AN AURAL AID TO GOVERN WALKING SPEED

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Summary A simple, lightweight, low cost audible timer has been developed to aid accurate pacing when using CDA hand carried sprayers.

INTRODUCTION

When pesticide application equipment is carried by a human operator the application rate is affected by walking speed. To assist in keeping a consistent walking speed a unit designed to give an audible signal at a fixed time interval has been designed.

The unit is very compact, light and easily carried in the breast pocket. It gives an audible signal at intervals of 1 second to which the operator can regulate his pace while spraying. Units with other time intervals have been produced but for adjustable time intervals a slightly larger model with more components can be made.

One pace of 0.5 metres per second will give a walking speed of 1.8 kilometres per hour.

Circuit

The unit consists of a unijunction relaxation oscillator and power source (9 volt PP3 battery) assembled as shown in fig. 1 inside a small aluminium box (8.5 x 3.0 x 2.7 cm). A single miniature jack socket (3.5 mm) is provided to connect an earpiece of a crystal type of approximately eight ohms impedance. No switch is needed, as when the earpiece is removed the only component connected across the battery is the capacitor. This should be a low leakage tantalum bead type which draws virtually no current. Within certain limits a longer time interval may be obtained by increasing R_1 or C, and vice-versa. If necessary a variable resistance can be used depending on the preferred walking speed and the length of each step.

The unit does not seem to be affected by temperature and is largely independent of battery voltage down to about 5 volts at which point the clicks become faint and erratic. Battery life should be about 60 hours of intermittent use.

Discussion

This unit should largely eliminate one of the causes of uneven application of pesticide when the operator walks whilst spraying.

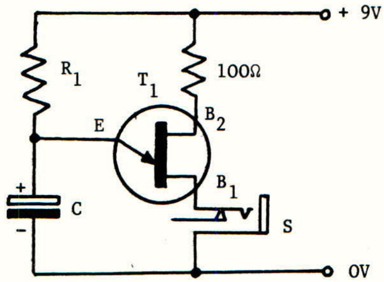
Appendix. Some useful information is listed below.

$$\text{Sprayer output in ml/sec} = \frac{\text{Walking speed (metres/min.)} \times \text{Rate (litres/ha)} \times \text{Swath (metres)}}{600}$$

$$\text{Walking speed (metres/min.)} = \frac{\text{Sprayer output ml/s} \times 600}{\text{Application rate (litres/ha)} \times \text{Swath (metres)}}$$

100 metres = approx. 110 marching paces.

Fig. 1.



T_1 = TIS43 or similar (2N2646 etc.)

S = earphone socket

C = 2.2μF/16 Volt (tantalum)

R_1 = 330kΩ (for 1s)

(R_1 = 150kΩ for ½s)

The total cost of parts is under £2 including VAT

MODIFICATIONS IN KNAPSACK MISTBLOWER DESIGN TO IMPROVE SPRAY EFFICIENCY ON TALL TREE CROPS

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Summary The design of a mistblower unit with the fan discharging vertically upwards through smooth bored hose to a rotary atomiser is described. Improvements were obtained in vertical throw and control over droplet size. In combination with increased air volume output these modifications can produce significant improvements in the spraying of tall tree crops.

INTRODUCTION

A sprayer capable of projecting droplets into the canopy of tall trees such as coconuts, oil palm, cocoa and rubber is needed especially on small plantations and in inaccessible parts of larger plantations. At present knapsack mistblowers are used, but few of these have a vertical throw greater than 8-9 metres (Clayphon, 1971). Poor vertical throw is attributed mainly to loss of efficiency when the air from the fan is ducted through two right angled bends. Also mistblowers with air shear nozzles often produce a wide spectrum of droplet sizes, especially at high flow rates and these can cause contamination by both fall-out and drift. Matthews (1975) suggested that vertical throw could be improved by rearranging the fan to deliver air directly upwards. The performance of a sprayer with this modification of the fan unit and designed to produce small droplets is described in this paper.

METHOD AND MATERIALS

A JLO L77 series two stroke engine and fan unit with a lighting coil in its magneto was modified by adding a new carburettor with butterfly choke to allow the fan to discharge vertically (Fig. 1). Smooth bore plastic hose with an integral reinforcing spiral was attached to the fan outlet instead of using corrugated hose.

Instead of an air shear nozzle, a centrifugal energy nozzle, the mini-ULVA†, was mounted in the airstream (Fig. 2) (Clayphon and Thornhill, 1974). This compact nozzle produces droplets within a narrow range of sizes (Johnstone and Johnstone, 1976). The mini-ULVA was adapted by replacing the flow restrictor housing by a hypodermic needle laid in the fluid channel cut in the motor housing.

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†From Micron Sprayers Ltd., Three Hills, Bromyard, Herefordshire.

Fig. 2. Nozzle assembly at outlet.

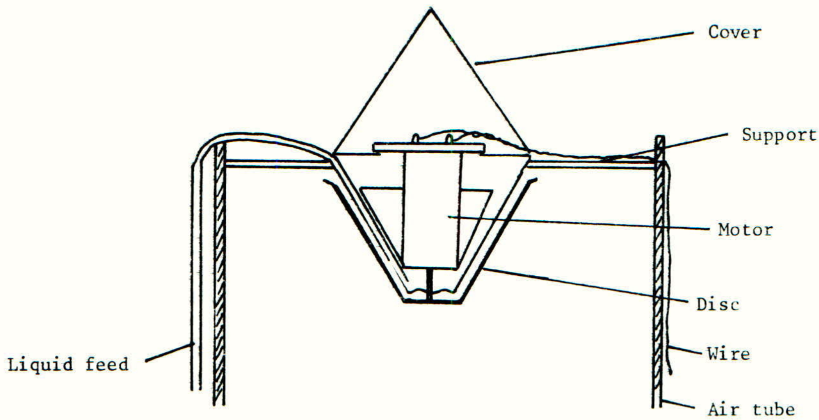
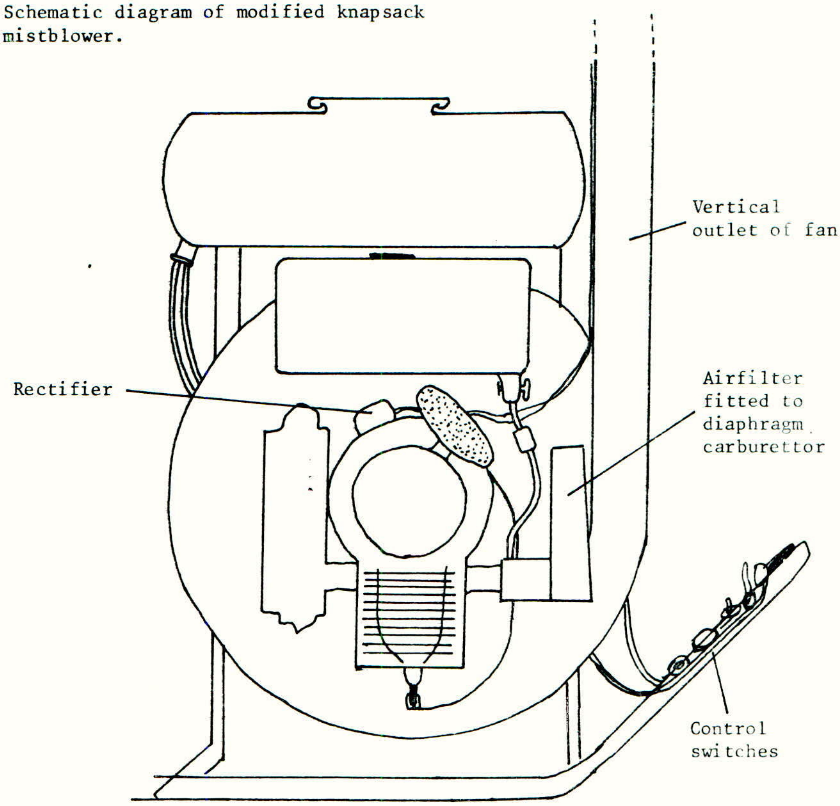


Fig. 1. Schematic diagram of modified knapsack mistblower.



The electric motor was powered by rectifying the 8 volt AC output of the lighting coil to 12 V DC at the operational speed of the engine (Fig. 3). The electric circuit included a potentiometer to vary the voltage and thus change the spinning disc speed.

A centrifugal pump fitted directly to the engine crankshaft pumped liquid to the nozzle and provided hydraulic agitation in the spray tank. The controls for the nozzle and engine were located on an aluminium arm clamped to the base of the knapsack frame and extending along the right side and to the front of the operator.

Air volume emitted by the experimental machine and a standard Fontan R12 mist-blower were measured with a Platon Gap meter. The sprayer was tested with a mixture of 36% oil* and water in which saturn yellow fluorescent pigment was suspended in the proportion of 7%. The liquid was fed at 10 ml/min. The droplets produced by different disc speeds were collected for measurement on magnesium oxide coated slides held for 5 seconds in the spray but with the nozzle out of the airstream. Disc speed was checked with an optical tachometer.

The vertical throw of the unit was determined by examining 12 leaves taken at random from each of five different levels up a sycamore tree after spraying for 15 secs. The relative cover of droplets on leaves was estimated in a darkened room under UV light (Morton, 1977).

RESULTS

The efficiency of the straight pipe and the smooth bore flexible hose enabled the experimental unit to produce a similar nozzle output to that of the FONTAN R12, regardless of the latter's higher engine speed and fan output (Table 1). Further improvements might be obtained by redesigning the shape of the experimental nozzle. The narrow spectrum of droplets could be varied from 45-60 μm VMD (Table 2). Changes in liquid viscosity and flow rate would also affect droplet size (Bals, 1970; Johnstone, Huntington and King, 1973) but the small droplets produced were readily projected to a height of at least 14 m (Table 3). This was confirmed by climbing the tree at night with a UV lamp when many leaves around this height were seen with spray deposits. Coverage was very good at and below 13 m.

Table 1

Air flow measurements of the experimental unit and the Fontan R12

Point of measurement	Experimental unit			Fontan R12		
	Engine speed rpm	Air vol. m^3/min	cumm. red. in air vol. m^3/mm	Engine speed rpm	Air vol. m^3/min	cumm. red. in air vol. m^3/mm
Fan Outlet	4,600	12.5	-	5,400	14.2	-
Elbow	-	-	-	5,500	13.9	0.3
Flexible hose	4,900	12.0	0.5	5,600	12.5	1.7
Plastic pipe	4,800	11.9	0.6	5,700	12.3	1.9
Nozzle	4,600	9.3	3.2	6,300	9.6	4.6

*ULVAPRON - provided by B.P. Trading Ltd.,

Table 2

Droplet sizes at different potentiometer settings

Potentiometer reading	Voltage	Disc speed R.P.M.	V.M.D.	Ratio VMD:NMD
10	12	14,500	45	1:1.12
7	11	13,000	51	1:1.23
2	10	11,900	56	1:1.12
0	9.8	11,800	59	1:1.19

Table 3

Coverage units assessed by Morton's (1977) method at different heights up a tree

Height (m)	4.8	7.7	11.5	13.0	14.2
Upper surface	13.8	11.25	7.0	2.7	0.2
Lower surface	20.25	7.13	2.17	0.4	0.08

CONCLUSIONS

The modifications made to a knapsack mistblower not only improved the performance in relation to droplet size but also significantly increased its vertical throw. These factors combined with a potential increase in air volume, produced by a redesigned nozzle and higher fan output, could considerably improve the penetration of a tree canopy. For as Randall (1971) pointed out air volume as opposed to air velocity is important when spraying tree crops so that the air within the canopy is replaced by air laden with droplets. The opportunity to increase the protection of oil palms over 5 years old (Wood, 1976) is just one example where the use of a modified mistblower requires field evaluation. Instead of the electrically driven disc, a propellor driven disc could be used provided a speed of over 13,000 rpm is achieved.

Note: This paper formed part of studies by R. Macfarlane submitted as a thesis for an M.Sc at University of London.

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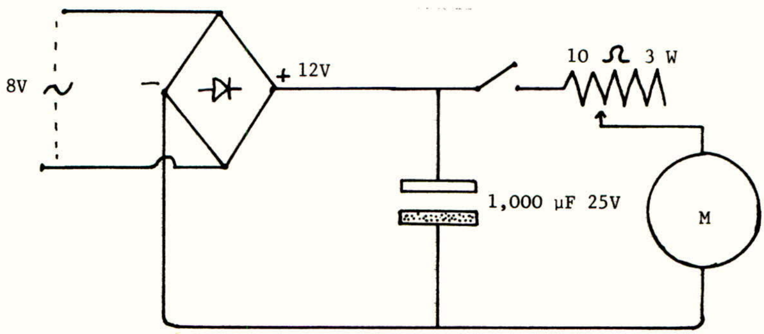

Fig. 3. Circuit diagram of the rectifier and potentiometer circuit

A COMPARISON OF CONTROLLED DROP AND CONVENTIONAL APPLICATION OF THREE SOIL-APPLIED HERBICIDES TO AN ORGANIC SOIL

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Summary Linuron, chlorpropham and simazine, each at two sub-lethal doses, were used for pre-emergence weed control on an organic soil. Each dose was applied in six volumes of spray liquid up to 640 l/ha. The two lowest volume rates, 20 and 40 l/ha, were applied using a controlled drop applicator, the others, 80, 160, 320 and 640 l/ha, were applied with conventional hydraulic nozzles.

The reduction in the overall weed populations and of *Matricaria matricarioides* by all herbicides was similar for controlled drop and the higher conventional volume applications. There were also no differences between volume rates for linuron and chlorpropham on *Polygonum lapathifolium* and linuron on *Chenopodium album*. Only with the remaining comparisons did the method of application affect the performance of the herbicides. Chlorpropham and simazine were less effective on *C. album* when sprayed with a controlled drop applicator and simazine tended to be more effective against *P. lapathifolium* at the lower volumes.

INTRODUCTION

The three main advantages of controlled drop application (CDA) compared to conventional hydraulic applications are an even spray deposit on the target's surface, reduced susceptibility to drift and a lower water requirement (Bals, 1975; Farmery, 1975; Taylor and Merritt, 1975). However most of the work on weed control with CDA has been with foliar-applied herbicides. The advantages of CDA are equally appropriate to soil-applied as they are to foliar-applied herbicides. Many soil-applied herbicides are used in the various crops grown on organic soils. Their timing is often critical because the interval between sowing and emergence can be short compared to that occurring on mineral soils. The risk of drift onto neighbouring valuable crops is further increased in open areas such as the Fens of Eastern England. CDA may help to both reduce drift and make best use of time when conditions are good. The decreased volume of water necessary for CDA may be further exploited by a reduction in the weight of the applicator which could allow spraying to be done when soil conditions do not allow the use of a heavy, conventional sprayer. CDA also offers the possibility of lightweight sprayer/drill combinations.

Work on mineral soils reported by Barzee and Stroube (1972) and Lerch (1974) suggest that very low volumes and controlled drop applications can be as effective as conventional medium volume sprays for soil-applied herbicides. They also suggested that wettable powder formulations would not be suitable for such applications. No work has been done on organic soils. The experiment described here investigated the effect of varying volume rates and the possibility of using CDA for liquid formulations of three soil-applied herbicides to an organic soil.

METHOD AND MATERIALS

The experiment was at the Arthur Rickwood Experimental Husbandry Farm, Mepal, Cambridgeshire on a 26% organic matter soil, pH 6.1. The design was a randomised block replicated three times with a plot size of 6 by 2.5 m. The following treatments were used: linuron (20% w/v e.c.) at 1.12 and 2.24 kg a.i./ha, chlorpropham (40% w/v e.c.) at 1.5 and 3.0 kg a.i./ha and simazine (50% w/v flowable suspension concentrate) at 2.0 and 4.0 kg a.i./ha. These were each applied in water at six volume rates: 20, 40, 80, 160, 320 and 640 l/ha. The two lower volumes were applied with the CDA sprayer described by Hind (1978) and the others with an Oxford Precision Sprayer. All treatments were fully randomised with eight untreated controls per replicate.

All controlled drop applications used a disc speed of 1700 rev/min which produced a 250 µm diameter drop size. Flow rates of the chemicals onto the disc and the speed of the sprayer were varied to give the desired volume rate for each treatment.

The higher volume rates were applied at a pressure of two bar using an Oxford Precision Sprayer fitted with four flat fan nozzles 0.5 m apart spraying a 2 m swathe. Different "Spraying Systems Teejets" were used for each volume rate: 650067 for 80 l/ha, 6501 for 160 l/ha, 6503 for 320 l/ha and 6506 for 640 l/ha. Walking speeds varied between 1.0 and 1.4 m/s.

Treatments were applied in the early morning of 1 June 77 to a freshly cultivated fine seedbed. Air temperatures ranged from 12°C at 05.00 hours to 16°C at 10.00 hours (start and finish). Wind speeds increased from nil at the start to 2.2 m/s by 10.00 hours.

Weeds were counted on 12 July 77 using ten 0.25 by 0.25 m random quadrats per plot. The major weeds, *Polygonum lapathifolium*, *Chenopodium album* and *Matricaria matricarioides* and the overall number of weeds were recorded.

RESULTS

The three major species accounted for 84% of the total population. Growth stages when assessed varied from emergence to 20 cm high but the average height most weeds was 15 cm. The weed counts were analysed as logarithmic transforma

Table 1 gives the total number of weeds per square metre and numbers of *P. lapathifolium*, *C. album* and *M. matricarioides*, for the different spray volumes of each herbicide (meaned for the two rates). There was no statistical difference between the relative weed control activity of the two doses at the six different volume rates and they are meaned for simplicity of presentation and comparison. The major comparisons in this experiment were between the controlled drop (20 and 40 l/ha) and conventional applications (80, 160, 320 and 640 l/ha).

Linuron

At all volume rates linuron significantly reduced the overall weed population but at 80 l/ha applied conventionally it gave poorer weed control than CDA at 20 l/ha and conventional at 320 l/ha. The numbers of *C. album* were also reduced at all volume rates but conventional spraying at 80 l/ha gave poorer control than all the other volumes. Numbers of *P. lapathifolium* and *M. matricarioides* were not significantly reduced.

Chlorpropham

All volume rates significantly reduced the overall weed population and the numbers of *P. lapathifolium* but there were no significant differences between volume rates. C. album was only controlled by 20, 160 and 320 l/ha and the reduction in numbers was greatest at the medium volume rates (160 and 320 l/ha). Only 160 l/ha gave a significant difference from the control for M. matricarioides yet there was no statistically significant differences between volume rates.

Simazine

C. album, M. matricarioides and total weed numbers were significantly reduced by all volume rates. Overall weed control was better at 320 and 640 l/ha than at 80 l/ha but the CDA applications of 20 and 40 l/ha were as good as the highest conventional volume applied. However, C. album was controlled better by 320 and 640 l/ha than 20 l/ha. P. lapathifolium was controlled better at 20 than at 80 l/ha. There were no significant differences between volume rates in the control of M. matricarioides.

DISCUSSION

The use of sub-optimal herbicide doses meant that overall weed control was poor but they did enable minor variations in weed control activity to be monitored and comparisons made between application volumes. The main object of the experiment was to see if controlled drop applications could be used for soil-applied herbicides on organic soils. The results of this experiment suggest that agronomically at least they are a reasonable proposition. Linuron gave its poorest control when applied at 80 l/ha but otherwise there were no differences between volume rates. This suggests that linuron can be satisfactorily applied by CDA but that low volume applications by conventional sprayers may result in some loss of weed control activity. This lower activity of the 80 l/ha volume rate cannot be adequately explained but could be caused by poor distribution of the small drops produced by the 650067 teejet. These drops appeared susceptible to drifting by wind speeds greater than 1.1 or 1.4 m/s.

The good control of P. lapathifolium by simazine applied at 20 l/ha and the poor control of C. album by simazine and chlorpropham applied at 20 and 40 l/ha suggest that controlled drop applications may sometimes vary in their effects between species. While CDA gave general weed control similar to conventional sprays with these three soil-applied herbicides on organic soils the subject is complex and too many general conclusions must not be tendered. More work is required (some is in progress at WRO) identifying and quantifying redistribution of the herbicide after reaching the soil surface. The degree of redistribution necessary to achieve the desired biological result may also be related to the root growth of the developing target plant and both these aspects will be actively pursued.

Acknowledgements

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Table 1

Number of live weeds per square metre for the different spray volumes of each herbicide (meaned for the two doses)

HERBICIDE	VOLUME RATE l/ha	TOTAL WEEDS x	TOTAL WEEDS log (10x)	POLYGONUM LAPATHIFOLIUM x	POLYGONUM LAPATHIFOLIUM log(10x)	CHENOPODIUM ALBUM x	CHENOPODIUM ALBUM log(10x)	MATRICARIA MATRICARIOIDES x	MATRICARIA MATRICARIOIDES log(10x)
LINURON	20	312	2.45	84	1.70	141	2.11	44	1.51
	40	368	2.52	87	1.80	190	2.19	47	1.63
	80	466	2.64	113	1.92	251	2.39	44	1.52
	160	335	2.51	75	1.65	161	2.20	52	1.63
	320	331	2.49	95	1.78	140	2.14	60	1.71
	640	413	2.58	155	1.86	139	2.13	71	1.72
CHLORPROPHAM	20	410	2.61	46	1.44	262	2.40	42	1.54
	40	409	2.60	27	1.36	294	2.46	37	1.52
	80	410	2.60	39	1.54	282	2.44	46	1.57
	160	326	2.50	54	1.55	200	2.28	31	1.34
	320	392	2.59	57	1.56	205	2.22	49	1.65
	640	481	2.67	50	1.50	329	2.50	50	1.67
SIMAZINE	20	232	2.35	57	1.51	145	2.15	4	0.46
	40	249	2.36	88	1.64	125	2.04	9	0.54
	80	292	2.45	112	1.89	137	2.10	6	0.62
	160	239	2.35	90	1.77	117	2.07	2	0.30
	320	181	2.22	58	1.54	93	1.94	2	0.33
	640	205	2.28	72	1.76	97	1.96	4	0.50
*S.E.			± 0.049		± 0.132		± 0.065		± 0.127
CONTROL		543	2.72	106	1.79	316	2.47	57	1.68
*S.E.			± 0.024		± 0.066		± 0.032		± 0.064

* Standard errors for logarithmic transformed data only.

THE INFLUENCE OF APPLICATION METHOD ON THE CONTROL OF WILD-OATS (AVENA FATUA L. AND AVENA LUDOVICIANA DUR.) IN WINTER WHEAT BY DIFENZOQUAT APPLIED AT A RANGE OF GROWTH STAGES

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Summary Controlled drop and conventional applications of difenzoquat at 1.0 kg a.i./ha and one half of this rate were made to four winter wheat crops, containing wild-oats, over two seasons. Applications at 15, 30, 45 and 225 l/ha were made when the crop had 3 to 4 leaves and 1 to 2 tillers, and at the pseudostem erect stage. When the crop had two nodes applications at 30 and 225 l/ha only were made. Applications at 225 l/ha were more consistent than controlled drop applications but not always significantly so. Evidence suggests that control may be marginally inferior at later application dates perhaps due to a failure to penetrate crop canopy.

The method of application of difenzoquat had no significant effect on wheat yields assessed on three experiments.

INTRODUCTION

The principle of controlled drop application of herbicides for the control of wild-oats in spring cereals is now firmly established. Early work demonstrated that both tri-allate and barban could be applied by this method with no major loss of efficacy (Taylor & Merritt, 1974). However, more recently further work on the control of A. fatua by controlled drop applications of difenzoquat has been carried out at the ARC Weed Research Organization in which good results in 1975 (Wilson & Taylor pers. comm) contrasted markedly with that obtained in 1976 (Wilson, 1976). Although wild-oat control was not considered poor it was consistently lower than that achieved at 225 l/ha and the results may have been influenced by climatic factors which also contrasted in the spring of each year (Cussans & Taylor, 1976).

The response of difenzoquat to surfactant levels is also of interest. The concentrations of surfactant are believed to be critical and this is reflected in the commercial recommendations, where the wetting agent is supplied separately and is mixed at a constant proportion, 0.5%, of the spray solution. There is, therefore, possible scope for economy with the lower volume rates used in controlled drop applications. Thus difenzoquat is a specially interesting compound to study particularly in winter wheat where it may be applied at a wide range of crop growth stages.

This paper describes four experiments, carried out between 1975 and 1977, designed to study the performance of controlled drop applications of difenzoquat against wild-oats at several different crop growth stages.

METHODS AND MATERIALS

Two experiments were set up in autumn 1975 and two more in autumn 1976 in winter wheat. The experiments were of a randomised block design containing three replicates. In 1975 the plots were 3 x 10 m and in 1976 3 x 9 m each.

Table 1 gives the experimental details. The cereal growth stages referred to in these experiments are those described by Zadoks, Chang and Konzak (1974).

The difenzoquat was applied at the field recommended rate of 1.0 kg a.i./ha and also at one half of this rate. In both years the aqueous concentrate was used for all treatments and 'Agral', a non-ionic surfactant was included in the spray solution at 0.5% v/v.

Conventional applications were made using a propane or carbon dioxide pressure sprayer fitted to a hand held 3 m boom. The herbicide was sprayed at a total volume rate of 225 l/ha using Spraying Systems 6502 'Tee-jets' at a pressure of 2.07 bar and walking at 1 m/s.

In 1975/76 the controlled drop treatments were applied using the machine described by Ayres (1976) with the exception that 3 units were used to cover the plot width of 3 m. The units (Farmery, 1975) embodied two spinning discs of the type described by Bals (1975). Volume rates were achieved by calibrating the flow rate of the herbicide to the units and then adjusting the forward walking speed. The volume rates and relative walking speeds were 15 l/ha (0.9 m/s), 30 l/ha (0.5 m/s) and 45 l/ha (0.3 m/s).

Applications in 1977 were made with a new machine which had units that incorporated three spinning discs. A description of the machine, built by WRO, ADAS and Cropsafe Ltd, is in preparation. The new machine enabled both flow rate and disc speed to be monitored accurately. A single controlled drop application volume rate of 30 l/ha was used in these two experiments and a walking speed of 0.7 m/s.

In both years all controlled drop application treatments were applied using uniform drops 225 µm in diameter.

Assessments

At each site, before the first treatments were applied, densities of wheat and wild-oats were determined using a number of random quadrats (0.1 m^2). The range of wild-oat growth stages together with seedling emergence was assessed on the control plots either at monthly intervals (Drayton and Hinton) or at each application date (Chislehampton and Cornwell). According to wild-oat density six or twelve fixed quadrats were set up at each site and different coloured rings used to identify the seedlings or plants counted on each occasion. At Drayton the wild-oat population comprised both *A. fatua* and *A ludoviciana* whereas at the other three sites only *A. fatua* was present.

A photographic record and a subjective assessment of crop cover was made before each application at Chislehampton and Cornwell.

In July the wild-oat panicles were assessed when fully open but before seed shedding commenced. All panicles were counted in six areas of 2 x 0.5 m, selected at random, on each plot. The number of seeds on each panicle was determined from a random sample of 30 panicles per plot. From this data estimates of the total seed produced per m^2 were derived.

Wheat yields were obtained at Hinton, Chislehampton and Cornwell by cutting a

Table 1

Variety, crop population and details of crop growth stage, numbers of wild-oats and weather conditions at each application at each site

Sites	Variety	Crop population/m^2	Application date	Crop growth stage	Wild-oat seedlings/m^2	Wind speed m/s	Temp °C	RH %
Drayton EHF	Maris Huntsman	221	4 December 1975	3 main stem leaves unfolded, 1 tiller	10.5	2-3.5	9.0	82
Hinton-in-the Hedges	Atou	214	5 December 1975	3 main stem leaves unfolded, 1 tiller	13.4	2.0	8.5	93
			16 April 1976	Pseudostem erect up to 6 tillers	22.1	2.0	10.0	53
Chislehampton	Flinor	183	24 March 1977	4 main stem leaves unfolded, 1-2 tillers	5.2	2.0	10.0	70
			18 April 1977	Pseudostem erect up to 6 tillers	8.3	2.0	8.5	63
			19 May 1977	2 nodes detectable	12.0	2.0	7.5	75
Cornwell	Maris Freeman	123	25 March 1977	3 main stem leaves unfolded, 1 tiller	15.7	2.5	8.0	81
			4 May 1977	4-5 main stem leaves unfolded, up to 5-6 tillers	21.3	2-3.5	9.5	81
			27 May 1977	2 nodes detectable	29.8	2.0	20.0	66

single swath of 1.5 m from the centre of each plot with a small plot combine harvester. The ends of the plots were first removed as discards. The grain from each plot was weighed and from this a sample of approximately 1 kg was taken, dried and re-weighed. A sub-sample ($\approx$ 300 g) was taken from this sample cleaned and sieved to remove wild-oat seeds, trash and grain $<$ 2.0 mm. From this data the yield of clean grain $>$ 2.0 mm at 85% d.m. was determined.

RESULTS

Control of wild-oats

The wild-oat control measured at the four sites may be seen in Table 2: the results are reported separately for treatments applied at each crop growth stage.

a. 3-4 main stem leaves, 1-2 tillers

At all four sites there was no significant difference statistically in wild-oat control in terms of seed production/m^2 between any volume or dose rate although the differences were sometimes large. The only exception was at Chislehampton where 30 l/ha was significantly better than 225 l/ha at the lower rate of difenzoquat. At Chislehampton and Cornwell the proportion of the total wild-oat population that had not emerged at spraying, 56% and 47% respectively, is reflected in the relatively poor control obtained compared with that achieved at Drayton and Hinton where only 39% and 21% had not emerged.

b. Pseudostem erect, up to 6 tillers

At Hinton, control at 30 l/ha from the higher rate of difenzoquat was as good as 225 l/ha. However, the performance from both rates of difenzoquat applied at 15 and 45 l/ha and of the lower rate at 30 l/ha was significantly poorer than that from 225 l/ha although they all achieved more than 92% control of wild-oat seeds. (Table 4). There was no significant difference between the half and the full rate of difenzoquat at 15 and 45 l/ha but at 30 and 225 l/ha the full rate was significantly better than the half rate. At Chislehampton levels of wild-oat control from the full rate of difenzoquat were high from both controlled drop and conventional applications with no significant difference between volume rates. Conversely at Cornwell, where in general lower levels of control were achieved, 30 l/ha was significantly poorer than 225 l/ha but only at the full rate of difenzoquat.

At Drayton rain fell within 1 hour of spraying and no data has been presented. as there was little or no effect of herbicide on the wild-oats.

c. 2 nodes detectable

There was no significant difference at Cornwell between volume rates at either dose level. However at Chislehampton 30 l/ha was significantly poorer than 225 l/ha at both the half and full rate of difenzoquat.

Effects on yields

Yield response at the three sites (Table 3) where a harvest assessment was made tended to vary with the degree of wild-oat control achieved. However there were no significant differences at any site between treatments or between herbicide treatments and the unsprayed control.

Table 2

Influence of volume rate on numbers of wild-oat seeds formed/m^2

Site		Drayton		Hinton-in-the-Hedges		Chislehampton		Cornwell	
Dose (kg a.i./ha)		0.5	1.0	0.5	1.0	0.5	1.0	0.5	1.0
Crop growth stage	Vol rate (l/ha)								
3-4 main stem leaves unfolded, 1-2 tillers	15	139(2.89)	124(2.72)	461(3.66)	649(3.76)				
	30	117(2.77)	42(2.49)	319(3.49)	264(3.41)	721(3.80)	1372(4.12)	3379(4.52)	3085(4.49)
	45	372(2.81)	71(1.87)	546(3.63)	299(3.46)				
	225	22(1.68)	76(2.77)	348(3.30)	318(3.47)	2019(4.25)	830(3.91)	2871(4.45)	2371(4.33)
Pseudostem erect	15			125(2.99)*	132(3.04)*				
	30			327(3.50)	8(0.79)*	421(3.61)	154(3.13)	1577(4.13)	774(3.88)*
	45			348(3.52)*	62(2.68)*				
	225			17(2.18)	3(0.67)	721(3.82)	162(3.10)	3289(4.47)	522(3.20)
2 nodes detectable	30					780(3.71)*	449(3.58)*	800(3.85)	197(3.27)
	225					24(2.27)	124(2.81)	319(3.50)	313(3.32)
Unsprayed control		2742(3.94)		4619(4.57)		5976(4.74)		7457(4.84)	
SE for comparisons between vol rates		(0.383)		(0.300)		(0.145)		(0.192)	

* Control significantly poorer (p = 0.05) than conventional volume rates

Logarithmically transformed values in parentheses. Drayton and Hinton-in-the-Hedges (Log._{10} 10x + 1)
Chislehampton and Cornwell (Log._{10} 10x)

Table 3

Yield response of wheat (clean grain >2.00 m) and 85% d.m. in the t/ha

Site		Hinton-in-the Hedges		Chislehampton		Cornwell	
Dose (kg a.i./ha)		0.5	1.0	0.5	1.0	0.5	1.0
Crop growth stage	Vol rate (l/ha)						
3-4 main stem leaves unfolded 1-2 tillers	15	5.69	5.68				
	30	5.63	5.46	5.02	4.46	4.62	5.08
	45	5.86	5.73				
	225	5.50	5.33	4.99	4.91	5.58	5.25
Pseudostem erect	15	5.70	5.80				
	30	5.47	5.73	4.71	4.99	5.45	5.39
	45	5.68	5.58				
	225	5.97	5.75	5.24	5.73	4.80	5.11
2 nodes detectable	30			4.95	5.35	4.49	4.70
	225			5.04	5.35	5.31	4.80
Unsprayed control		5.35		5.21		4.59	
SE for comparison between vol rates		0.200		0.412		0.354	

DISCUSSION

Because of the nature of the original data, as presented in Table 3, the statistical analysis was made on logarithmically transformed data. The parameter measured, wild-oat seeds/m^2 was derived from panicle numbers and mean seeds/panicle. As seeds/panicle were broadly similar for each herbicide treatment the accuracy of the final assessment was largely dependant on the panicle numbers. However variations in panicle numbers are reflected in fairly high standard errors with the result that large differences in seeds/m^2 between treatments were not always statistically significant.

The performance of difenzoquat at the full rate was generally good with wild-oat control only falling below 89% for some applications made when the crop had 3-4 mainstem leaves and 1-2 tillers. (Table 4). However the end-result was affected by the protracted emergence of wild-oat seedlings and the degree of natural mortality. In addition, the other significant factors to be considered when interpreting these results are crop population and the increase in crop canopy. These differed between sites for example at Chislehampton the population was high and the canopy dense, whereas at Cornwell the reverse was true. Therefore comparisons particularly those where a high degree of wild-oat control was achieved are sometimes difficult to interpret.

Data from the 1975/6 experiments was limited to two growth stages. At both sites the tendency was for better control with 30 and 225 l/ha than with 15 or 45 l/ha although this only reached significance at the second application at Hinton. The better results obtained at 30 than at 45 l/ha are contrary to previous WRO work

Table 4

Influence of volume rate on control of wild-oats with difenzoquat

(Figures expressed as % reduction of wild-oat seeds/m^2)

Site		Drayton		Hinton-in-the Hedges		Chislehampton		Cornwell	
Dose (kg a.i./ha)		0.5	1.0	0.5	1.0	0.5	1.0	0.5	1.0
Crop growth stage	Vol rate (l/ha)								
	15	94.9	95.5	90.0	85.9				
3-4 mainstem	30	95.7	98.5	93.1	94.3	87.9	77.0	54.7	58.6
leaves, 1-2 tillers	45	86.4	97.4	88.2	93.5				
	225	99.2	97.2	92.5	93.1	66.2	86.1	61.5	68.2
	15			97.3	97.1				
Pseudostem	30			92.9	99.8	93.0	97.4	78.9	89.6
erect	45			92.5	98.7				
	225			99.6	99.9	87.9	97.3	55.9	93.0
2 nodes	30					86.9	92.5	89.3	97.4
detectable	225					99.6	97.9	95.7	95.8

(Cussans and Taylor, 1976) and the reason for this is not clear. Weather conditions at the time appeared stable and all treatments were applied within 1½ hours.

The wet cold winter and early spring of 1976/7 delayed wild-oat emergence at Chislehampton and Cornwell and all the early applications gave poor levels of control. However subsequent applications at 225 l/ha gave an increase in wild-oat control at each date for both sites. This trend follows the pattern of wild-oat seedling emergence in the spring which was similar at both Chislehampton and Cornwell. The reduction in wild-oats from controlled drop applications at Cornwell also shows this trend towards better control with later applications. At Chislehampton however, wild oat control at 30 l/ha was significantly inferior with the full rate of difenzoquat at the third date to results from the second date of application. This inconsistency may possibly be related to crop population and the increase in the density of its crop canopy. Variations in leaf size and numbers of leaves per plant are unlikely to be significantly different between the two varieties at these two sites. However the lower crop population at Cornwell resulted in a more open crop canopy. Photographic evidence supports this and it is possible that drop penetration to the wild-oats was impeded by the dense crop at Chislehampton.

The lack of significance in yield response is somewhat surprising and may be due to several factors. The particularly dry summer and fairly low wild-oat population may have been the cause at Hinton in 1976. The yields from Cornwell and Chislehampton were probably affected by the poor level of control obtained from the early applications where most yield increase occurs. However, conditions at harvest were also difficult because of the prolonged wet conditions in August 1977.

In conclusion the general indication from these experiments was that applications of difenzoquat at 225 l/ha were more consistent than controlled drop applications but not always significantly so. Evidence suggests that control may be marginally inferior at later applications perhaps due to a failure of the drops to penetrate the canopy and more work on this aspect is required.

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