PROCESSORS & GROWERS RESEARCH ORGANISATION

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Project Number: FV72b

Project Title: Air assisted sprayers : drift and spray deposition studies in Brussels sprouts, leeks and lettuce.

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Location of Project: Gedney Marsh and Moulton Seas End, S. Lincs.

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Key words: Brussels sprouts, lettuce, leeks.

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PRACTICAL SECTION FOR GROWERS

Air assisted sprayers: drift and spray deposition studies in Brussels sprouts, leeks and lettuce

APPLICATION: The objective of the experiment was to evaluate spray drift and deposition with and without air assistance using a Degania sprayer (cone nozzles) and a Hardi Twin-boom sprayer (flat fan nozzles) over Brussels sprouts, leeks and lettuce at advanced stages of maturity when fungicides or insecticides might be applied.

Air assistance considerably reduced drift over Brussels sprouts, leeks and lettuce, compared with conventional sprays. It could therefore be predicted that air assistance at higher wind speeds may produce less drift than conventional sprays at lower wind speeds. This would benefit the user by allowing more spray opportunities and thus optimising application timing. Air assistance deposited more spray on lower sprout buttons than conventional sprays. In a more open crop, leeks, although total deposit was greater with air assistance there was little difference between deposit on inner and outer leaves.

The results can be used to demonstrate to the Regulatory Authorities that air assisted sprays could safely be applied at higher wind speeds than guide-lines suggest in the Code of Practice for the Safe Use of Pesticides. The use of air directed down into the crop canopy offers possibilities of better control of certain sprout diseases.

SUMMARY

Air assisted sprayers: drift and spray deposition studies in Brussels sprouts, leeks and lettuce

OBJECTIVE: Reduction in spray drift would reduce risk of accidental operator and public exposure and also accidental spray damage to crops. The ability of air assisted sprayers to reduce spray drift may be partly dependent on the crop surface over which it is applied. The aim of this investigation was to evaluate spray drift with conventional sprays and with air assistance using Degania and Hardi Twin-boom sprayers over different crop plant types: Brussels sprouts, leeks and Iceberg lettuce at advanced stages of maturity.

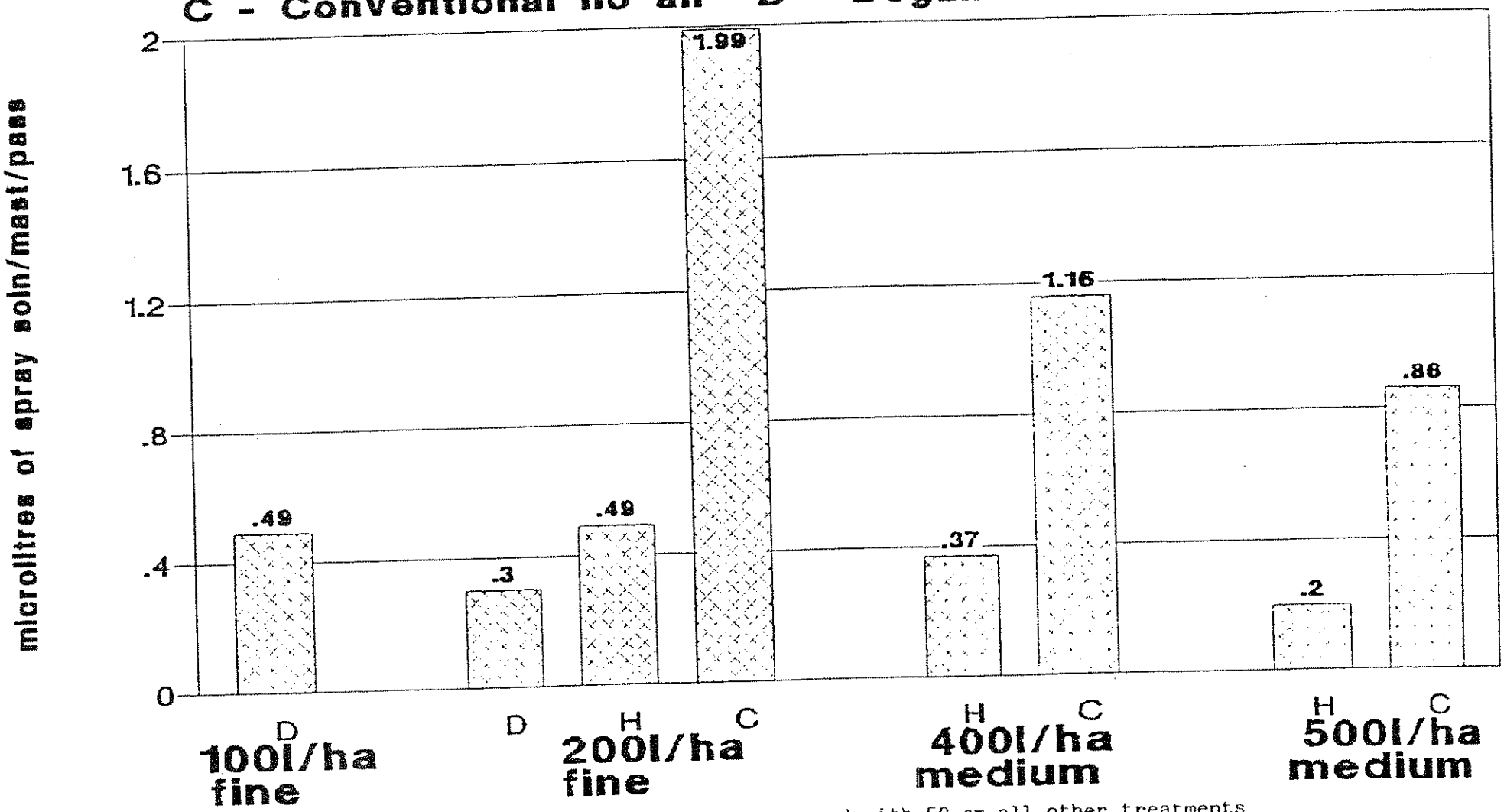
Spray deposition in sprouts and leeks was also assessed.

Product recommendations for fungicides and insecticides in these crops are for high water volumes e.g. 600 to 1500 l/ha, applied with medium spray quality, although lower volumes may often be used in practice. Degania suggest fine sprays applied with cone nozzles normally up to 100 l/ha. The Hardi Twin-boom (flat fan nozzles) can apply higher volumes.

RESULTS: Results for drift measurements in μl/mast/pass per 100 l/ha applied are presented for a range of volumes and spray quality in the following histograms:

Brussels sprouts:Drift in microlitres/mast/pass per 100l/ha sprayed

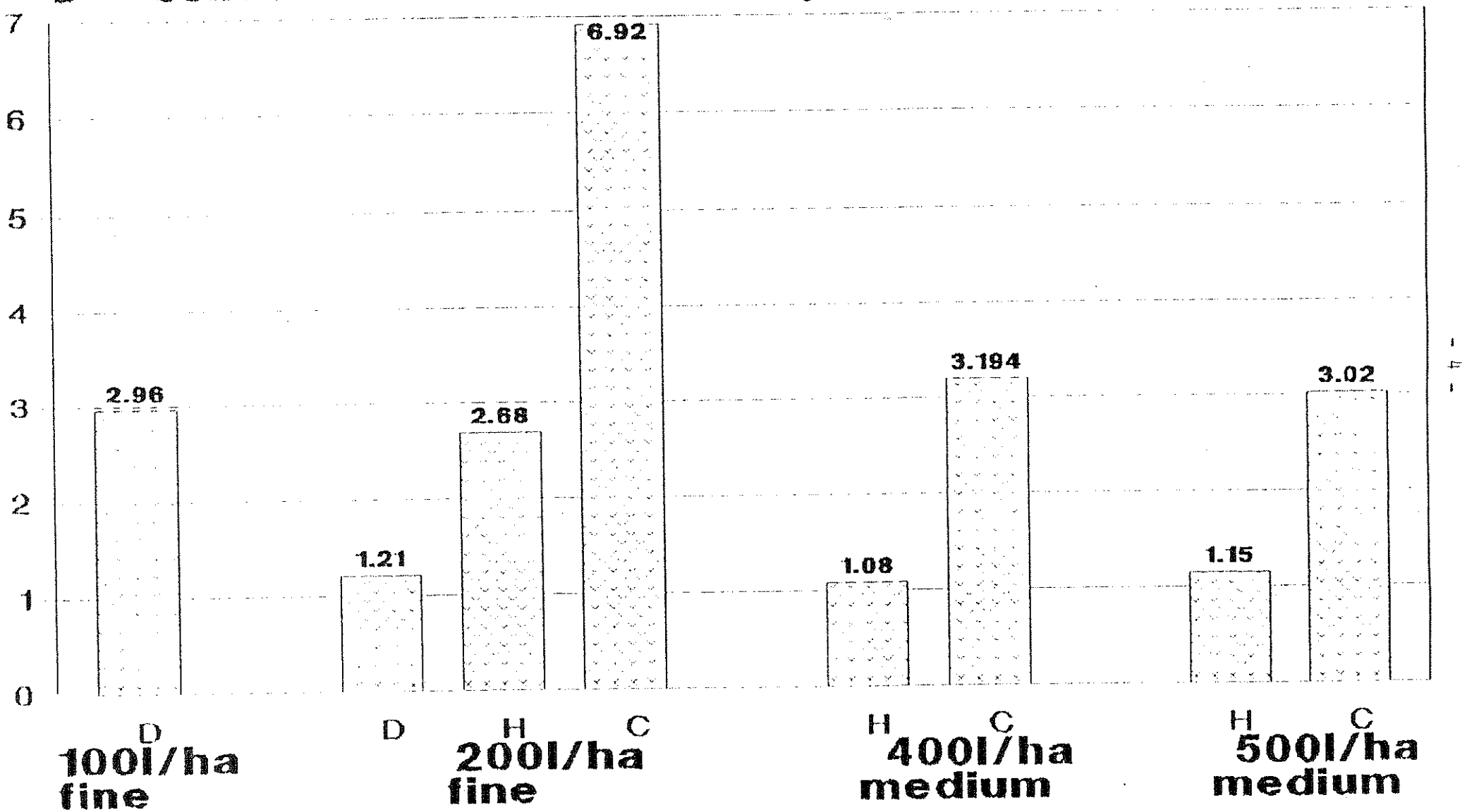
H - Hardi Twin-boom full air
C - Conventional no air D - Degania full air



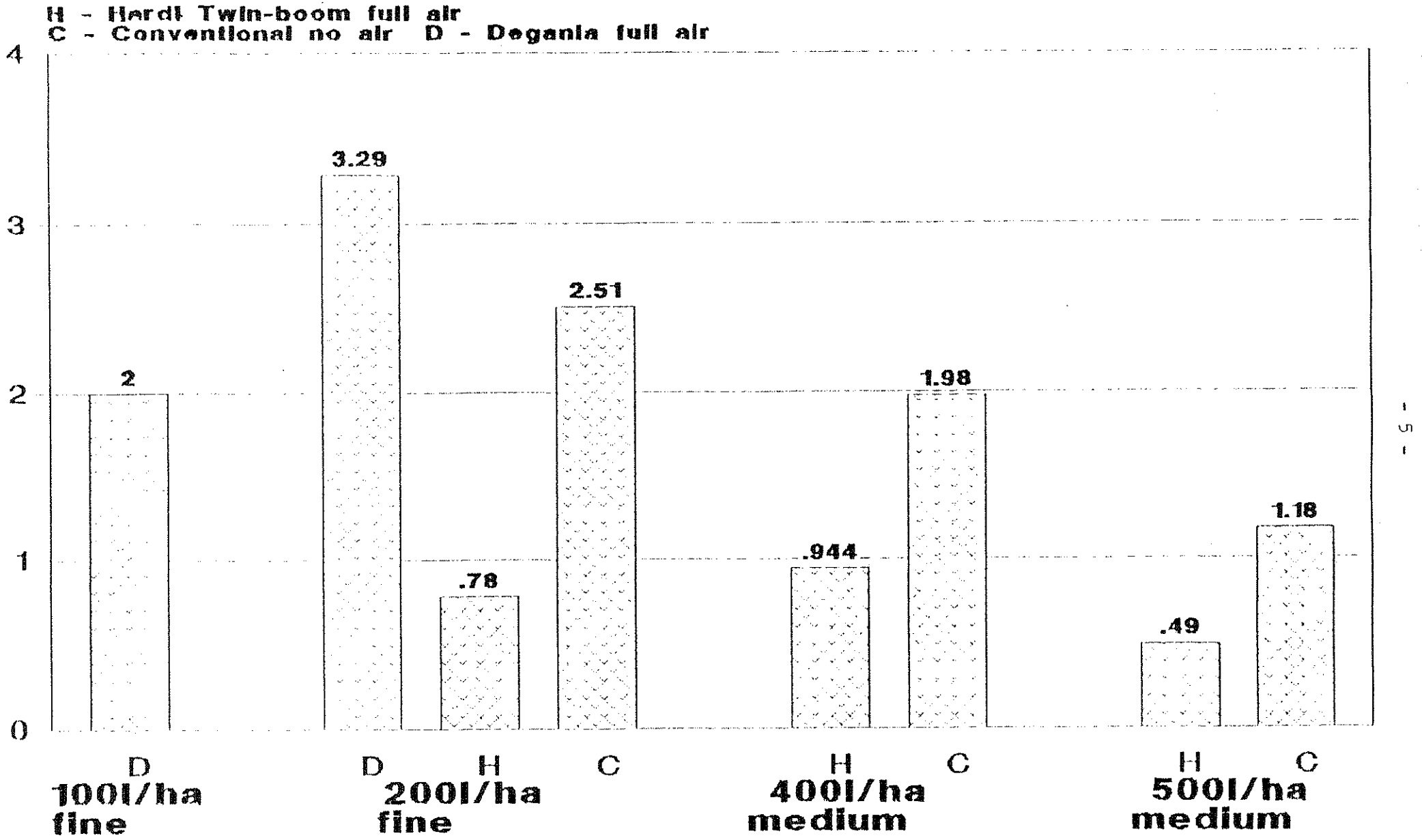
Lower boom height 25 cm in Brussels sprouts, compared with 50 cm all other treatments

Leeks:Drift in microlitres/mast/pass per 100l/ha sprayed

H - Hardi Twin-boom full air
C - Conventional no air D - Deganla full air



Lettuce:Drift in microlitres/mast/pass per 100l/ha sprayed



General trends are seen:-

Drift was greater for fine spray droplets applied at 200 l/ha volume, than for medium spray droplets at 400 and 500 l/ha.

Both types of air assistance reduced drift but with one exception, with the Degania at 200 l/ha over lettuce. This may be because the mature iceberg lettuce presented a closed solid surface and the spray, which emerges from small holes at greater speed than the Hardi Twin-boom, bounced off the target.

The histograms illustrate that 200 l/ha and fine spray quality a reduction in drift over Brussels sprouts of 67% (Hardi) and 80% (Degania) could be expected with air assistance. Over leeks the reduction is 61% (Hardi) and 82% (Degania) and lettuce 69% (Hardi) but there is more drift with Degania.

When a correction factor is applied (see full report) to take into account varying wind speeds the trend is similar over sprouts, 34% (Hardi), 88% (Degania), over leeks 54% (Hardi), 76% (Degania), over lettuce 52% (Hardi), 0% (Degania).

Spray deposition data are limited but suggested that in sprouts air assistance would deposit more chemical on the lower buttons than conventional sprays, particularly with the Hardi. More chemical in fine spray at 200 l/ha would be deposited than with medium spray quality. Perhaps fine droplets are needed to penetrate and circulate in a tall dense crop.

In leeks, with fine sprays at 100 l/ha more total spray was deposited on inner and outer leaves with air assistance. Deposit values suggest that for this crop, with waxy upright leaves, fine deposits may be beneficial. Otherwise there was little difference in deposit on inner or outer leaves and no clear trends emerged.

ACTION POINTS: Air assistance considerably reduced drift over Brussels sprouts and leeks. However, where the target is a closed surface, (soil where a crop at early stages offers little cover) or mature, (dense Iceberg lettuce) consideration should be given to reducing air assistance (particularly for the Degania if 200 l/ha volumes are used).

Although air assistance deposited more spray on leek plants and on lower sprout buttons it should not be assumed that lower pesticide rates can be used. Efficacy was not tested for lower dose rates or lower volumes. In high value vegetable crops, quality is all important and this should not be put at risk.

In certain cases, chemical product labels may prohibit use of volumes lower than recommended particularly for toxic chemicals, in others volumes can be reduced by one tenth of that recommended with several conditions (see Code of Practice for Safe Use of Pesticides).

BENEFITS: From the results it could be predicted that air assistance at higher wind speeds will produce less drift than conventional sprays at lower wind speeds. This would benefit the user by allowing more spray opportunities and thus optimising the timing of application. The information can be used to suggest to the Regulatory authorities that spraying might safely be carried out at higher wind speeds than the 2-4 mph at boom height (Force 2 at a height of 10m) suggested in the Code of Practice for Safe Use of Pesticides, without contravening COPR or COSHH.

A further advantage of air assistance is that total deposit on the target surface could be increased as shown in leeks. In the case of sprouts, more spray on lower buttons (and leaf area) could perhaps achieve better control of some diseases.

Air assisted sprayers: drift and spray deposition studies in Brussels sprouts, leeks and lettuce

INTRODUCTION: Reduction in spray drift would reduce risk of accidental operator and public exposure and also accidental spray damage. The ability of an air assisted sprayer to reduce spray drift may be partially dependent on the crop surface over which it is applied and crops chosen for this study are of different plant types.

The aim of this investigation was to evaluate spray drift with conventional sprays and with air assistance using a Degania sprayer (cone nozzles) or a Hardi Twin-boom sprayer (flat fan nozzles) over Brussels sprouts, leeks and lettuce at advanced stages of maturity. Spray deposition in sprouts and leeks were also assessed.

If it were shown that air assistance reduces drift over vegetable crops, the information could be used to demonstrate to the Regulatory Authorities that spraying could safely be carried out at higher wind speeds than suggested in the 'Code of Practice for the Safe Use of Pesticides' without contravening the requirements of COPR and COSHH.

Project collaborators were S. Cooper, Harper Adams Agricultural College, W. Taylor, Hardi International who carried out the analyses and M. Holman of Ferrag Limited.

We acknowledge the help of J.E. Piccaver & Co., and Cooley Fresh Foods in providing trial sites.

MATERIALS AND METHODS:

Crops: All crops were grown to a high standard, were healthy, vigorous and weed free.

Brussels Sprouts: (On 25 August) cv. Cor, grown at 50cm plant spacing, height 80cm. Crop cover 100%. Growth stage 5-6 weeks before harvest, fungicide application stage.

Location: Gedney Marsh, S. Lincs.

Weather: 18°C 44 RH overcast 100% cloud cover at 11.30 am-to
11°C 81 RH overcast 100% cloud cover at 5.30 pm.

Iceberg Lettuce: (On 25 August) cv. Saladin, grown on 35cm square planting arrangement in 120cm wide beds with a 50cm pathway between beds. Crop cover within beds 90%. Growth stage nearly mature and at a stage when aphid sprays might be applied.

Location: Gedney Marsh, S. Lincs.

Weather: 18°C 43 RH overcast 100% cloud cover at 12.30 am-to
14°C 55 RH overcast 100% cloud cover at 4.00 pm.

Leeks: (On 26 August) cv. Albana, grown on 20cm square planting arrangement in 150cm wide beds, wheelings between beds on 180cm centres. Crop cover 50%, growth stage 10 leaves, shank about 2.5cm width, at a stage when fungicides might be applied.

Location: Moulton Seas End, S. Lincs.

Weather: 14°C 46 RH sunny no cloud at 11.30 am - to
15°C 44 RH sunny no cloud at 2.30 pm.

Product label recommendations for fungicides for sprouts, leeks and lettuce are for water volumes of up to 1500 l/ha e.g. Favour 600 SC (metalaxyl/thiram) 750-1500 l/ha in mature lettuce, Bayfidan (triadimenol) 400-600 l/ha in sprouts, Bayleton (triadimefon) at 600 l/ha in leeks, although for logistical reasons lower volumes are often used in practice. Most recommendations are for medium spray quality.

The Degania machine would only operate at 200 l/ha maximum volume and Degania recommend that most sprays are applied at 100 l/ha or less with their machine.

Sprayer treatments are shown in Table 1.

Table 1 - Sprayer Treatments for Drift Measurements and Deposition Studies

Drift Measurements

Sprayer	Air	Nozzle				Water Volume l/ha	Pressure Bar
		Code	Output l/min	Spray quality	Volume Median Diameter		
Degania	+	Albuz brown	0.3	fine	125	100	2.97
Degania	+	Albuz yellow	0.6	fine	122	200	3.5
Hardi Twin-boom	+	411014	1.2	fine	123	200	5.0
Hardi Twin-boom	+	411024	2.3	medium	198	400	4.0
Hardi Twin-boom	+	411024	3.0	medium	187	500	6.2
Conventional	-	411014	1.2	fine	123	200	5.0
Conventional	-	411024	2.3	medium	198	400	4.0
Conventional	-	411024	3.0	medium	187	500	6.2

Deposition Studies

Sprayer	Air	Nozzle		Water volume l/ha	Pressure Bar
		Code	Spray quality		
Degania	+	Albuz brown	fine	100	2.97
Degania	+	Albuz yellow	fine	200	3.5
Hardi Twin-boom	+	411014	fine	200	5.0
Hardi Twin-boom	+	411024	medium	400	4.0
Conventional	-	411014	fine	200	5.0
Conventional	-	411024	medium	400	4.0

Speed of sprayers for all treatments 7.2 km/hr (4.5 mph)
Hardi Twin-boom, full air assistance, air at 30° angle rearward
Degania, full air assistance, nozzle at 30° angle into a vertical airstream
Volume Median Diameter (VMD) data derived by a Malvern 2600
Spray quality BCPC definition.

Sprayers: Both machines had 12m wide booms and were tractor mounted. The Hardi Twin-boom was supplied by Hardi Limited and Degania by Ferrag Limited. The Hardi was also used for conventional applications with the air bag folded and tied down to occupy as little space as possible to simulate a normal sprayer boom.

Degania: Albuz hollow cone nozzles at 25cm spacing at 30° angle into the vertical air stream. Boom height 25cm above top of sprout crop, 50cm above leeks and lettuce, air speed about 30 metres/sec.

Hardi Twin-boom: Hardi flat fan nozzles at 50cm spacing. Airstream at 30° angle rearward. Air speed 21 metres/sec. Boom height 50cm above top of all crops.

Conventional: Hardi flat fan nozzles at 50cm spacing, vertical. Boom height 50cm above top of all crops.

Spray Solution: Water 0.1% Agral non-ionic surfactant (to simulate wetter in pesticides) and a fluorescein tracer dye to quantify deposit of spray drift. Reference samples of solution were taken from the sprayer tank at intervals for instrument calibration and so that the experimental values could be determined later.

Spray drift measurements: Drift measurements were carried out using a technique where drifting droplets of spray solution containing fluorescent dye were caught on pipe cleaners attached to masts. Four masts 5m high, were placed at 10m intervals, 5m down wind of the edge of the spray boom pass in lettuce and leeks (but 17m in error in sprouts). Direction of travel of the sprayer was parallel to the line of masts, but at right angles to the wind direction so that wind blew across the spray swath and carried drifting droplets through the target area on the masts. Pairs of pipe cleaners were placed above crop height at 0.5m intervals up the mast, 9 pairs in sprouts, 10 pairs in lettuce and leeks. Four 100m passes (2 in each direction) were made along the same track with the sprayer, which sprayed tracer solution at the appropriate treatment volume etc. (Table 1).

Wind Speed: Measurements of wind speed were taken during each treatment using a Monroe anemometer at a height of 2.0m, as the sprayer passed each mast for every pass and a mean wind speed was calculated.

Spray deposits: These were measured on a separate area of crop for a single pass for the treatment shown in Table 1.

Sprout buttons from upper and lower portions of 10 random plants were taken (one button from each side of the stem, i.e. forward and rear relative to the direction of sprayer travel, to give a total of 20 from upper and 20 from lower stem.

In leeks, 16mm leaf discs were removed with a cutter, 10 from the inner leaves and 10 from outer leaves. This was replicated twice. Samples of untreated leeks and sprouts were taken to measure any natural fluorescence of the crops.

It was not feasible to study spray deposits on Iceberg lettuce leaves.

The samples were immediately placed in a black polythene container to exclude light and taken to PGRO. They were soaked in a solution containing alkaline buffer and surfactant to remove spray deposits. Deposits from sprouts, leeks, pipe cleaners and reference samples from the sprayer tank were all analysed.

The sprout button samples unlike leek leaf discs, were a non-uniform size with upper buttons smaller than lower ones, so dry weights were therefore measured.

Data: The raw values were summed up for pipe cleaners on each mast. and values for plant deposits were meaned. Both were then 'normalised' to 100 l/ha so that volume rates could be compared. The values then relate to the amount of pesticide which would be deposited on sprouts and leeks and not to spray droplet cover. The background fluorescence of untreated leeks were deducted from the spray deposit values. There was no fluorescence at the wavelength used for untreated sprouts. Spray deposits on sprouts were divided by button dry weights so that treatments could be compared. 'Driftability' was calculated to take into account the different wind speeds measured at the time of each treatment.

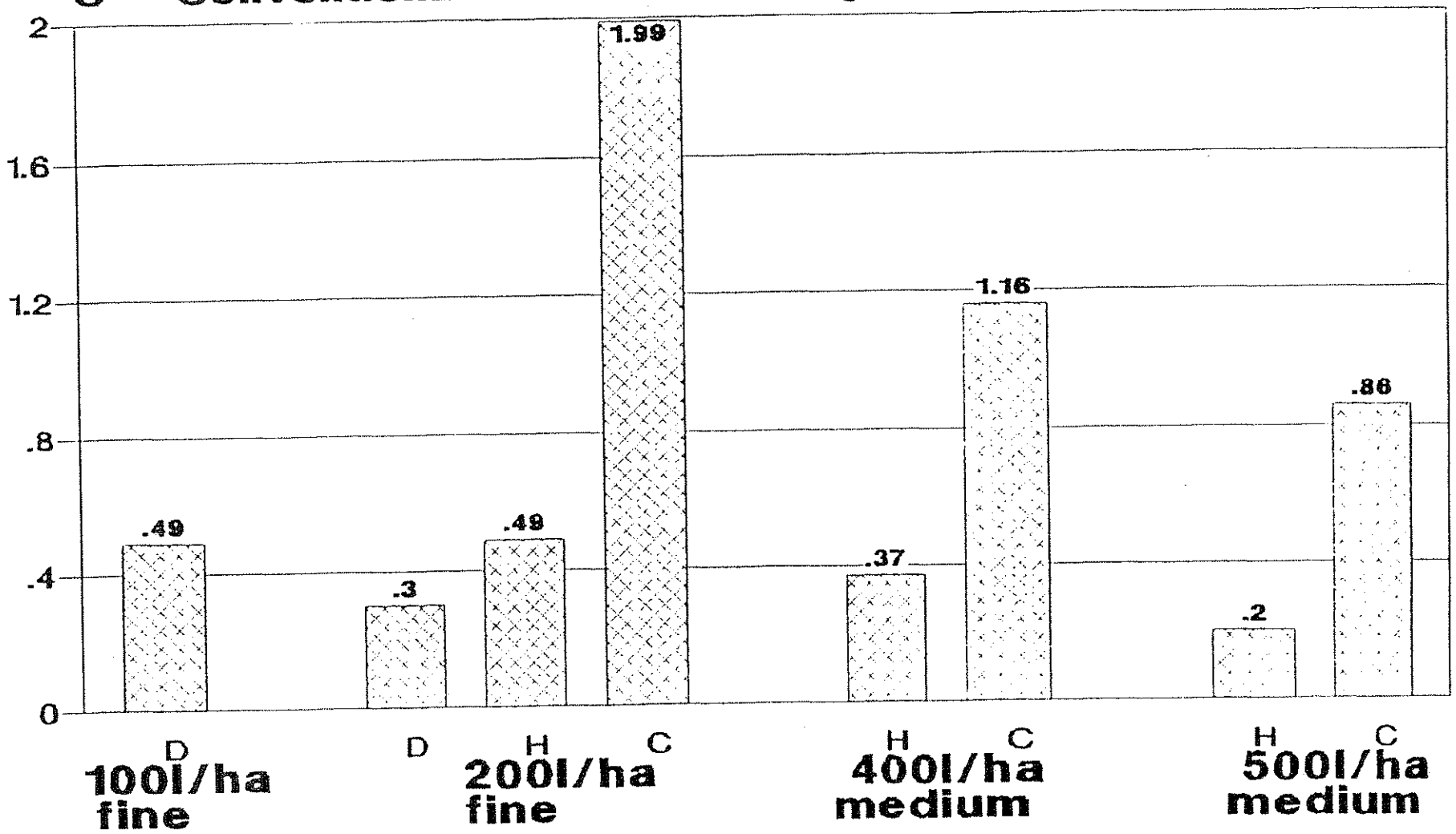
ible 2: The accumulated volume of spray collected on drift masts from 4 sprayer passes (µl of spray solution), mean wind speed etres/sec, µl per 100 l/ha, and µl/mast/pass per 100 l/ha apllied and "Driftability"

Sprayer	Air	Spray Quality	Volume	µl (4 passes) Mast 1	2	3	4	Total	Mean Wind speed metres/sec	µl (per 100 l/ha)	µl (at 100 l/ha) per mast/pass	Driftability# µl (at 100 l/ha)
eeks												
egania	+	fine	100	13.8	17.1	8.5	8.0	47.4	4.1	47.4	2.96	15.29
egania	+	fine	200	15.8	7.8	7.7	7.3	38.6	3.6	19.3	1.21	7.42
ardi Twin-boom	+	fine	200	22.6	22.8	19.2	21.2	85.8	4.0	42.9	2.68	14.30
ardi Twin-boom	+	medium	400	18.8	17.5	16.7	15.6	68.6	4.0	17.2	1.08	5.70
ardi Twin-boom	+	medium	500	25.2	27.8	22.7	16.4	92.1	3.7	18.4	1.15	4.97
onventional	-	fine	200	56.0	61.4	51.0	52.9	221.3	4.6	110.7	6.92	30.75
onventional	-	medium	400	47.1	59.9	46.3	51.0	204.3	3.7	51.1	3.19	18.90
onventional	-	medium	500	60.6	73.3	68.0	39.8	241.7	4.1	48.3	3.02	15.58
ettuce												
eania	+	fine	100	8.4	7.1	9.1	7.4	32.0	3.5	32.0	2.0	12.80
egania	+	fine	200	23.0	17.7	31.0	33.5	105.2	4.0	52.6	3.29	17.53
ardi Twin-boom	+	fine	200	4.7	6.6	7.4	6.2	24.9	2.5	12.5	0.78	8.30
ardi Twin-boom	+	medium	400	14.0	11.9	16.9	17.5	60.3	4.0	15.1	0.94	5.03
ardi Twin-boom	+	medium	500	9.7	9.5	9.6	10.6	39.4	2.2	7.9	0.49	6.58
onventional	-	fine	200	23.6	18.7	21.2	17.5	81.0	2.3	40.1	2.51	17.43
onventional	-	medium	400	26.2	29.4	41.2	30.0	126.8	4.7	31.7	1.98	8.57
onventional	-	medium	500	26.1	24.6	25.8	18.1	94.6	3.4	18.9	1.18	7.88
russels Sprouts												
egania$	+	fine	100	2.3	1.9	1.9	1.8	7.9	3.8	7.9	0.49	2.82
egania$	+	fine	200	2.6	2.3	1.8	2.8	9.5	3.3	4.8	0.30	2.09
ardi Twin-boom	+	fine	200	6.5	4.1	2.4	2.6	15.6	1.5*	7.8	0.49	15.60
ardi Twin-boom	+	medium	400	6.3	6.5	5.9	4.8	23.5	1.8*	5.9	0.37	7.38
ardi Twin-boom	+	medium	500	5.6	4.6	4.8	3.1	18.1	1.0*	3.6	0.20	-
onventional	-	fine	200	10.6	13.9	14.0	9.0	47.5	2.0	23.8	1.49	23.80
onventional	-	medium	400	15.5	25.5	18.8	14.2	74.0	3.3	18.5	1.16	8.04
onventional	-	medium	500	18.4	15.9	16.9	17.5	68.7	2.5	13.7	0.86	9.13

Driftability = (µl total (4 masts, 4 passes) spray drift per 100 l/ha applied) divided by (wind speed metres/sec -1)
Boom at 25cm height above crop; * wind speeds less than ideal

Brussels sprouts:Drift in microlitres/mast/pass per 100l/ha sprayed

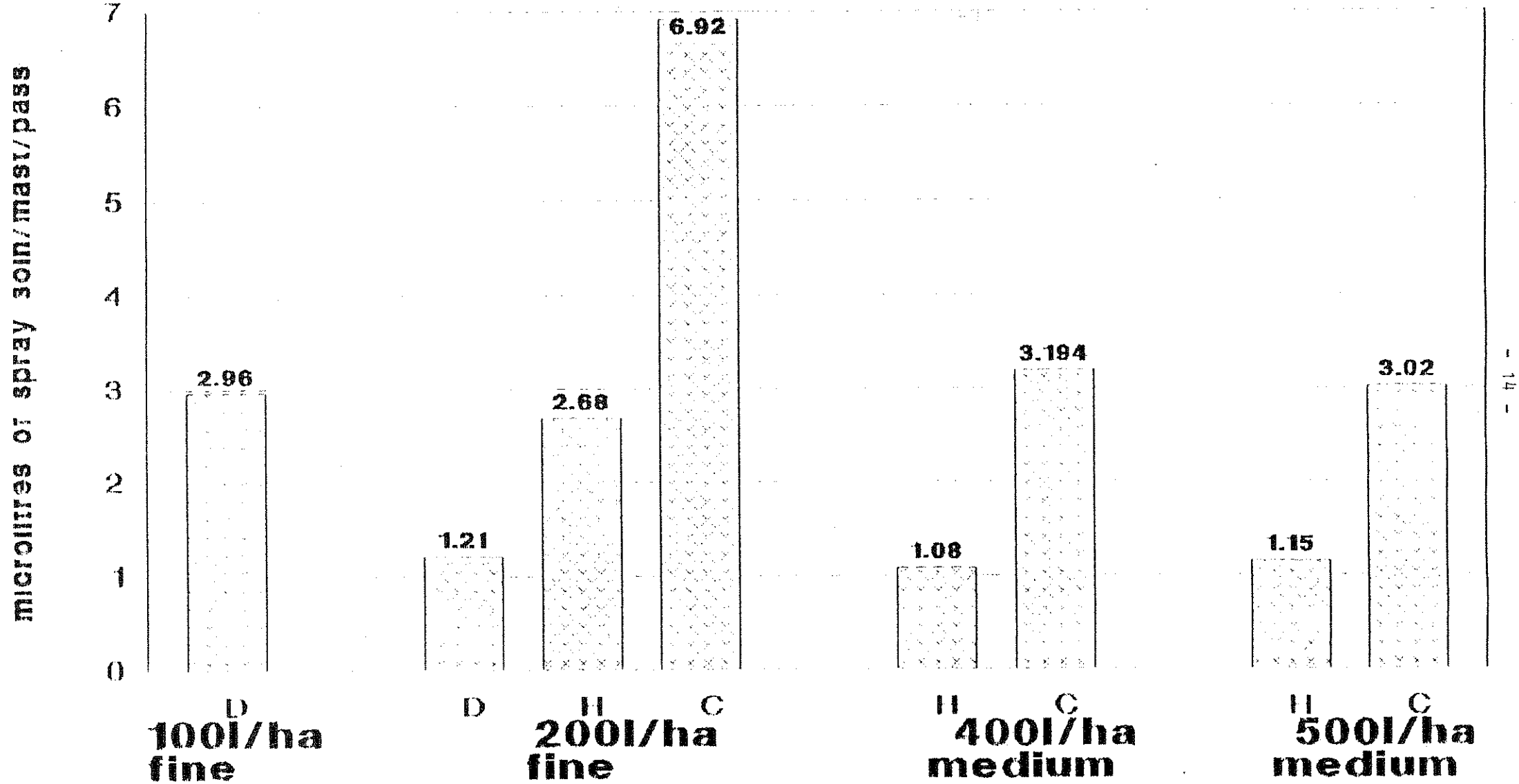
H - Hardi Twin-boom full air
C - Conventional no air D - Deganla full air



Lower boom height 25 cm in Brussels sprouts, compared with 50 cm all other treatments

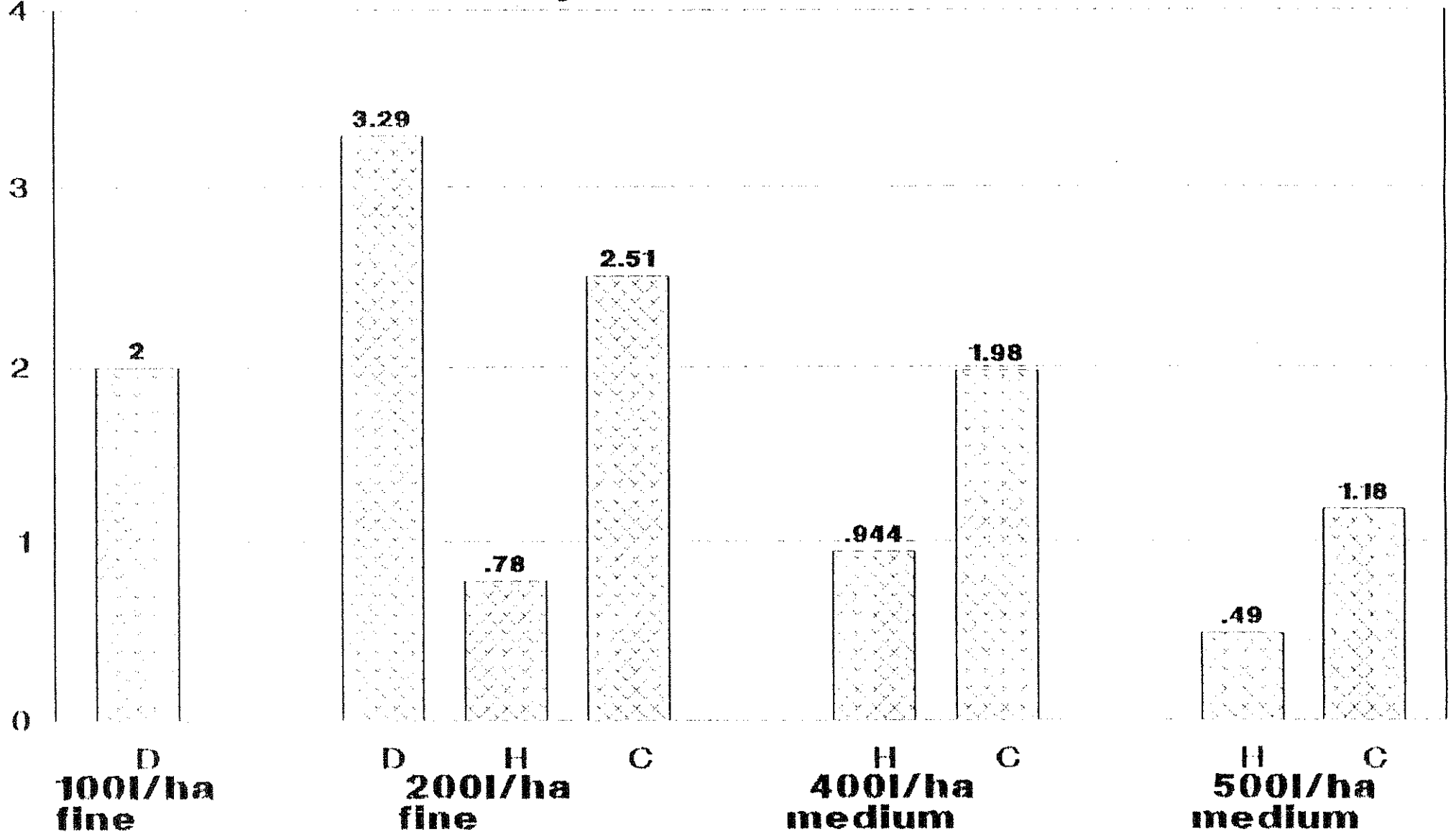
Leeks:Drift in microlitres/mast/pass per 100l/ha sprayed

H - Hardi Twin-boom full air
C - Conventional no air D - Deganla full air



Lettuce:Drift in microlitres/mast/pass per 100l/ha sprayed

H - Hardi Twin-boom full air
C - Conventional no air D - Degania full air



The values shown in Tables 3 and 4 are corrected for volume (100 l/ha) and therefore relate to the amount of pesticide which would be deposited and not spray droplet cover.

Table 3 - Spray deposit Brussels sprout buttons in µl (per 100 l/ha) for a 20 button sample; µl/g dry weight sprouts.

Sprayer	Air	Spray Quality	Volume Water	Button position	Dry weight 20 buttons (g)	Deposit µl per 100 l/ha	Deposit µl/g buttons per 100 l/ha
Degania*	+	fine	100	upper	8.221	4.0	0.49
				lower	14.754	3.0	0.20
Degania*	+	fine	200	upper	7.170	5.5	0.77
				lower	15.349	3.5	0.23
Hardi Twin-boom	+	fine	200	upper	7.512	7.5	1.0
				lower	17.222	12.0	0.7
Hardi Twin-boom	+	medium	400	upper	6.739	5.0	0.74
				lower	14.018	6.5	0.46
Conventional	-	fine	200	upper	6.290	4.0	0.64
				lower	11.670	2.0	0.17
Conventional	-	medium	400	upper	8.458	6.25	0.74
				lower	13.375	2.25	0.17

* Boom at 25cm height above crop

The reading for fluorescence of untreated sprout buttons was zero, so no adjustment was needed.

Table 4 - Spray deposit leeks in µl per 100 l/ha for a 10 leaf disc sample

Sprayer	Air	Spray Quality	Volume Water l/ha	Leaf Position	Deposit µl (per 100 l/ha)
Degania	+	fine	100	inner	1.45
				outer	1.40
Degania	+	fine	200	inner	2.15
				outer	2.60
Hardi Twin-boom	+	fine	200	inner	3.15
				outer	1.35
Hardi Twin-boom	+	medium	400	inner	0.99
				outer	0.80
Conventional	-	fine	200	inner	1.63
				outer	1.43
Conventional	-	medium	400	inner	1.15
				outer	0.86

Untreated leeks had a natural fluorescence and this background level was subtracted from the other readings.

RESULTS AND DISCUSSION:

The drift clouds over Brussels sprouts were sampled in error at a greater distance from the spray swath than that for the other two crops so comparisons between sprouts and the other two crops should not be made. However, relative values of treatments for each crop are similar (Table 2). At the end of the day on August 25, the wind speeds suddenly dropped for the Hardi Twin-boom treatments and were less than ideal. Data in Table 2 is also presented as a Histogram (Figure 1).

General trends are seen:-

Table 2 shows that drift was greater for fine spray droplets applied at 200 l/ha volume, than for medium spray droplets at 400 and 500 l/ha.

Both types of air assistance reduced drift but with one exception, the Degania at 200 l/ha over lettuce. This may have been because the mature Iceberg lettuce presented a closed solid surface and the spray, which emerges from small holes at greater speed than the Hardi Twin-boom, bounced off the target.

At 200 l/ha and fine spray quality a reduction in drift over Brussels sprouts of 67% (Hardi) and 80% (Degania at lower boom height, 25 cm above the top of the crop) could be expected with air assistance. Over leeks the drift reduction is 61% (Hardi) and 82% (Degania) and lettuce 69% (Hardi) but there is more drift with Degania.

When a correction factor is applied to take into account varying wind speeds (shown as Driftability (Table 2)) the trend is similar: over sprouts, 34% (Hardi), 88% (Degania); over leeks 54% (Hardi), 76% (Degania); over lettuce 52% (Hardi), 0% (Degania).

Biological effects are partly dependent on the dose transferred to the plant, its location and the form that spray takes once on the surface. In the latter context it is drop size, numbers and surface cover that are often cited. The data derived here (Tables 3 & 4) are relative quantities of a theoretical pesticide and its general location on the plant. This is only one of several factors that may affect product efficacy.

In sprouts (Table 3) air assistance deposited more chemical on the lower buttons than conventional sprays, particularly with the Hardi. More chemical in fine spray at 200 l/ha was deposited than with medium spray quality. Perhaps fine droplets are needed to penetrate and circulate in a tall dense crop.

In leeks (Table 4), with fine sprays at 100 l/ha more total chemical was deposited on inner and outer leaves with air assistance, but not with air assistance and the Hardi Twin-boom at 400 l/ha and medium sprays. Deposit values suggest that for this crop, with waxy upright leaves, fine deposits may be beneficial. Otherwise there was little difference in deposit on inner or outer leaves and no clear trends emerged. However the deposition data is limited. It should be noted that the Degania at 200 l/ha was producing smaller droplets than at 100 l/ha in contrast with the Hardi Twin-boom and Conventional which gave a fine spray at 200 l/ha and medium droplets at 400 l/ha.

CONCLUSIONS: Air assistance considerably reduced drift over Brussels sprouts, leeks and lettuce. Drop size, volume and air assistance interact and the general effect was similar to that observed in agricultural crops.

The exception for the Degania at 200 l/ha in mature Iceberg lettuce, where it is possible that higher speed droplets bounced off the dense closed surface, suggest that the operator should consider absorptive characteristics of the crop before adjusting the amount of air. However, Degania do not recommend the use of high volumes and 80/100 l/ha is the normal range.

It could be predicted that air assistance at higher wind speeds may produce less drift than conventional sprays at lower wind speeds. This would benefit the user by allowing more spray opportunities and thus optimising the application timing.

A further advantage of air assistance is that the total deposit on the target surface could be increased. In a dense sprout crop, air assistance could deposit more spray on lower buttons and lower leaves and perhaps achieve better control of certain diseases.

Contract between PGRO (hereinafter called the "Contractor") and the Horticultural Development Council (hereinafter called the "Council") for a research and development project.

1. TITLE OF PROJECT

Contract No: FV/72b
Contract Date: 17.9.93

AIR ASSISTED SPRAYERS; DRIFT AND SPRAY DEPOSITION STUDIES IN BRUSSELS SPROUTS, LEEKS AND LETTUCE

2. BACKGROUND AND COMMERCIAL OBJECTIVES

Reduction in spray drift would reduce risk of accidental operator and public exposure and also accidental spray damage. It would also allow more spray opportunities which could optimise control of pests, diseases and weeds.

The HSE have stated that it is for the user to demonstrate that spraying at higher wind speeds would not contravene requirements of COSHH or COPR.

The ability of air assisted sprayers to reduce spray drift is partially dependent on the crop surface over which it is applied. Reduction in drift has been demonstrated in cereals, sugar beet and faba beans but information is needed in other crops, such as Brussels sprouts, leeks and lettuce, which have very different canopy structures.

Such information could be used to demonstrate to the regulatory authorities that air assisted sprays could be safely used at higher wind speeds than specified in the Code of Practice for the Safe Use of Pesticides.

The use of air to direct sprays down into the crop canopy could also offer possibilities of improved spray deposition and better control of some pests and foliar diseases. This may be particularly useful in Brussels sprouts and possibly leeks.

3. POTENTIAL FINANCIAL BENEFITS FOR THE INDUSTRY

If it is shown that air resistance reduces drift when spraying certain vegetable crops the data could be used to demonstrate that spraying could be safely carried out at higher wind speeds than 4 mph. This would allow more spraying opportunities, and improved spray deposition would optimise control of pests, diseases and weeds.

4. SCIENTIFIC/TECHNICAL TARGET OF THE WORK

The aim of the investigation is to evaluate spray drift with and without the use of air assistance using a Degania sprayer with (cone nozzles) and a Hardi twin-boom sprayer (flat fan nozzles) in Brussels sprouts and leeks and lettuce at advanced stages of maturity when fungicides would normally be applied.

Spray deposition in Brussels sprouts, and if feasible, leeks will also be assessed.

The study will not include biological efficacy assessment and it is not a trial to compare the two sprayers.

5. CLOSELY RELATED WORK

Spray drift studies with air assisted sprayers have been undertaken by Silsoe College and Morley Research Centre in arable crops. Spray deposition in sprouts has been studied by LARS/HRI in 1987/88.

6. DESCRIPTION OF THE WORK

Crops: Brussels sprouts and leeks (drift and spray deposition)
Lettuce (drift only)

Growth Stage: Advanced, fungicide application timing. End August sprouts and lettuce, for leeks to be ascertained.

Sprayers:
(i) Degania, Hollow cone nozzles 25 cm spacing at 30° angle; height 20 cm above crop
(ii) Hardi twin boom + air, Hardi flat fan nozzles 50 cm spacing angle 30°; height 40-50 cm above crop
(iii) Conventional (Hardi, sleeve removed)

Sprays: Water + fluorescein dye

Treatments (drift studies: lettuce, Brussels sprouts & leeks

Sprayer	Speed km/h	Nozzle	Pressure bar	Spray Vol. l/ha
#1 Hardi twin + air	7.2	Hardi 411024 (med/fine)	8	600
#2 Degania	7.2	Albuz green (coarse)	8	600
#3 Conventional	7.2	Hardi 411024 (med/fine)	8	600
4 Hardi twin + air	7.2	Hardi 411014	5	200
5 Degania	7.2	Albuz yellow (med)	3	200
6 Conventional	7.2	Hardi 411014	5	200
# or 1 Hardi twin + air	7.2	Hardi 411024 (med)	4	400
2 Degania	7.2	Albuz red (med)	3.5	400
3 Conventional	7.2	Hardi 411024 (med)	4	400

Four passes of tractor (2 in one direction and 2 in opposite direction).

End of boom 5 m from masts, which are placed down wind of sprayer, pipe cleaners at 0.5 m in intervals at 7 positions per mast. Wind speed measured for each pass.

Area required and crop lost: 20 m x 100 m per crop. Use same area for all treatments.

Treatments spray deposition; Brussels sprouts and leeks on separate area

Treatments to include 5,6 & 7 untreated. One plot for each treatment. Plot size ½ boom width x 20m.

Samples of upper and lower sprout buttons on two sides of plant (4) at 4 positions per plot.

Samples of upper and lower leaves leeks (2) at 4 positions per plot. Sampling technique circular portions of leaves removed with a punch.

Area required per crop (sprouts and leeks) : 4 x 6 x 20 m.

Analysis of samples in coded containers to be carried out by Hardi (codes unknown to Hardi).

Drift studies: 6 samples (leek)
6 samples (Brussels sprouts)
6 samples (lettuce)

Deposition studies: 4 x 4 x 4 samples (including untreated) sprouts
4 x 2 x 4 samples (including untreated) leeks

Total: 114 samples analysed

7. COMMENCEMENT DATE AND DURATION

Start date 01.09.93; duration 4 months.
A final report will be produced by 31.12.93.

8. STAFF RESPONSIBILITIES

Project Leader:	C M Knott, PGRO
Project Co-ordinators	A Whitlock
	P Shepherd

9. LOCATION

In commercial crops in South Lincolnshire.

Contract No: FV/72B

TERMS AND CONDITIONS

The Council's standard terms and conditions of contract shall apply.

Signed for the Contractor(s)

Signature.....

Position.....DIRECTOR.....

Date.....28/9/93.....

Signed for the Contractor(s)

Signature.....

Position.....

Date.....

Signed for the Council

Signature.....

Position.....CHIEF EXECUTIVE.....

Date.....17.9.93.....