damage (0-10 scale; 0 = no effect, 10 = complete crop kill), all plots. Percentage overall plot cover of all weeds, percentage cover of each weed species, all plots.
04/06/2019	14	30 (V6)	Phytotox Efficacy	Crop damage (0-10 scale; 0 = no effect, 10 = complete crop kill), all plots. Percentage overall plot cover of all weeds, percentage cover of each weed species, all plots.
18/06/2019	28	32 (V7)	Phytotox Efficacy	Crop damage (0-10 scale; 0 = no effect, 10 = complete crop kill), all plots. Percentage overall plot cover of all weeds, percentage cover of each weed species, all plots.
13/08/2019	84	73 (Harvest) (R2 – Milk)	Yield Quality	All plots were assessed for cob numbers and weight in field, and then sent for marketable quality at growers quality control department.

* DA – days after application of T2

Assessment details - Site 2

Evaluation date	Evaluation Timing (DA)*	Crop Growth Stage (BBCH)	Evaluation type	What was assessed and how (e.g. dead or live pest; disease incidence and severity; yield, marketable quality)
21/05/2019	0	15 (V4)	Phytotox Efficacy	Crop damage (0-10 scale; 0 = no effect, 10 = complete crop kill), all plots. Percentage overall plot cover of all weeds, plus 3 quadrat readings – all weed species counted within quadrat.
04/06/2019	14	19 (V7)	Phytotox Efficacy	Crop damage (0-10 scale; 0 = no effect, 10 = complete crop kill), all plots. Percentage overall plot cover of all weeds, plus 3 quadrat readings – all weed species counted within quadrat.
19/06/2019	29	33 (V7)	Phytotox Efficacy	Crop damage (0-10 scale; 0 = no effect, 10 = complete crop kill), all plots. Percentage overall plot cover of all weeds, plus percentage cover – all weed species.
06/08/2019	77	73 (Harvest) (R2 – Milk)	Yield Quality	All plots were assessed for cob numbers and weight in field, and then sent for marketable quality at growers QC.

* DA – days after application of T2

Statistical analysis

Both trials were a randomised block design, each with three replicates of fourteen treatments, including two untreated controls. A grower standard was included—Callisto 0.75 L/ha + Fornet 0.75 L/ha (Treatment 3)—to provide a comparison for treatment efficacies and crop safety.

As the distribution of weeds was uneven across each trial—which is not unexpected in field situations—so there was a need to transform these variables prior to analysis. An angular transformation was used.

All data were analysed by ANOVA using GenStat 18.4 by Chris Dyer at RSK ADAS. For the calculation of % efficacy, an angular transformation of the data was carried out and then Abbott's formula was applied to the back transformed means, resulting in figures for the % reduction in weeds.

Results

Phytotoxicity

The results of phytotoxicity assessments from three dates are presented in the tables below. These were scored on a scale from 0 to 10, with 0 being 'no effect', and 10 being 'dead'. Plots deemed to have commercially acceptable level of damage were scored 2 or below—see below for full scale:

Crop Tolerance Score	Equivalent to Crop Damage (% Phytotoxicity)
10	Complete crop kill
9	90%
8	80%
7	70%
6	60%
5	50%
4	40%
3	30%
2*	20%*
1	10%
0	No damage

** 2 = Acceptable damage, i.e. damage unlikely to reduce yield, and acceptable to the farmer.*

At Site 1, a greater effect from post-emergence treatments was observed. It was a larger crop at a later growth stage when the herbicides were applied, and sweetcorn becomes intolerant of herbicides as it enters growth stages at 6 leaves or above. The post-emergence application at Site 1 was also applied as the buttress roots were growing, and selected treatments caused deformation of the growth of the roots. These effects were not seen at Site 2, as the crop was at an earlier growth stage and these roots were not yet being formed.

Despite these greater effects from many of the treatments, three caused very little effect on the crop. These were; Stomp Aqua followed by either AHDB 9990, AHDB 9856, or AHDB 9859 applied as an inter-row application. Effects caused by the remaining treatments included transient yellowing or chlorosis of foliage and an associated check to speed of growth, scorch and white spots on the leaves, or deformation of the buttress roots. The latter is an important effect to consider as the buttress roots stabilise the sweetcorn when it gets taller, and any damage can lead to an increased risk of lodging.

The commercial standard, Callisto + Fornet 6OD caused slight yellowing and check to the speed of growth of the crop, but it should be noted that growers expect this to happen at the growth stage it was applied at Site 1, and accept this effect. This effect was also seen at an equivalent level on the treatments Callisto + Fornet 6OD + AHDB 9856, AHDB 9985 + AHDB 9857 and AHDB 9858 at four weeks after application. The crop had recovered from these

effects by the time of harvest. The buttress root deformation was a more severe effect and this persisted until harvest. Treatments which caused this to occur were those which included AHDB 9866 and AHDB 9867.

Moderate spotting and scorch was caused by AHDB 9859 applied over the crop at 1/3 rate, but the effect was transient and the crop was recovering by four weeks after application and had fully recovered by harvest.

No concerning effects were seen on the sweetcorn crop at Site 2 by one month after application, but earlier after application at two weeks post spraying there were slight effects on the crop from five of the treatments. This was exhibited as yellowing in plots treated with Callisto + Fornet 6OD, Callisto + Fornet 6OD + AHDB 9856 and AHDB 9867; and there was scorch and white spotting on the foliage from the two treatments where AHDB 9859 was applied. Although the product didn't kill any of the crop when applied over the foliage, less effect was seen from AHDB 9859 when it was applied as an inter-row application.

Table 2. Mean crop damage scores at **Site 1** throughout trial period, assessed at 14 and 28 days after treatment application (DAA). Treatments were applied on 21st May 2019. Phytotoxicity scale of 0-10; 0 = no effect, 10 = complete crop death. Scores ≤2 deemed commercially acceptable damage, and those >2 are highlighted in red. Fb = followed by.

Treatment	Mean Phytotoxicity Score (0-10)	
	14 DAA 4th June	28 DAA 18th June
Untreated	0.0	0.0
Callisto 0.75 L/ha Fornet 6OD 0.75 L/ha	4.0	4.0
Callisto 0.75 L/ha Fornet 6OD 0.75 L/ha AHDB 9856	4.3	3.7
Stomp Aqua 3.3 L/ha fb AHDB 9856	2.0	1.0
AHDB 9986 + AHDB 9857	3.0	3.0
AHDB 9858	3.3	3.0
AHDB 9867	4.0	4.7
Stomp Aqua 3.3 L/ha fb AHDB 9867	3.7	6.3
AHDB 9866	6.3	5.3
Stomp Aqua 3.3 L/ha fb AHDB 9866	2.7	6.0
Stomp Aqua 3.3 L/ha fb AHDB 9859 (1/3 rate)	5.0	3.0
Stomp Aqua 3.3 L/ha fb AHDB 9859 (Inter Row)	2.3	1.0
Stomp Aqua 3.3 L/ha fb AHDB 9990	1.3	1.7
F prob. value	**<0.001**	**<0.001**
d.f.	**27**	**27**
L.S.D.	**2.027**	**1.083**

Table 3. Mean crop damage scores at **Site 2** throughout trial period, assessed at 14 and 28 days after treatment application (DAA). Treatments applied on 21st May 2019. Phytotoxicity scale of 0-10; 0 = no effect, 10 = complete crop death. Scores ≤2 deemed commercially acceptable damage, and those >2 are highlighted in red.

Treatment	Mean Phytotoxicity Score (0-10)	
	14 DAA 4th June	28 DAA 18th June
Untreated	0.0	0.0
Callisto 0.75 L/ha Fornet 6OD 0.75 L/ha	3.0	0.0
Callisto 0.75 L/ha Fornet 6OD 0.75 L/ha AHDB 9856	2.3	1.3
Stomp Aqua 3.3 L/ha fb AHDB 9856	2.0	0.8
AHDB 9986 + AHDB 9857	2.0	1.0
AHDB 9858	1.0	2.0
AHDB 9867	2.3	0.5
Stomp Aqua 3.3 L/ha fb AHDB 9867	1.3	0.5
AHDB 9866	2.0	1.0
Stomp Aqua 3.3 L/ha fb AHDB 9866	1.3	1.0
Stomp Aqua 3.3 L/ha fb AHDB 9859 (1/3 rate)	3.3	0.0
Stomp Aqua 3.3 L/ha fb AHDB 9859 (Inter Row)	2.7	1.0
Stomp Aqua 3.3 L/ha fb AHDB 9990	1.7	0.0
F prob. value	**<0.001**	**<0.001**
d.f.	**27**	**27**
L.S.D.	**1.128**	**0.685**

Efficacy

The weed species and levels at each of the sites differed, with a higher weed population at Site 1, but with a narrower range of species. The weed species at Site 1 consisted mainly of fat hen (*Chenopodium album*) and redshank (*Polygonum persicaria*) (**Table 6**), while the key weeds at Site 2 were fat hen, chickweed (*Stellaria media*), black nightshade (*Solanum nigrum*), groundsel (*Senecio vulgaris*), and fumitory (*Fumaria officinalis*) (**Table 7**). Results are shown for the top three weeds only for Site 2.

Eleven treatments significantly reduced the percentage of weed cover at both sites for four weeks after herbicide application, when compared to the untreated ($P < 0.001$). At the time of the post-emergence spray application, the plots treated with a pre-emergence herbicide had significantly lower weed at Site 1, though this did not always lead to them having the greatest reduction in weed population by the end of the assessment period. The post-emergence applications still had an influence on overall efficacy.

The best performing treatments were the standard, Callisto + Fornet 6OD, Callisto + Fornet 6OD + AHDB 9856, AHDB 9867 and Stomp followed by AHDB 9867, all which reduced weed levels by greater than 85% at both trial sites.

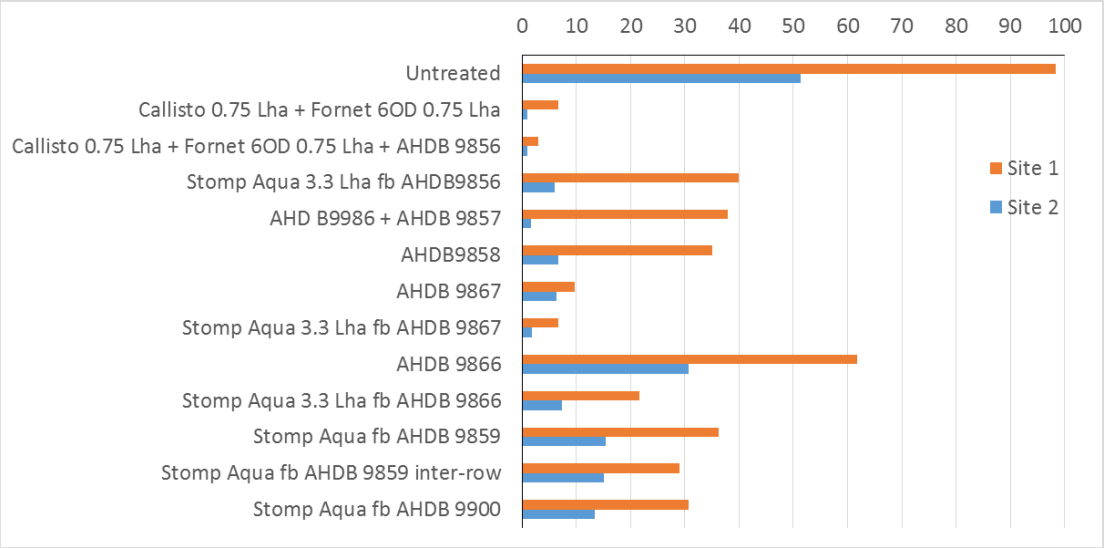
Table 4. Summary of treatment efficacies at **Site 1** throughout trial period, assessed at 0, 14 and 28 days after treatment application. Treatments applied on 21st May 2019. Figures in **bold** are significantly different from the untreated.

Treatment	Mean Weed Cover (% per plot)		
	0 DAA (21st May) Baseline	14 DAA (4th June)	28 DAA (18th June)
Untreated	31.7	93.5	98.3
Callisto 0.75 L/ha Fornet 6OD 0.75 L/ha	36.7	**16.0**	**6.7**
Callisto 0.75 L/ha Fornet 6OD 0.75 L/ha AHDB 9856	28.33	**2.7**	**3.0**
Stomp Aqua 3.3 L/ha fb AHDB 9856	**3.7**	**21.7**	**40.0**
AHDB 9986 + AHDB 9857	33.3	**36.7**	**38.0**
AHDB 9858	35.0	**45.0**	**35.0**
AHDB 9867	35.0	**21.7**	**9.7**
Stomp Aqua 3.3 L/ha fb AHDB 9867	**6.3**	**8.0**	**6.7**
AHDB 9866	**23.3**	**63.3**	**61.7**
Stomp Aqua 3.3 L/ha fb AHDB 9866	**5.7**	**16.7**	**21.7**
Stomp Aqua 3.3 L/ha fb AHDB 9859 (1/3 rate)	**4.0**	**15.7**	**36.3**
Stomp Aqua 3.3 L/ha fb AHDB 9859 (Inter Row)	**5.0**	**28.3**	**29.0**
Stomp Aqua 3.3 L/ha fb AHDB 9990	**4.3**	**23.3**	**30.7**
F prob. value	**<0.001**	**<0.001**	**<0.001**
d.f.	**27**	**27**	**27**
L.S.D.	**6.346**	**23.58**	**27.93**

Table 5. Summary of treatment efficacies at **Site 2** throughout trial period, assessed at 0, 14 and 28 days after treatment application. Treatments applied on 21st May 2019. Figures in **bold** are significantly different from the untreated.

Treatment	Mean Weed Cover (% per plot)		
	0 DAA (21st May) Baseline	18 DAA (4th June)	29 DAA (18th June)
Untreated	0.9	9.8	51.3
Callisto 0.75 L/ha Fornet 6OD 0.75 L/ha	1.6	**1.2**	**1.0**
Callisto 0.75 L/ha Fornet 6OD 0.75 L/ha AHDB 9856	1.6	**0.4**	**1.0**
Stomp Aqua 3.3 L/ha fb AHDB 9856	0.4	**1.3**	**6.0**
AHDB 9986 + AHDB 9857	1.4	**1.9**	**1.7**
AHDB 9858	0.8	**4.3**	**6.7**
AHDB 9867	1.2	**1.6**	**6.3**
Stomp Aqua 3.3 L/ha fb AHDB 9867	0.6	**1.6**	**1.8**
AHDB 9866	1.8	5.5	30.7
Stomp Aqua 3.3 L/ha fb AHDB 9866	0.4	**1.3**	**7.3**
Stomp Aqua 3.3 L/ha fb AHDB 9859 (1/3 rate)	0.4	**1.7**	**15.3**
Stomp Aqua 3.3 L/ha fb AHDB 9859 (Inter Row)	0.5	**1.6**	**15.0**
AHDB 9990	0.5	**2.8**	**13.3**
F prob. value	**0.002**	**0.004**	**<0.001**
d.f.	**27**	**27**	**27**
L.S.D.	**0.7733**	**5.019**	**10.29**

Figure 1. Percentage weed cover at **Site 1** and **Site 2** at 28 and 29 days after the post-emergence application. LSD (Site 1) = 27.93, LSD (Site 2) = 10.29



All treatments significantly reduced the percentage of redshank at Site 1; Stomp Aqua 3.3 L/ha pre-emergence followed by AHDB 9867, AHDB 9867 alone and Callisto + Fornet 6OD + AHDB 9856 gave the greatest reduction in redshank (**Table 6**).The percentage cover of fat hen was significantly reduced by all treatments at both sites (**Table 6** and **Table 7**) with the exception of AHDB 9866 applied as a single post-emergence application at Site 1; at Site 2 the product did give significant control of fat hen, but it only reduced cover by 75.2% when compared to the control, which meant it was still one of the poorest performing treatments against this weed species in the trial . The standard Callisto + Fornet 6OD gave the greatest reduction in fat hen with 100% control of the weed.

There were differences between products in the weed species significantly controlled by selected treatments at four weeks after application. While the application of AHDB 9856 after a pre-em of Stomp only reduced redshank by 35.6% at Site 1, this treatment reduced fat hen by 83.1% at the same site, and was one of the top four products in the trial for control of fat hen. Conversely AHDB 9858 only reduced fat hen by 45.7% compared to the control, but performed better against redshank, reducing the weed level by 83.1%.

At Site 2 (**Table 7**), population levels of individual weed species were lower but there were still significant differences. Control of fat hen by the treatments followed a similar trend in performance to Site 1, and all products gave significant control of the weed at that site. Seven treatments significantly reduced the percentage cover of chickweed, there were the standard, Callisto + Fornet 6OD, Callisto + Fornet 6OD + AHDB 9856, AHDB 9986 + AHDB 9857, AHDB 9867 and Stomp Aqua pre-emergence followed by either AHDB 9856, AHDB 9867, or AHDB 9900. It is not surprising that AHDB 9859 did not control chickweed as this is a particular weakness for this product. There were very low levels of black nightshade in the trial at 4.5% plot cover, but with the exception of AHDB 9866, and Stomp Aqua followed by AHDB 9900 or AHDB 9859 applied inter-row, all other treatments significantly reduced this weed.

Table 6. Mean levels of main weed species present at **Site 1** throughout the trial period, at 28 days after post-emergence treatment application. Figures in **bold** are significantly different from the untreated.

Treatment	Mean % weed species cover		% weed reduction compared to untreated	
	Redshank	Fat hen	Redshank	Fat hen
Untreated	49.2	49.2	-	-

Treatment	Mean % weed species cover		% weed reduction compared to untreated	
	Redshank	Fat hen	Redshank	Fat hen
Callisto 0.75 L/ha Fornet 6OD 0.75 L/ha	**6.7**	**0.0**	86.4	100.0
Callisto 0.75 L/ha Fornet 6OD 0.75 L/ha AHDB 9856	**2.3**	**0.7**	95.3	98.4
Stomp Aqua 3.3 L/ha fb AHDB 9856	**31.7**	**8.3**	35.6	83.1
AHDB 9986 + AHDB 9857	**27.3**	**10.7**	44.4	78.3
AHDB 9858	**8.3**	**26.7**	83.1	45.7
AHDB 9867	**0.3**	**9.3**	99.3	81.1
Stomp Aqua 3.3 L/ha fb AHDB 9867	**0.0**	**6.7**	100.0	86.4
AHDB 9866	**21.7**	40.0	55.9	18.6
Stomp Aqua 3.3 L/ha fb AHDB 9866	**11.7**	**10.0**	76.3	79.6
Stomp Aqua 3.3 L/ha fb AHDB 9859 (1/3 rate)	**27.7**	**8.7**	43.7	82.4
Stomp Aqua 3.3 L/ha fb AHDB 9859 (Inter Row)	**16.7**	**12.3**	66.1	74.9
Stomp Aqua 3.3 L/ha fb AHDB 9990	**13.3**	**17.3**	72.9	64.7
F prob. value	**<0.001**	**<0.001**		
d.f.	**27**	**27**		
L.S.D.	**15.96**	**14.40**		

Table 7. Mean % cover of main weed species present at **Site 2** throughout the trial period, at 29 days after post-emergence treatment application. Figures in **bold** are significantly different from the untreated.

Treatment	Mean % weed species cover		
	Fat hen	Chickweed	Black nightshade
Untreated	24.2	11.0	4.5
Callisto 0.75 L/ha Fornet 6OD 0.75 L/ha	**0.0**	**0.3**	**0.0**
Callisto 0.75 L/ha Fornet 6OD 0.75 L/ha AHDB 9856	**0.3**	**0.2**	**0.2**
Stomp Aqua 3.3 L/ha fb AHDB 9856	**0.7**	**1.0**	**1.0**
AHDB 9986 + AHDB 9857	**1.0**	**0.3**	**0.0**
AHDB 9858	**1.5**	2.7	**0.0**

Treatment	Mean % weed species cover		
	Fat hen	Chickweed	Black nightshade
AHDB 9867	**0.8**	**0.3**	**0.0**
Stomp Aqua 3.3 L/ha fb AHDB 9867	**0.0**	**0.0**	**0.3**
AHDB 9866	**6.0**	15.3	2.7
Stomp Aqua 3.3 L/ha fb AHDB 9866	**1.5**	2.3	**0.2**
Stomp Aqua 3.3 L/ha fb AHDB 9859 (1/3 rate)	**2.7**	5.7	**0.7**
Stomp Aqua 3.3 L/ha fb AHDB 9859 (Inter Row)	**1.7**	6.7	2.3
Stomp Aqua 3.3 L/ha fb AHDB 9990	**8.3**	**0.3**	2.3
F prob. value	**<0.001**	**0.010**	**0.005**
d.f.	**27**	**27**	**27**
L.S.D.	**11.79**	**8.984**	**2.755**

Table 8. Mean % cover of main weed species present at **Site 2** throughout the trial period, at 29 days after treatment application. Figures in **bold** are significantly different from the untreated. Negative (-) figures indicate an increase in weed cover.

Treatment	% weed reduction compared to untreated		
	Fat hen	Chickweed	Black nightshade
Callisto 0.75 L/ha Fornet 6OD 0.75 L/ha	100.0	96.9	100.0
Callisto 0.75 L/ha Fornet 6OD 0.75 L/ha AHDB 9856	98.6	98.5	96.3
Stomp Aqua 3.3 L/ha fb AHDB 9856	97.3	90.9	77.8
AHDB 9986 + AHDB 9857	95.8	96.9	100.0
AHDB 9858	93.8	75.7	100.0
AHDB 9867	96.5	96.9	100.0
Stomp Aqua 3.3 L/ha fb AHDB 9867	100.0	100.0	92.6
AHDB 9866	75.2	-39.4	40.7
Stomp Aqua 3.3 L/ha fb AHDB 9866	93.8	78.8	96.3
Stomp Aqua 3.3 L/ha fb AHDB 9859 (1/3 rate)	88.9	48.5	85.2
Stomp Aqua 3.3 L/ha fb AHDB 9859 (Inter Row)	93.1	39.4	48.2
Stomp Aqua 3.3 L/ha fb AHDB 9990	65.5	96.9	48.2

Yield

There were significant differences in yield at Site 1 when compared to the untreated control, and seven treatments had 4.4 to 14.3 % greater marketable yield than those treated with the current standard (Callisto + Fornet 6OD) (**Table 9**). Those treatments were Callisto + Fornet 6OD + AHDB 9856, AHDB 9858, Stomp Aqua pre-em followed by AHDB 9856, AHDB 9867, AHDB 9866, AHDB 9990 applied post-emergence or AHDB 9859 applied inter-row.

There are no significant differences in marketable yield between the treatments and the untreated control at Site 2 despite the appearance of differences in the percentage marketable yields, and a 20% lower marketable yield between the mean highest yield and the untreated control (**Table 10**). This is likely due to the variability in the crop growth differences where the plastic came off selected rows in high winds.

Reasons for unmarketability were listed as mainly undersized cobs or unfertilized tips.

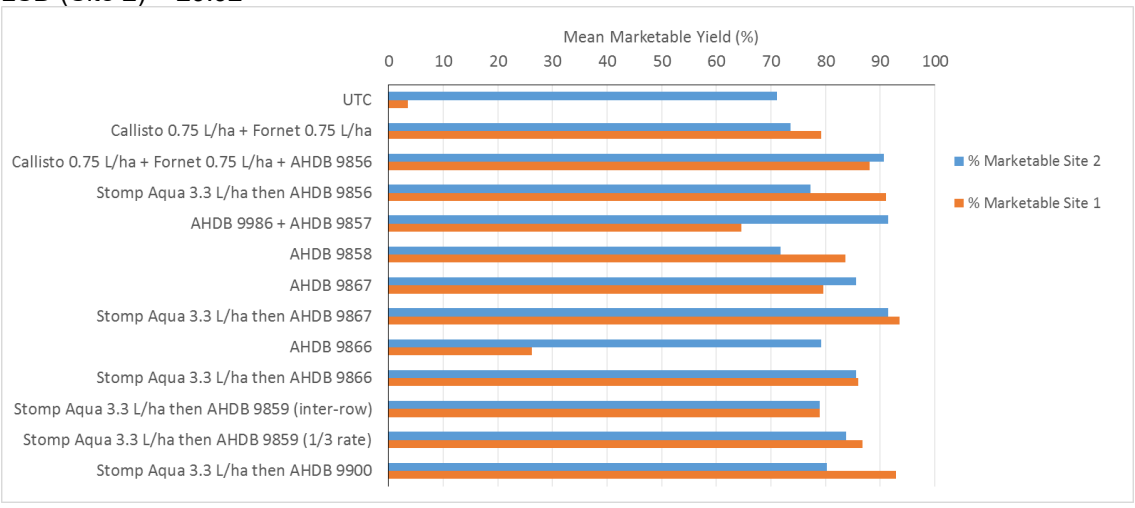
Table 9: Percentage of Marketable Yield and cob measurements for **Site 1** at harvest (13 August). Figures in **bold** are significantly different from the untreated.

Treatment	Mean % Marketable Yield	Mean Cob Length (cm)	Mean Cob Width (cm)
Untreated	3.6	10.7	2.08
Callisto 0.75 L/ha Fornet 6OD 0.75 L/ha	**79.2**	**17.5**	**4.67**
Callisto 0.75 L/ha Fornet 6OD 0.75 L/ha AHDB 9856	**88.1**	**18.7**	**4.77**
Stomp Aqua 3.3 L/ha fb AHDB 9856	**91.1**	**19.2**	**4.80**
AHDB 9986 + AHDB 9857	**64.6**	**18.2**	**4.63**
AHDB 9858	**83.6**	**17.8**	**4.60**
AHDB 9867	**79.6**	**17.7**	**4.67**
Stomp Aqua 3.3 L/ha fb AHDB 9867	**93.5**	**17.8**	**4.80**
AHDB 9866	**26.3**	**15.2**	**3.93**
Stomp Aqua 3.3 L/ha fb AHDB 9866	**85.9**	**17.5**	**4.80**
Stomp Aqua 3.3 L/ha fb AHDB 9859 (1/3 rate)	**78.9**	**18.5**	**4.87**
Stomp Aqua 3.3 L/ha fb AHDB 9859 (Inter Row)	**86.7**	**18.5**	**4.83**
Stomp Aqua 3.3 L/ha fb AHDB 9990	**92.9**	**18.5**	**4.87**
F prob. value	**<0.001**	**<0.001**	**<0.001**
d.f.	**27**	**27**	**27**
L.S.D.	**21.10**	**1.856**	**0.4625**

Table 10: Percentage of Marketable Yield and cob measurements for **Site 2** at harvest (6 August). Figures in **bold** are significantly different from the untreated.

	Mean % Marketable Yield	Mean Cob Length (cm)	Mean Cob Width (cm)
Untreated	71.1	19.1	4.62
Callisto 0.75 L/ha Fornet 6OD 0.75 L/ha	73.7	16.7	4.77
Callisto 0.75 L/ha Fornet 6OD 0.75 L/ha AHDB 9856	90.7	18.3	4.57
Stomp Aqua 3.3 L/ha fb AHDB 9856	77.3	18.5	4.30
AHDB 9986 + AHDB 9857	91.4	19.8	4.63
AHDB 9858	71.8	17.8	4.60
AHDB 9867	85.6	19.3	4.30
Stomp Aqua 3.3 L/ha fb AHDB 9867	91.5	18.2	4.77
AHDB 9866	79.2	18.0	4.57
Stomp Aqua 3.3 L/ha fb AHDB 9866	85.6	18.5	4.50
Stomp Aqua 3.3 L/ha fb AHDB 9859 (1/3 rate)	79.0	16.5	4.53
Stomp Aqua 3.3 L/ha fb AHDB 9859 (Inter Row)	83.8	16.8	4.50
AHDB 9990	80.3	18.0	4.33
F prob. value	**NS**	**NS**	**NS**
d.f.	**27**	**27**	**27**
L.S.D.	**29.92**	**3.323**	**4.245**

Figure 2. Percentage marketable yield at **Site 1** and **Site 2** at harvest. LSD (Site 1) = 21.10, LSD (Site 2) = 29.92



Discussion

Five post-emergence treatments showed greater efficacy, as well as an increase in yield compared to the standard (Callisto + Fornet 6OD), and were also of at least equivalent safety for use in sweetcorn grown under plastic covers. Those treatments were Callisto + Fornet 6OD + AHDB 9856, AHDB 9858, Stomp Aqua applied pre-em followed by AHDB 9856, AHDB 9990 applied post-emergence or AHDB 9859 applied inter-row.

At Site 1, a greater effect from post-emergence treatments was observed. It was a larger crop at a later growth stage when the herbicides were applied, and sweetcorn becomes intolerant of herbicides as it enters growth stages at 6 leaves or above. The post-emergence application at Site 1 was also applied as the buttress roots were growing, and selected treatments caused deformation of the growth of the roots. These effects were not seen at Site 2, as the crop was at an earlier growth stage and these roots were not yet being formed.

The buttress root deformation was a more severe effect and this persisted until harvest, but yield was not reduced by this effect where efficacy was good. Treatments which caused the deformation to occur were those which included AHDB 9866 and AHDB 9867. AHDB 9867 was one of the best performing products for weed control, and marketable yield was equivalent to or above that of the standard. The buttress root effects would have had a greater effect on yield if the crop had lodged, but this can be mitigated by timing application of the product before the roots are forming.

Despite these greater effects from many of the treatments, three caused very little effect on the crop. These were; Stomp Aqua followed by either AHDB 9990, AHDB 9856, or AHDB 9859 applied as an inter-row application. Effects caused by the remaining treatments included transient yellowing or chlorosis of foliage and an associated check to speed of growth, scorch and white spots on the leaves, or deformation of the buttress roots. The latter is an important effect to consider as the buttress roots stabilise the sweetcorn when it gets taller, and any damage can lead to an increased risk of lodging.

The commercial standard, Callisto + Fornet 6OD caused slight yellowing and check to the speed of growth of the crop, but it should be noted that growers expect this to happen at the growth stage it was applied at Site 1, and accept this effect. This effect was also seen at an equivalent level on the treatments Callisto + Fornet 6OD + AHDB 9856, AHDB 9985 + AHDB 9857 and AHDB 9858 at four weeks after application. The crop had recovered from these effects by the time of harvest.

Moderate spotting and scorch was caused by AHDB 9859 applied over the crop at 1/3 rate, but the effect was transient and the crop was recovering by four weeks after application and had fully recovered by harvest.

No concerning effects were seen on the sweetcorn crop at Site 2 by one month after application, but earlier after application at two weeks post spraying there were slight effects on the crop from five of the treatments. This was exhibited as yellowing in plots treated with Callisto + Fornet 6OD, Callisto + Fornet 6OD + AHDB 9856 and AHDB 9867; and there was scorch and white spotting on the foliage from the two treatments where AHDB 9859 was applied. Although the product didn't kill any of the crop when applied over the foliage, less effect was seen from AHDB 9859 when it was applied as an inter-row application.

The weed species and levels at each of the sites differed, with a higher weed population at Site 1, but with a narrower range of species. The weed species at Site 1 consisted mainly of fat hen (*Chenopodium album*) and redshank (*Polygonum persicaria*) (**Table 6**), while the key weeds at Site 2 were fat hen, chickweed (*Stellaria media*), black nightshade (*Solanum nigrum*), groundsel (*Senecio vulgaris*), and fumitory (*Fumaria officinalis*) (**Table 7**). Results are shown for the top three weeds only for Site 2.

All treatments significantly reduced the percentage of redshank at Site 1; Stomp Aqua 3.3 L/ha pre-emergence followed by AHDB 9867, AHDB 9867 alone and Callisto + Fornet 6OD + AHDB 9856 gave the greatest reduction in redshank (**Table 6**).The percentage cover of fat hen was significantly reduced by all treatments at both sites (**Table 6** and **Table 7**) with the exception of

AHDB 9866 applied as a single post-emergence application at Site 1; at Site 2 the product did give significant control of fat hen, but it only reduced cover by 75.2% when compared to the control, which meant it was still one of the poorest performing treatments against this weed species in the trial . The standard Callisto + Fornet 6OD gave the greatest reduction in fat hen with 100% control of the weed.

There were differences between products in the weed species significantly controlled by selected treatments at four weeks after application. While the application of AHDB 9856 after a pre-em of Stomp only reduced redshank by 35.6% at Site 1, this treatment reduced fat hen by 83.1% at the same site, and was one of the top four products in the trial for control of fat hen. Conversely AHDB 9858 only reduced fat hen by 45.7% compared to the control, but performed better against redshank, reducing the weed level by 83.1%.

At Site 2 (**Table 7**), population levels of individual weed species were lower but there were still significant differences. Control of fat hen by the treatments followed a similar trend in performance to Site 1, and all products gave significant control of the weed at that site. Seven treatments significantly reduced the percentage cover of chickweed, there were the standard, Callisto + Fornet 6OD, Callisto + Fornet 6OD + AHDB 9856, AHDB 9986 + AHDB 9857, AHDB 9867 and Stomp Aqua pre-emergence followed by either AHDB 9856, AHDB 9867, or AHDB 9900. AHDB 9859 did not control chickweed as this is a particular weakness for this product. There were very low levels of black nightshade in the trial at 4.5% plot cover, but with the exception of AHDB 9866, and Stomp Aqua followed by AHDB 9900 or AHDB 9859 applied inter-row, all other treatments significantly reduced this weed.

Overall, eleven treatments significantly reduced the percentage of weed cover at both sites for four weeks after herbicide application, when compared to the untreated ($P < 0.001$). At the time of the post-emergence spray application, the plots treated with a pre-emergence herbicide had significantly lower weed at Site 1, though this did not always lead to them having the greatest reduction in weed population by the end of the assessment period. The post-emergence applications still had an influence on overall efficacy.

The best performing treatments by efficacy were the standard, Callisto + Fornet 6OD, Callisto + Fornet 6OD + AHDB 9856, AHDB 9867 and Stomp followed by AHDB 9867, all which reduced weed levels by greater than 85% at both trial sites. However, AHDB 9867 does cause buttress root deformation if applied when the roots are forming, and if authorised for use on sweetcorn, timing of application would need to be considered.

There were significant differences in yield at Site 1 when compared to the untreated control, and seven treatments had 4.4 to 14.3 % greater marketable yield than those treated with the current standard (Callisto + Fornet 6OD) (**Table 9**). Those treatments were Callisto + Fornet 6OD + AHDB 9856, AHDB 9858, Stomp Aqua pre-em followed by AHDB 9856, AHDB 9867, AHDB 9866, AHDB 9990 applied post-emergence or AHDB 9859 applied inter-row.

There are no significant differences in marketable yield between the treatments and the untreated control at Site 2 despite the appearance of differences in the percentage marketable yields, and a 20% lower marketable yield between the mean highest yield and the untreated control (**Table 10**). This is likely due to the variability in the crop growth differences where the plastic came off selected rows in high winds.

Conclusions

- Five post-emergence treatments improved weed control and were also of at least equivalent crop safety to the current standard (Callisto + Fornet 6OD), in sweetcorn grown under plastic covers. Yield in these treatments was also greater than in the plots where the standard was applied.
    - These are - Callisto + Fornet 6OD + AHDB 9856, AHDB 9858, Stomp Aqua applied pre-em followed by AHDB 9856, AHDB 9990 applied post-emergence or AHDB 9859 applied inter-row.
- AHDB 9867 was one of the best performing products for weed control, and marketable yield was equivalent to or above that of the standard, but care needs to be taken with application timing to avoid damage to buttress roots.

Acknowledgements
AHDB for funding the work, and the crop protection companies for their financial contributions as well as providing samples for the trials. Thanks should also be given to the growers who provided sites and crops for the trials as well as technical input, particularly Grant Lumsden, Jim Smith and Neil Caims from Barfoots, Sussex.

Appendix
a. Crop diary – events related to growing crop

Crop details

Site 1			
Crop	**Cultivar**	**Planting date**	**Row width (m)**
Sweetcorn	Early Bird	10/04/2019	2 rows per 1.65 m bed

Previous cropping

Site 1	
Year	**Crop**
2014	TBC
2015	TBC

Active ingredients(s)/fertiliser(s) applied to trial area

Site 1		
Date	**Product**	**Rate (kg/ha)**
01/04/2019	MOP	250
01/04/2019	OEN 39.0N 0.0P	270

Pesticides applied to trial area

No chemical inputs applied to trial area.

Details of irrigation regime

Irrigation regime was weather-dependent—no official scheme followed.

Crop details

Site 2			
Crop	**Cultivar**	**Planting date**	**Row width (m)**
Sweetcorn	Early Bird	16/04/2019	4 rows per 1.65 m bed

Previous cropping

Site 2	
Year	**Crop**
2014	
2015	

Active ingredients(s)/fertiliser(s) applied to trial area

Site 2		
Date	**Product**	**Rate (kg/ha)**
01/04/2019	MOP	250
01/04/2019	OEN 39.0N 0.0P	270

Pesticides applied to trial area

No chemical inputs applied to trial area.

Details of irrigation regime

Irrigation regime was weather-dependent—no official scheme followed.

b. Photos of crop effects at 1 month after application – Site 1

Untreated control

Callisto + Fornet 6OD (standard)

Scorch spots caused by AHDB 9859 applied over the crop

Buttress root deformation caused by AHDB 9867

Plot photos

Untreated control

3. Callisto + Fornet 6OD (standard)

4. Callisto + Fornet 6OD + AHDB 9856

5. Stomp Aqua 3.3 L/ha then AHDB 9856 post-emergence

6. AHDB 9986 + AHDB 9857

7. AHDB 9858

		
8. AHDB 9867 post-emergence	**9. Stomp Aqua 3.3 L/ha then AHDB 9867 post-emergence**	**10. AHDB 9866**
		
11. Stomp Aqua 3.3 L/ha then AHDB 9866 post-emergence	**12. Stomp Aqua 3.3 L/ha then AHDB 9859 applied over crop 1/3 rate**	**13. Stomp Aqua 3.3 L/ha then AHDB 9859 applied inter-row**
		
14. Stomp Aqua 3.3 L/ha then AHDB 9990 post-emergence		

c. Trial diary

Site 1	
Date	**Event**
11/04/2019	Plots drilled and treatment application.
29/04/2019	Phytotox assessment.
21/05/2019	Weeds, phytotox assessment.
04/06/2019	Weeds, phytotox assessment.
18/06/2019	Weeds, phytotox assessment.

Site 2	
Date	**Event**
17/04/2019	Plots drilled and treatment application.
29/04/2019	Phytotox assessment.
21/05/2019	Weeds, phytotox assessment.
04/06/2019	Weeds, phytotox assessment.
18/06/2019	Weeds, phytotox assessment.

d. Climatological data during study period

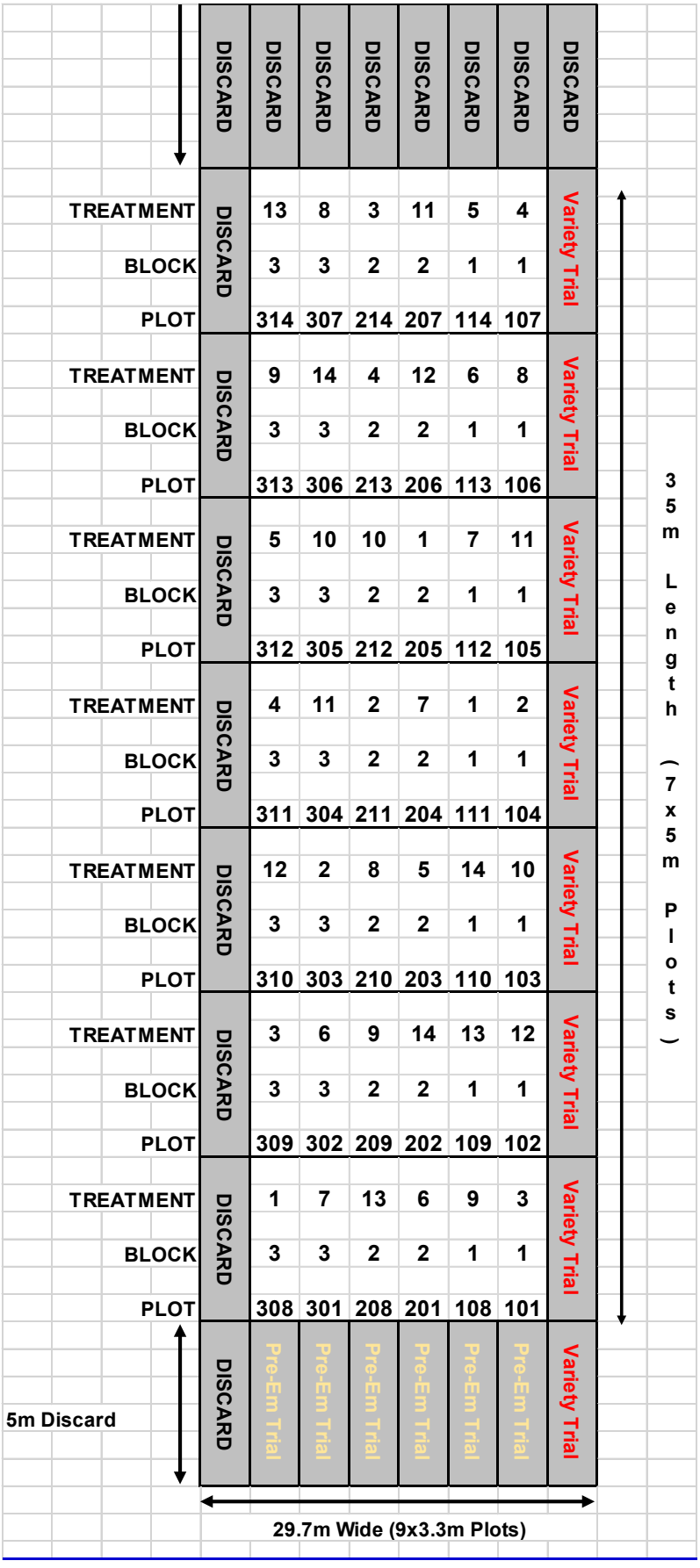
Site 2			
Date	**Temperature °C (minimum)**	**Temperature °C (maximum)**	**Rainfall (mm)**
16/04/2019	14	23	
17/04/2019	7	24	
18/04/2019	10	25	
19/04/2019	8	26	
20/04/2019	9	28	
21/04/2019	5	27	
22/04/2019	6	23	
23/04/2019	10	24	
24/04/2019	9	17	
25/04/2019	9	18	
26/04/2019	7	17	
27/04/2019	9	16	
28/04/2019	7	18	
29/04/2019	4	19	
30/04/2019	4	18	
01/05/2019	7	17	
02/05/2019	7	18	
03/05/2019	5	17	
04/05/2019	5	15	
05/05/2019	3	15	
06/05/2019	6	16	
07/05/2019	5	16	
08/05/2019	10	16	
09/05/2019	8	15	
10/05/2019	4	18	
11/05/2019	7	19	
12/05/2019	6	19	
13/05/2019	5	19	
14/05/2019	8	22	
15/05/2019	6	21	
16/05/2019	6	21	
17/05/2019	8	14	
18/05/2019	9	23	
19/05/2019	7	23	
20/05/2019	12	24	
21/05/2019	9	28	
22/05/2019	9	26	
23/05/2019	6	26	
24/05/2019	9	27	
25/05/2019	13	26	
26/05/2019	10	24	
27/05/2019	8	23	
28/05/2019	8	21	
29/05/2019	7	16	
30/05/2019	14	25	
31/05/2019	12	25	
01/06/2019	8	26	

02/06/2019	14	27	
03/06/2019	11	23	
04/06/2019	10	19	
05/06/2019	11	20	
06/06/2019	11	22	
07/06/2019	12	19	
08/06/2019	11	19	
09/06/2019	8	22	
10/06/2019	10	13	
11/06/2019	10	20	
12/06/2019	11	20	
13/06/2019	12	17	
14/06/2019	13	19	
15/06/2019	11	18	
16/06/2019	10	18	
17/06/2019	12	21	
18/06/2019	11	19	
19/06/2019	14	21	
20/06/2019	11	20	
21/06/2019	9	23	
22/06/2019	8	23	
23/06/2019	12	26	
24/06/2019	16	23	
25/06/2019	15	27	
26/06/2019	17	26	
27/06/2019	14	26	
28/06/2019	14	29	
29/06/2019	17	32	
30/06/2019	14	25	
01/07/2019	13	28	
02/07/2019	11	26	
03/07/2019	13	24	
04/07/2019	10	26	
05/07/2019	13	29	
06/07/2019	15	27	
07/07/2019	16	19	
08/07/2019	14	22	
09/07/2019	15	24	
10/07/2019	13	26	
11/07/2019	16	28	
12/07/2019	16	28	
13/07/2019	15	27	
14/07/2019	14	24	
15/07/2019	11	25	
16/07/2019	11	25	
17/07/2019	11	26	
18/07/2019	16	24	
19/07/2019	11	19	
20/07/2019	15	23	
21/07/2019	12	24	
22/07/2019	16	26	
23/07/2019	15	30	
24/07/2019	19	29	

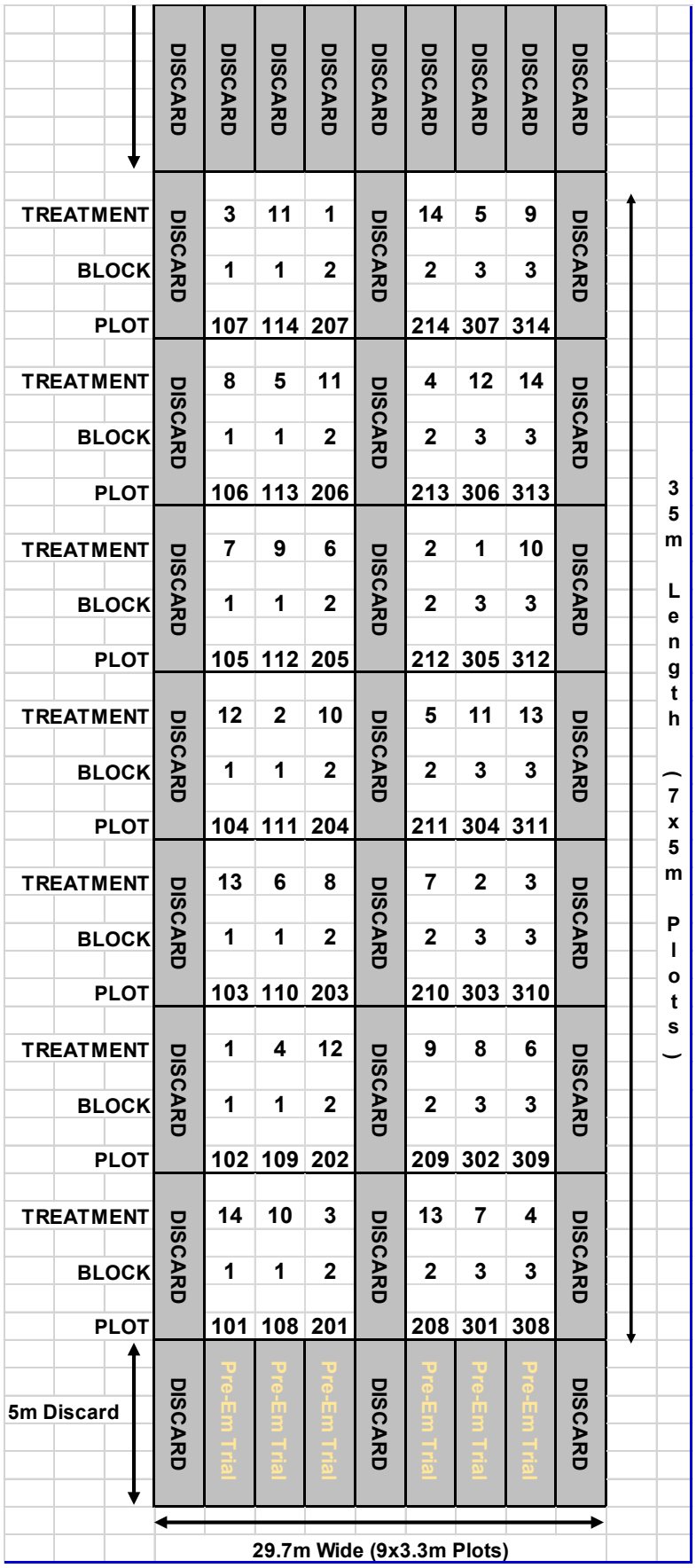
25/07/2019	17	31	
26/07/2019	19	24	
27/07/2019	17	24	
28/07/2019	14	24	
29/07/2019	13	24	
30/07/2019	18	20	
31/07/2019	17	24	
01/08/2019	12	25	
02/08/2019	15	27	
03/08/2019	15	23	
04/08/2019	15	25	
05/08/2019	17	26	
06/08/2019	17	24	

e. Trial design

Site 1



Site 2


DISCARD
TREATMENT
BLOCK
PLOT
3 11 1 14 5 9
1 1 2 2 3 3
107 114 207 214 307 314
8 5 11 4 12 14
1 1 2 2 3 3
106 113 206 213 306 313
7 9 6 2 1 10
1 1 2 2 3 3
105 112 205 212 305 312
12 2 10 5 11 13
1 1 2 2 3 3
104 111 204 211 304 311
13 6 8 7 2 3
1 1 2 2 3 3
103 110 203 210 303 310
1 4 12 9 8 6
1 1 2 2 3 3
102 109 202 209 302 309
14 10 3 13 7 4
1 1 2 2 3 3
101 108 201 208 301 308
Pre-Em Trial
35m Length (7x5m Plots)
5m Discard
29.7m Wide (9x3.3m Plots)

f. ORETO certificate

Certificate of

Official Recognition of Efficacy Testing Facilities or Organisations in the United Kingdom

This certifies that

RSK ADAS Ltd

complies with the minimum standards laid down in Regulation (EC) 1107/2009 for efficacy testing.

The above Facility/Organisation has been officially recognised as being competent to carry out efficacy trials/tests in the United Kingdom in the following categories:

Agriculture/Horticulture
Stored Crops
Biologicals and Semiochemicals

Date of issue: 1 June 2018
Effective date: 18 March 2018
Expiry date: 17 March 2023

Signature Alison Richardson
Authorised signatory

Certification Number
ORETO 409

HSE
Chemicals Regulation Division

Department of Agriculture and Rural Development