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HDC FV40 - Improving crop establishment by seed priming, pelleting and the dibber drill

HDC FV40b - Improving crop establishment by the dibber drill.

Report to HDC

FV40 - Improving crop establishment seed priming pelleting and the dibber drill

FV40b - Improving crop establishment by the dibber drill

FINAL REPORT (March 1994)

HDC CONTRACTS

FV40	-	Improving crop establishment by seed priming, pelleting and the dibber drill
FV40b	-	Improving crop establishment by the dibber drill

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CONTENTS

RELEVANCE TO GROWERS AND PRACTICAL APPLICATION

APPLICATION

The main objectives of the work were to examine under a wide range of seedbed conditions, the performance of the Silsoe Research Institute dibber drills in comparison with a coulter drill and a coulter drill with a seed-press wheel immediately following the coulter opening mechanism.

The dibber drills gave greater uniformity of spacing between plants in the row and in depth of sowing. They also gave greater compaction of soil beneath the seed. These differences were associated with higher, more reliable seedling emergence and on some occasions earlier and more uniform emergence than from coulter drills. The benefits were particularly evident on 'capped' seed beds and for lettuce.

Provided the mechanism proved to be reliable in field-scale operations, a dibbing system could offer a significant advance in establishment technology for some widely-spaced crops e.g. onion, leek, parsnips and lettuce. The drill could also be of interest for establishment of the sugar beet crop. A 'spin-off' from the work suggests that a seed press-wheel fitted immediately behind the point of seed delivery on the drill would be beneficial, especially in drying soils.

The application of Soiltex at 125 l in 1000 litres water per hectare significantly reduced the adverse effects of soil capping on seedling emergence.

Whilst the use of primed, pelleted seeds improved seedling emergence and reduced the spread of emergence there were in these experiments no demonstrable effects of this at harvest. It was calculated, for onion, that the reduction in spread of emergence would need to be of the order of 4 days to significantly influence the uniformity of bulb size.

SUMMARY

There is increasing need to improve the reliability of crop establishment to give more uniform stands of plants and to target plant densities more accurately to improve the uniformity of size of harvested product.

The scientific literature indicates that uniformity of sowing depth, spacing between plants within the row, good seed soil contact and low impedance of soil to shoot and root growth in the pre-emergence phase are prerequisites for successful and uniform plant establishment. With currently available coulter drills and seed singulation mechanisms it is not possible to achieve all of these objectives unless exceptional care is taken in seedbed preparation and during sowing. Potentially, these problems can be overcome by a 'dibbing' technique in which the seed is pushed into the soil. This action creates a slightly consolidated pillar of soil beneath the seed so improving the capillary flow of water to the seed and improving seed/soil contact so reducing resistance to water transfer from soil to seed. In addition, the depth of sowing can be precisely controlled irrespective of soil topography and, as there is no covering of soil for the seed, impedance to shoot growth is reduced.

The main objective of the work reported here was to examine under a wide range of seedbed conditions, the performance of the SRI dibber drills in comparison with a coulter drill. A subsidiary set of objectives was to examine whether the performance of seed lot varied with drill type, whether there were interactions with post-sowing irrigation practice and whether impedance to shoot growth could be reduced by the

use of Soiltex and Alcosorb.

The claimed advantages in uniformity of spacing within the row and depth of sowing for the dibber drill were confirmed (Tables 1 and 2). Additionally, the greater compaction beneath the seed from dibbing and presumably greater seed/soil contact was associated with higher percentage emergence in all crops. However, higher emergence also occurred from dibbing when a soil cap or crust formed on the conventionally-sown seed beds (Tables 1 and 3). In the absence of measurements of water flow to seed in the compacted zone of soil beneath it, it is difficult to draw firm conclusions about the reasons for improvements in seedling emergence. However, in lettuce in those cases where the penetration resistance above the seed was similar for 'dibbed' and 'coulter' sown crops percentage seedling emergence was improved by dibbing. This suggests that improved water supply possibly by better seed soil contact or improved soil capillarity to the seeds was a factor and, indeed, there were improvements in percentage emergence from the use of a seed press wheel on the coulter drill in onion (Table 3), leek (Table 4) and lettuce (Table 5). Nevertheless, there was variability in response from sowing to sowing. In lettuce, the benefits from a press wheel were greater in a drying seed bed (Expt 1/1992; Fig.1b, Table 5) than in a wet seed bed (Expt 2, 1993; Fig. 1c, Table 5). It is not possible to identify the precise seed bed moisture contents at sowing for a range of soils when a seed press wheel would be beneficial or the magnitude of the downward pressure needed for different seed-bed soil moisture contents. This needs further investigation. The reduction in growth of onion on the dibber drill plots in 1992 suggests that there may be a balance to be struck between the degree of consolidation required with all drilling systems for satisfactory germination and establishment compared with that permitting rapid seedling root and shoot growth.

As a soil ameliorant, Soiltex, where it reduced soil impedance (lettuce Expt 1/93 vs Expt 2/93) improved seedling emergence significantly. However, there were no consistent effects of using Alcosorb with the dibber drill and it is possible that, where this was applied in wet conditions, it reduced germination and or emergence by creating anaerobic conditions around the seeds (Expt 2/92; onion; Table 3, Fig. 1b).

In general, the dibber drill gave higher percentage emergence than the coulter drills, and earlier emergence though not consistently. Occasionally, the dibber drill improved the synchrony of emergence, for example, in onion and lettuce (Tables 3 and 5) which contributed to greater uniformity of plant size at maturity Fig 2, Fig 3. In onion, percentage emergence was in the range of 70 to 90%, except in Expt 2/91, where it was low, possibly as a result of dry seed bed conditions at the time of germination (Fig.1 d). By contrast, in leek, results with the dibber were variable but emergence overall was low suggesting that soil moisture supply to the seeds in the drying seed beds used in these experiments was a major over-riding factor. In addition, leeks exhibit thermodormancy above c. 20-25°C which may have depressed germination and emergence further. In confirmation of previous results on lettuce the dibber drill gave high (>80%) seedling emergence and consistently higher than from a coulter drill, though the addition of a press wheel to the coulter drill substantially improved establishment. Figure 4 shows for 19 different sowings combining MAFF- and HDC-funded work over four years that the dibber drilling system has given consistently higher percentage seedling emergence than the coulter system and where, under wet conditions, the dibbed holes had been covered percentage emergence exceeded 75% on most occasions. In dry conditions, emergence overall was reduced but, in general, the dibber drill gave higher percentage seedling emergence. At this level of consistency, drilling to a stand could provide a viable and possibly cheaper alternative to transplanting for crop establishment. For lettuce, similar seedling establishment performances were obtained with both the mechanically simplified version (light-weight or Mark III) and the prototype (Mark II) dibber drills (Table 5). Provided the mechanism proved reliable in field-scale operations, the dibbing system could offer a significant advance in establishment technology for some crops. However, the speed of operation of the dibbing mechanism limits the number of seeds that can be sown per metre run and so, as, currently designed, its use would be restricted to relatively widely-spaced crops such as onion, leek, parsnip, lettuce and sugar beet.

In general, the claimed advantages of priming in more rapid emergence, particulary early in the season, were confirmed in onion, leek and parsnip. There were also small improvements in uniformity of emergence but all of these advantages were insufficient to influence final yield or yield components in these crops. It is estimated from MAFF-funded work that, in onion, improvements in uniformity of bulb size from the use of primed seed can be detected if priming reduced the spread of emergence by at least four days which was the maximum reduction achieved in these experiments. In general, the percentage seedling emergence achieved with all of the drills reflected the initial and differing qualities of the primed and untreated seeds used, there being no interactions between these treatments and drilling method.

EXPERIMENTAL SECTION

Introduction

There is increasing pressure to improve the proportion of the crop that is marketable to reduce costs. Work at HRI Wellesbourne funded by MAFF has shown that there is a close relationship between marketable yield, variation in size of product and the number of plants established and the time of emergence of seedlings within a crop. Several surveys by ADAS have shown that target stands of plants are rarely achieved in practice. Perhaps of greater impact on efficiency is that plant stands are unpredictable.

Research at HRI funded by MAFF had quantified the effects of seed quality on crop establishment and crop uniformity. It had identified methods for improving seed quality both during production and processing and by developing new seed treatments such as priming. However, it also became clear that improvements in seed quality alone would not secure improvements in seedling establishment consistently.

Currently available drills for sowing small-seeded vegetables have a number of weaknesses especially the inability to control seed depth, to ensure good seed/soil contact and to reduce or avoid impedance to growth through soil of the root and shoot. Potentially, these problems can be overcome by using a 'dibbing' technique in which the seed is pushed into the soil. This action creates slight consolidation beneath the seed so improving capillary flow of water to the seed and improving seed/soil contact to reduce resistance to water transfer from soil to seed. In addition, the depth of sowing is precise irrespective of changes in soil surface level along the drill line and, as there is no covering of soil over the seed, impedance to shoot growth is reduced.

Since the 1960s, several attempts have been made in Europe and USA to design a 'commercial' dibber drill but none have proved to be entirely successful. However, recently Silsoe Research Institute designed and built a prototype dibber drill in the early 1980s and in a series of trials sponsored by MAFF it outperformed standard coulter drills, giving earlier and higher seedling emergence. Further MAFF funding led to the production of a commercial prototype, the Mark II, and further development, incorporating some features of existing commercial drills led to the Lightweight dibber drill. Here, we report on the performance of these two drills compared with a standard coulter drill (Stanhay unit) and a coulter drill with seed press wheel (Singulaire) on onion, leek lettuce and parsnip crops sown under a wide range of seedbed conditions. The work also examined the potential interactions with drill type of using seed of different viability, using primed and pelleted seeds and the use of anticapping agents such as Soiltex and Alcosorb.

THE METHODS AND EXPERIMENTS

Seed Stocks Used

With the exception of Expt 2/1991 on onion, where the cultivar was Rijnsburger

Robusta, cv. Hysam was used. In leek, the cultivars were Javelin and King Richard, in parsnip the cultivar was Lancer and in lettuce, Saladin. Details of the seed lots, germination percentages are given in Appendix tables. Seeds were primed either in Bioreactors (Gray *et al.*, 1993) or in drums (Rowse, 1991).

Drills and drilling

In all three years, a coulter drill (C) (Stanhay 766, Stanhay Webb) and a dibber drill (D) (Mark II in 1991, 1992 and 1993) and Mark III (in 1993) were mounted on the same tool bar. The coulter drill with seed presswheel (CPW) (Stanhay Singulaire 785, Stanhay Webb) was mounted on a separate tool frame. For all drills, the spacing set between seed positions was 50 mm. In both D & CPW, dry soil was scraped from the surface in front of the drill line and the reference soil level was taken as the level traversed by the leading wheel of the drill. Where Alcosorb 400 was applied 3 or 4 granules per hole were used and details of application rates for Soiltex where it was used, are given in Appendix tables. Application was as a band 130 mm wide over the line of dibbed holes or to the soil in a band above the line of seeds sown with C and CPW.

Crop Husbandry

A basal fertiliser (for details see Appendix Tables) was applied in the spring and seed beds were prepared with a reciprocating harrow following application of nitrogen fertiliser (see Appendix Tables). In some of the experiments the seed beds were heavily irrigated following sowing in an attempt to induce slumping of the soil surface and to increase impedance to seedling growth. Otherwise, no water was applied to aid emergence though where crops were grown to maturity water was applied when calculated soil moisture deficits reached 25 mm. Details of the sowing dates, and rainfall and irrigation in the post-sowing period are shown in Figures 1a, b, c, d.

Weeds were controlled by the application of appropriate herbicides, by hand weeding and hoeing. Applications of fungicides and pesticides were applied as recommended for good commercial practice to control diseases and pests. Details are given in Appendix tables.

Experiments

Onion

In Expt 1/1991, untreated seeds of high and low quality were sown on 26 March at Kirton and on 28 March at Wellesbourne using drills, C and D with or without Alcosorb granules to D applied after sowing. There were four drilled rows per bed (1.52m wide), two for each drill and the plots were 12m in length with the central 10m being used for records of seedling emergence and plant weight at maturity. The treatments were randomised and there were four replicates. In Expt 2/1991 untreated and primed seeds of low and high quality were sown on 9 May at Kirton and 14 May at Wellesbourne as in Expt 1. Other details were identical except that seedling emergence records only were taken. A Latin Square design was used for the seed treatment x quality combination as main plots and the drill comparisons were assigned to subplots. There were four replicates.

In Expt 1/1992, primed and unprimed seeds were sown at Wellesbourne on 10 March and at Kirton on 2 April using a C drill with and without Soiltex and a D drill with and without Alcosorb. There were two rows per bed each 7 m long, the centre 5m of which was recorded for emergence. In Expt 2/1992, sown on 22 April at Wellesbourne two treatments, additional to those in Expt 1/1992 were included. These were a CPW drill with or without an application of Soiltex. There were three rows per bed and plots were 12m long of which the centre 10 m was recorded for emergence. The design was a split plot/randomised block for both experiments.

In Expt 3/1992, untreated seeds were sown on 4 March using C and D drills as in Expt 1. Three irrigation treatments were imposed but these are not described in detail. There were four replicates and the design was a Latin Square with irrigation to sub-plots.

In Expt 4/1992, untreated seeds were sown on 22 July using C and CPW drills and plots were established with and without Soiltex. Four irrigation treatments were also imposed but these are not described in detail. There were four rows per 1.52 m-wide bed each 2 m long and seeds were 20mm apart. The design was a split plot.

Leek

Expt 1/1991 with cv. Javelin sown on 21 May was identical in design to Expt 2/1991 in onion and Expt 2/1992 with cv. King Richard sown on 6 May was identical to Expt 2/1992 with onion. Expt 3/1992 with cv. King Richard sown on 6 June had identical treatments to Expt 3/1992 with onion.

Lettuce

In Expt 1/1992 cv. Saladin seeds were sown on 8 June using a C drill, CPW drill with and without Soiltex and a D drill with and without Alcosorb. Plots were 8 m long, the central 6 m of which was recorded for emergence, and there were 3 rows per 1.52 m bed. There were six replicates.

In Expt 1/1993, four treatments in addition to those used in 1992 were included. These were a Mark III D drill with and without Alcosorb and plots were irrigated or received natural rainfall. Seeds were sown with these four drilling systems on 22 July and in Expt 2/1993 on 2 September. There were two rows per bed and plots were 10 m long. The design was a split plot, with three replicates, irrigation being assigned to main plots.

Parsnip

Expt 1/91 with cv Lancer sown on 7 May was identical intreatments and design to Leek 1/91 and Onion 2/91. Other details are given in the Appendix tables.

Records taken and analysis

In all experiments the numbers of emerged seedlings were counted daily or every other day until no more emerged. For Expt 1/1991 in onion, 1/1991 in leek, 1/1991 in parsnip, seedlings emerging in the recorded length of row were marked with coloured rings to denote the day of emergence and the individual fresh weights of plants from these seedlings were recorded at harvest.

Using a microprocessor force gauge (Mecmesin Ltd, Broadbridge Heath, RH12 3JR) with a 1.4 mm diameter rod in 1991 and a 60° 'relieved cone' head to SRI design in 1992 and 1993, 60 readings of penetration force of the first 5 mm from the top of the seedbed (to represent a depth of soil 'cap') and to a depth of 25 mm (sowing depth) directly above the seed position were made before or soon after seedling emergence. Estimates of the depth of sowing of seeds were made by cutting off leek and onion seedlings at soil level and measuring the distance to the base plate of 60 seedlings per plot. The distance between plants in the row on plots where percentage seedling emergence was similar gave an estimate of mean spacing and uniformity of spacing between plants.

Mean times from sowing to emergence and spread of times of emergence (Orchard, 1977) were calculated. Percentage emergence data were angularly transformed before analysis of variance.

RESULTS

Drill performance and seedbed amelioration

In general, the D drill reduced soil impedance above, but increased it below the seed (Table 1). The effects of Soiltex and Alcosorb on soil impedance above the seed were inconsistent (Table 1). There were small differences in mean sowing depth from the three drills but, in general, the D drill gave considerably less variation in sowing depth than C or CPW drills (Table 2). At similar established plant densities D gave greater uniformity of spacing between plants than C or CPW drills.

Seedling emergence and subsequent crop growth

Sowing dates, predicted times of germination based on (Finch-Savage and Phelps, 1993) the start and end of the seedling emergence phase together with rainfall and times of irrigation are shown in Figs 1,a,b,c,d and e.

In 1991, a period of heavy rain followed by drying winds at W created a soil crust impeding seedling emergence of onions in Expt 1. At Kirton, no irrigation was given but frequent showers during the germination period kept the seed bed moist (Fig 1d).

In Expt 2 with onion, little rainfall fell in the period from sowing to emergence but the seedbed was irrigated. For leek (Expt 1) no irrigation was applied and the seedbed soil water potential remained below -1.1MPa, calculated from Walker and

Barnes (1981), for 12 days following sowing so delaying emergence. In 1992 and 1993 seedbeds remained moist throughout sowing and emergence periods of all crops even when they were not irrigated.

Onion

The different qualities of seed used (germination percentage of 92% as opposed to 85%) had no effect on mean emergence time or spread of emergence but percentage emergence reflected the difference in percentage germination. Primed seeds emerged between 2.0 and 4.4 days earlier than untreated seeds and although primed seeds reduced spread of emergence and increased the percentage emergence effects were small (data not presented).

Over the seven site/sowing date combinations the D drill gave slightly earlier emergence than the C drill in five of these with no difference in the others (Table 3). In four of the sowings the dibber reduced the spread of emergence. Percentage emergence was increased by the D drill in all but one of the site/sowings and the effects on percentage emergence, and indeed the other emergence characteristics were greater, in Expt 1/1991 at Wellesbourne where the soil had severely crusted over to form a hard cap. Soil crusts as hard did not occur in the other experiments.

There were no clear benefits of applying Alcosorb or Soiltex. There were no interactions between drill type and seed quality or priming and no interactions between drill type and timing of post-sowing irrigation.

Despite similar times of emergence in Expt 1/92 whole plant weights at harvest were substantially lower, 199 as opposed to 236g (LSD, 34.8), from the D-sown plots than the C-sown plots. During the early stages of growth (up to one true-leaf) the plants were similar in size but differences became apparent as the plants grew, the poorer growth possibly being associated with greater compaction of the seedbed (Table 1).

Mean plant weight at harvest declined with delay in emergence, which was on average, 5.0 g per plant for each day's delay in emergence (Fig. 2). Analysis of variance showed that 'day of emergence' accounted for 40%-60% of the variation in plant weight at maturity depending upon the drill and seed lot used. As a result the D drill, which gave lower spreads of emergence than the C drill, reduced the coefficient of variation in plant weight from 46 to 38% (LSD, 3.6) and increased the proportion of the total yield falling into the central size class (Fig. 3). As a result of this and the higher plant populations established marketable yields of bulbs >40 mm in diameter from the D drill were 55.0 t ha^{-1}, 16 t higher than for the C drill.

Leek

Priming reducing mean germination time from 21.1 to 15.2 days in 1991 and from 14.1 to 13.1 days in 1992. In 1991, percentage emergence was 53%, averaged over all other treatments, for primed compared with 42% for untreated seeds whereas in 1992 seedling emergence, at 55%, was unaffected by priming. There was no effect of priming on spread of emergence nor were there any interactions between seed priming and drilling system.

In 1991, the D drill gave earlier and higher emergence than the C drill. In 1992, emergence was earlier from D, where Alcosorb was used to cover the seeds, but the effect of Alcosorb on percentage seedling emergence was variable (Table 4). The effects of using a press wheel (CPW drill) were inconsistent. Mean plant weight at harvest declined with a delay in emergence (Fig. 2), which was on average, 5 g/plant for each day's delay in emergence. Analysis of variance showed that for all drill and seed treatments combined, day of emergence accounted for 43% of the variation in plant weight at harvest. There was no effect of drill type on spread of emergence nor on the uniformity of the crop.

Lettuce

The D drills gave earlier emergence than either C or CPW drills and, with the exception of 1992, gave lower spreads of emergence (Table 5). The D drill also gave higher percentage emergence than the C drill at all sowings and higher than the CPW drill with press wheel on two of the three sowing occasions (Table 5). The addition of Soiltex reduced mean emergence time, spread of emergence and increased percentage seedling emergence (Table 5) on the occasions when it reduced soil impedance (Table 1). There were no significant differences in performance between the Mark II or Mark III dibber.

A comparison of data from the present experiments with previously published data for lettuce by Wurr *et al.*, 1985 and Finch-Savage *et al.*, 1991 is shown in Fig. 4.

Parsnip

Overall percentage seedling emergence was 51% and differed little for high and low quality seed but primed seed (56%) gave significantly higher emergence than unprimed seed (51%). Primed seed also emerged in 19 days c.6 days earlier than untreated seeds but there were no effects on the spread of emergence.

Percentage emergence from D with Alcosorb was significantly higher than from C which in turn was higher than from D without Alcosorb (Table 6). Seedlings from the D sown plots emerged between 1 and 3 days earlier than those from C plots. Plant weight declined by about 5g for each day's delay in emergence.

We thank, Stanhay-Webb, Germain's (UK) Ltd and Elsoms Seeds for help with this work.

Table 1 **Force gauge readings on seed beds to a depth of 5mm and 25mm (Newtons). In 1991 a 1.4mm diameter rod and in 1992 and 1993 a 60° 'relieved cone' head were used on the penetrometer**

Site Crop	**Drill Type**		**Experiments**			
			Expt 1/91		**Expt 1/92**	
			0-5mm	0-25mm	0-5mm	0-25mm
Wellesbourne -Onion	Coulter	(C)	1.10	1.90	1.64	6.30
	Dibber with Alcosorb	(D+A)	0.73	4.10	0.96	13.1
	Dibber without Alcosorb	(D-A)	1.33	4.79	-	-
Kirton -Onion		C	0.42	2.75	0.34	3.16
		D+A	0.42	4.01	0.40	4.90
		D-A	0.60	4.66	0.53	5.41
			Expt 2/92			
Wellesbourne -Leek	Coulter with Soiltex	(C+S)	1.39	7.67		
		(D+A)	0.97	11.92		
	Coulter with Presswheel	(CPW+S)	1.18	6.29		
	with Soiltex		1.33	7.77		
	Coulter without Soiltex	(C-S)	2.17	10.68		
		(D-A)	2.17	5.83		
	Coulter with Presswheel without Soiltex	(CPW-S)				
			Expt 3/92			
Wellesbourne -Lettuce		C+S	0.67	5.52		
		D+A	1.43	10.27		
		CPW+S	0.95	4.64		
		C-S	0.99	6.82		
		D-A	0.57	13.47		
		CPW-S	1.15	6.11		
Wellesbourne -Lettuce			**Expt 1/93**		**Expt 2/93**	
		C*	1.84	4.93	2.06	
		CPW	2.32	4.40	2.23	
	*Mark II Dibber		2.66	8.99	2.63	
	*Mark III Dibber		2.04	7.92	2.60	
	LSD (p=0.05)		0.47	1.02	0.86	
	Soiltex		1.84	-	2.49	
	Without soiltex		2.59	-	2.27	
	LSD (p=0.05)		0.34		0.61	

*Mean of Soiltex & without Soiltex

Table 2 Sowing depths, uniformity of sowing depth and of spacing between plants

Site/Crop	Drill type		Sowing Depth			
			Expt 2/91		Expt 2/92	
			Mean depth (D)	Coefficient of variation of depth (CV)	D	CV
Wellesbourne -Onion	Coulter	(C)	34.5	12.5	25.2	15.4
	Dibber	(D)	30.2	10.4	23.8	12.2
	Coulter with Presswheel	(CPW)	-	-	27.0	14.8
	LSD(p=0.05)				0.67	1.66
					1.3	2.3
		C	17.8	24.8		
		D	17.0	19.2		
			Expt 2/91		Expt 2/92	
Wellesbourne -Leek		C	24.9	20.1	24.6	13.9
		D	20.3	12.2	23.4	15.7
		CPW	-	-	28.6	14.4

Site/Crop		Drill type	Coefficient of variation of plant spacing
			Expt 2/92
Wellesbourne		C	90
		D	53
-Onion		CPW	66
		LSD (p=0.05)	23
			Expt 2/92
-Lettuce		C	40
		D	26
		CPW	47
		LSD (p=0.05)	23
			Expt 3/93
		C	42
		CPW	44
	Mark II	Dibber	32
	Mark III	Dibber	28
		LSD (p=0.05)	12.0

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	Mean emergence time (days)		Spread emergence		Percentage emergence	
Expt 1/91 (mean over seed quality)	**Wellesbourne(W)**	**Kirton(K)**	**W**	**K**	**W**	**K**
Coulter	30.4	22.3	14.6	10.6	47(43)	80(63)*
Dibber with Alcosorb	24.3	22.2	10.0	12.0	85(68)	89(71)
Dibber without Alcosorb	26.7	22.7	10.0	10.8	86(68)	88(70)
LSD (p=0.05)	0.72				(3.06)	
for same level of site	0.84				(3.38)	
Expt 2/91 mean over priming and seed quality						
Coulter	-	14.2	-	7.9	-	47(43)
Dibber with Alcosorb	-	14.3	-	9.3	-	54(48)
Dibber without Alcosorb	-	14.3	-	9.3	-	55(48)
LSD (p=0.05)		0.60		0.40		3.0
Expt 1/92 (mean over primed seed)						
Coulter with Soiltex	27.7	22.4	8.2	6.8	78(62)	72(58)
Coulter without Soiltex	27.6	22.6	9.2	6.7	76(61)	70(57)
Dibber with Alcosorb	29.1	24.8	10.2	8.9	76(61)	72(58)
Dibber without Alcosorb	26.8	25.3	9.9	9.2	81(65)	69(56)
LSD (p=0.05)	0.44	0.42	0.044		2.8	2.0
Expt 2/92 (mean over priming)						
Coulter with Soiltex	14.4	-	6.4	-	67(55)	-
Coulter + Presswheel with Soiltex	14.4	-	6.7	-	86(68)	-
Dibber with Alcosorb	14.8	-	6.0	-	69(56)	-
Coulter without Soiltex	14.1	-	6.1	-	64(53)	-
Coulter + Presswheel, without Soiltex	14.6	-	6.3	-	81(65)	-
Dibber without Alcosorb	13.5	-	4.6	-	80(64)	-
LSD (p=0.05)	0.42			-	(4.0)	
Expt 3/92 (mean over irrigation timing)						
Coulter with Soiltex	26.3	-	13.0	-	72(58)	-
Coulter without Soiltex	27.3	-	13.0	-	69(56)	-
Dibber with Alcosorb	24.5	-	12.5	-	79(63)	-
Dibber without Alcosorb	23.7	-	11.9	-	80(64)	-
LSD (p=0.05)	1.12				5.0	
Expt 4/92 (mean over irrigation timing)						
Coulter with Soiltex	13.9	-	12.0	-	69(56)	-
Coulter without Soiltex	13.8	-	10.6	-	70(57)	-
Coulter + Presswheel with Soiltex	12.1	-	10.3	-	70(56)	-
Coulter + Presswheel without Soiltex	12.7	-	10.1	-	72(58)	-
LSD (p=0.05)	0.94				4.4	

* The figures on parentheses in this and the following tables are angular transformed data for use with the LSD to determine levels of significance. The differences between pairs of values on the table must be greater than the LSD to be significantly different.

Table 4 Effect of seed drills and soil amelioration on leek seedling emergence (mean over seed quality and priming

		Mean emergence time (days)	Percentage emergence
Expt 1/91			
Coulter without Soiltex	(C-S)	19.9	29(32)
Dibber with Alcosorb	(D+A)	17.0	52(46)
Dibber without Alcosorb	(D-A)	17.5	62(52)
LSD (p=0.05)		0.9	2.54
Expt 2/92			
Coulter with Soiltex	(C+S)	12.4	59(50)
Coulter with Presswheel with Soiltex	(CPW+S)	13.0	66(55)
Dibber with Alcosorb	(D+A)	11.8	56(49)
Coulter without Soiltex	C-S	13.6	56(49)
Coulter with Presswheel without Soiltex	(CPW-S)	14.9	53(46)
Dibber without Alcosorb	D-A	15.8	37(37)
LSD (p=0.05)		0.42	4.6
Ext 3/92			
Coulter with Soiltex	C+S	19.0	48(43)
Coulter without Soiltex	C-S	18.2	49(44)
Dibber with Alcosorb	D+S	14.2	55(48)
Dibber without Alcosorb	D - S	14.5	56(48)
LSD (p=0.05)		0.50	4.6

Table 5 Effect of seed drills and soil amelioration on lettuce seedling emergence

		Mean emergence time (days)	Spread of emergence days)	Percentage emergence
Expt 1.1992				
(mean over Alcosorb and Soiltex)				
Coulter	(C)	9.6	10.0	77(62)
Coulter with Presswheel	(CPM)	7.9	10.3	89(72)
Dibber	(D)	8.3	9.3	87(64)
LSD (p=0.05)		1.2		(2.8)
Expt 1 1993				
	C	7.1	3.9	74(60)
	CPW	7.7	3.7	71(58)
MarkII Dibber	(DII)	5.7	3.0	82(66)
Mark III Dibber	(DIII)	5.3	2.9	84(67)
LSD (p=0.05)		0.58		(4.2)
Without Soiltex		6.7	3.6	
Soiltex		6.2	3.2	73(59)
LSD (p=0.05)		0.42		83(66)
				(3.0)
Expt 2 1993				
	C	10.8	4.7	70(57)
	CPW	11.1	4.6	76(61)
	DII	10.0	4.0	84(67)
	DIII	9.7	4.5	81(64)
LSD (p=0.05)		0.54		(2.72)
Without Soiltex		10.6	4.6	79(63)
Soiltex		10.2	4.3	77(62)
LSD (p=0.05)		0.38		(1.92)

Table 6: **Effect of seed drill and soil amelioration of parsnip seedling emergence**

	Mean emergence time (days)	Percentage emergence
Coulter	23.2	56 (49)
Dibber with Alcosorb	20.6	63 (52)
Dibber without Alcosorb	22.0	42 (41)
LSD (p=0.05)	1.2	(1.9)

LEGENDS TO FIGURES

Figure 1 - Sowing dates (•), predicted times of seed germination (○), periods over which seeds emerge (⊢⊣), times of irrigation (↓) and rainfall for experiments in (a) 1991, (b) 1992 and (c) 1993 at Wellesbourne, (d) 1991 and (e) 1992 at Kirton

Figure 2 - The dependence of mean plant weight at harvest on the relative times of emergence of (○) onion and (•) leek and (□) parsnip seedlings in the population.

Figure 3 - The effect of the dibber (□) and coulter drills (■) on the distribution of sizes of onion bulbs.

Figure 4 - Comparison of percentage seedling emergence from a coulter (△), a dibber drill with no seed covering material (○) and with a seed covering material (•). (Data from Wurr *et al.*, 1985; Finch-Savage *et al., 1991* and current paper)

Figure 1.

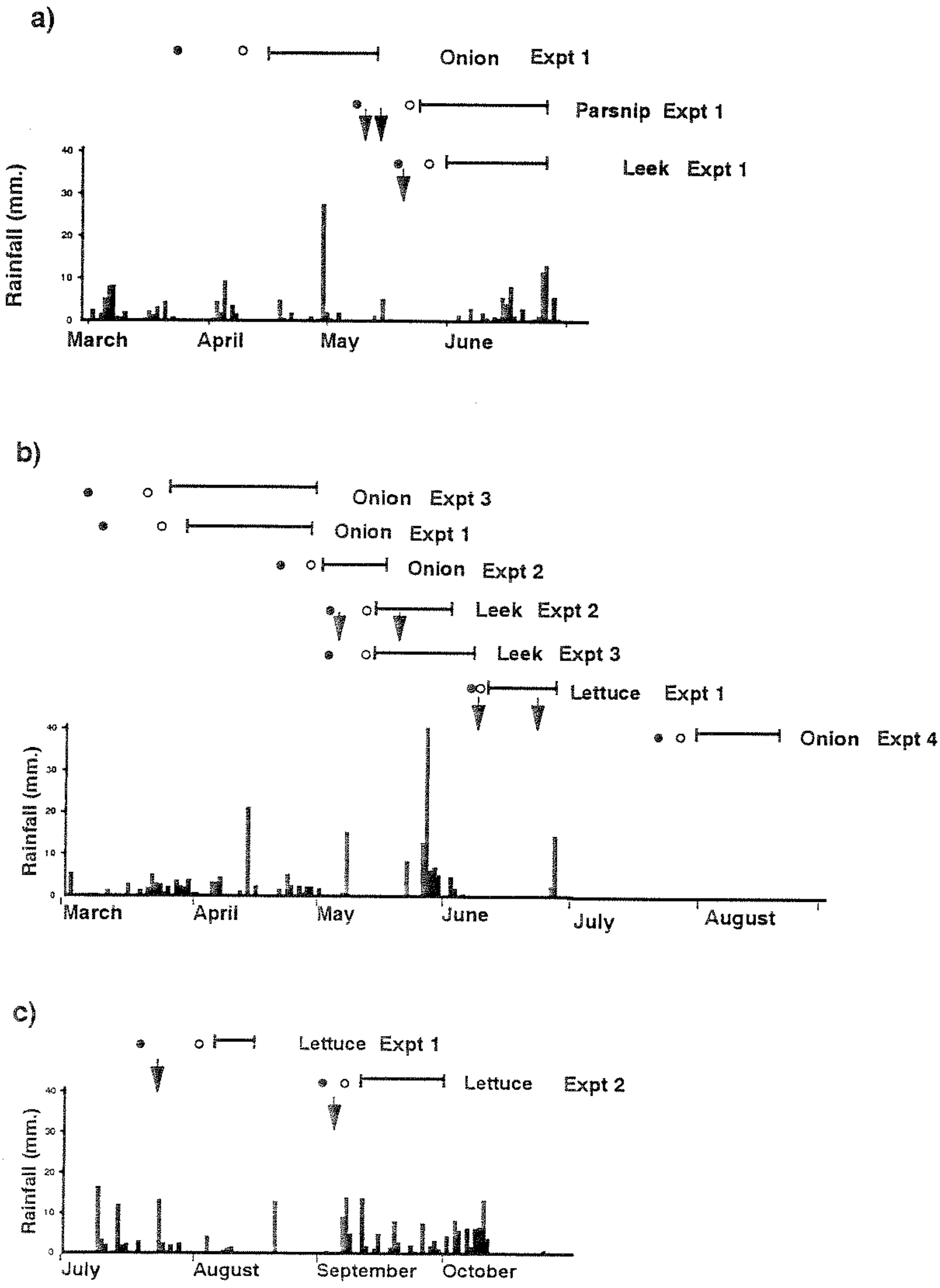
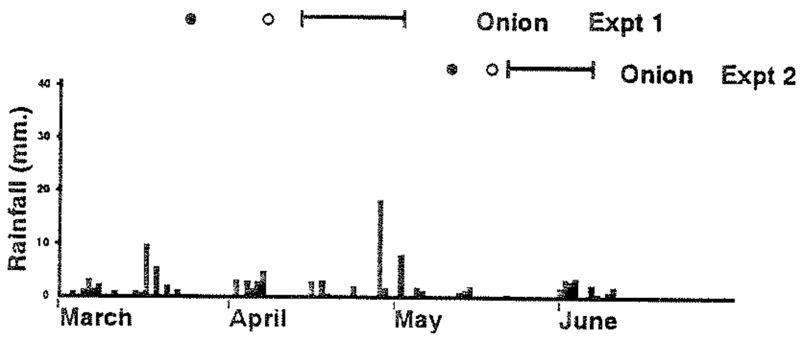

a)
Onion Expt 1
Parsnip Expt 1
Leek Expt 1
Rainfall (mm.)
40
30
20
10
0
March
April
May
June
b)
Onion Expt 3
Onion Expt 1
Onion Expt 2
Leek Expt 2
Leek Expt 3
Lettuce Expt 1
Onion Expt 4
Rainfall (mm.)
40
30
20
10
0
March
April
May
June
July
August
c)
Lettuce Expt 1
Lettuce Expt 2
Rainfall (mm.)
40
30
20
10
0
July
August
September
October

Figure 1

d)


Onion Expt 1
Onion Expt 2
Rainfall (mm.)
40
30
20
10
0
March
April
May
June

e)

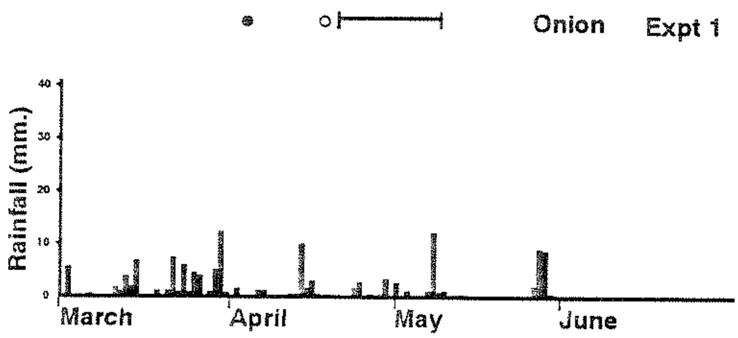

Onion Expt 1
Rainfall (mm.)
40
30
20
10
0
March
April
May
June

Figure 2.

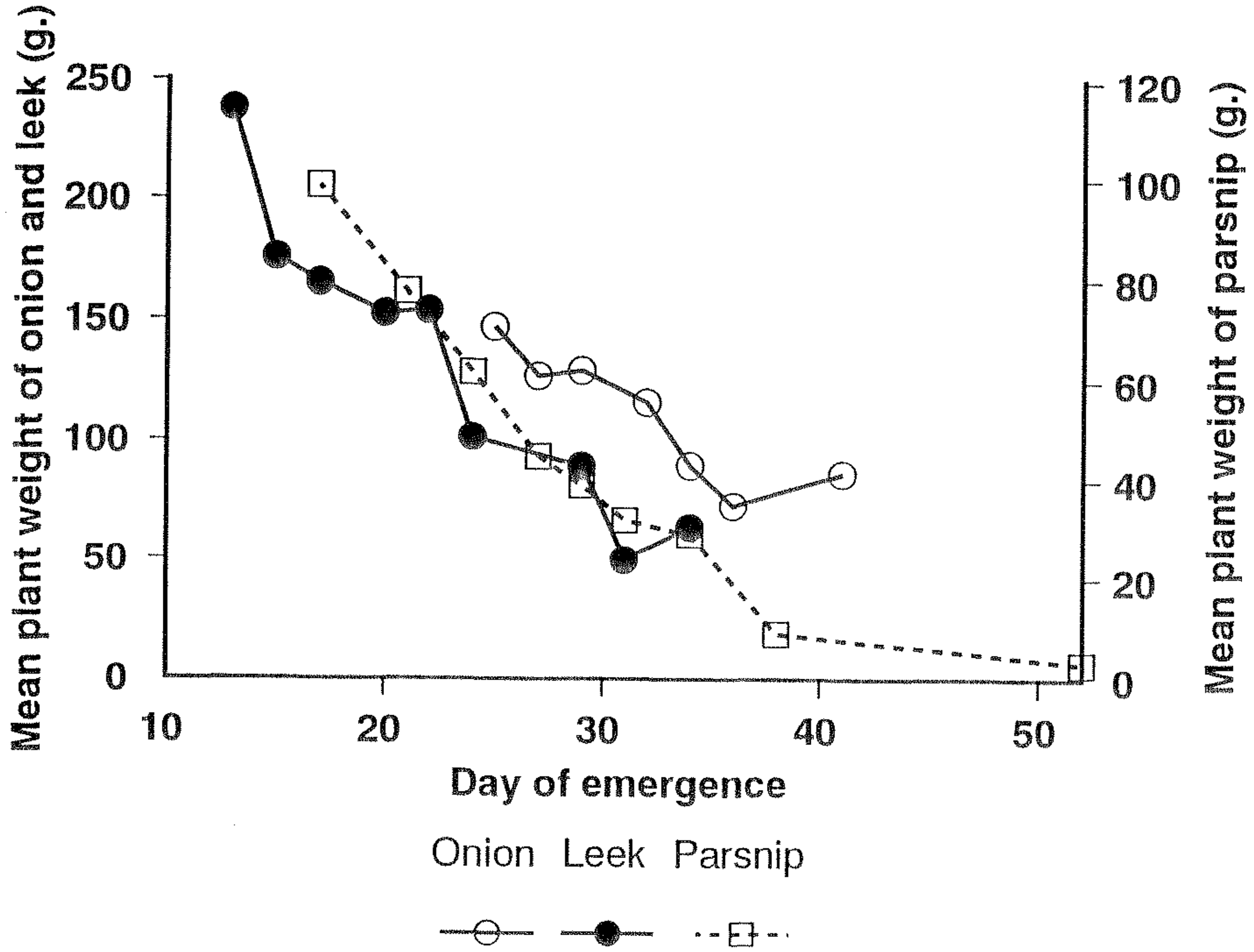

Mean plant weight of onion and leek (g.)
250
200
150
100
50
0
10
20
30
40
50
Day of emergence
120
100
80
60
40
20
0
Mean plant weight of parsnip (g.)
Onion Leek Parsnip

Figure 3.

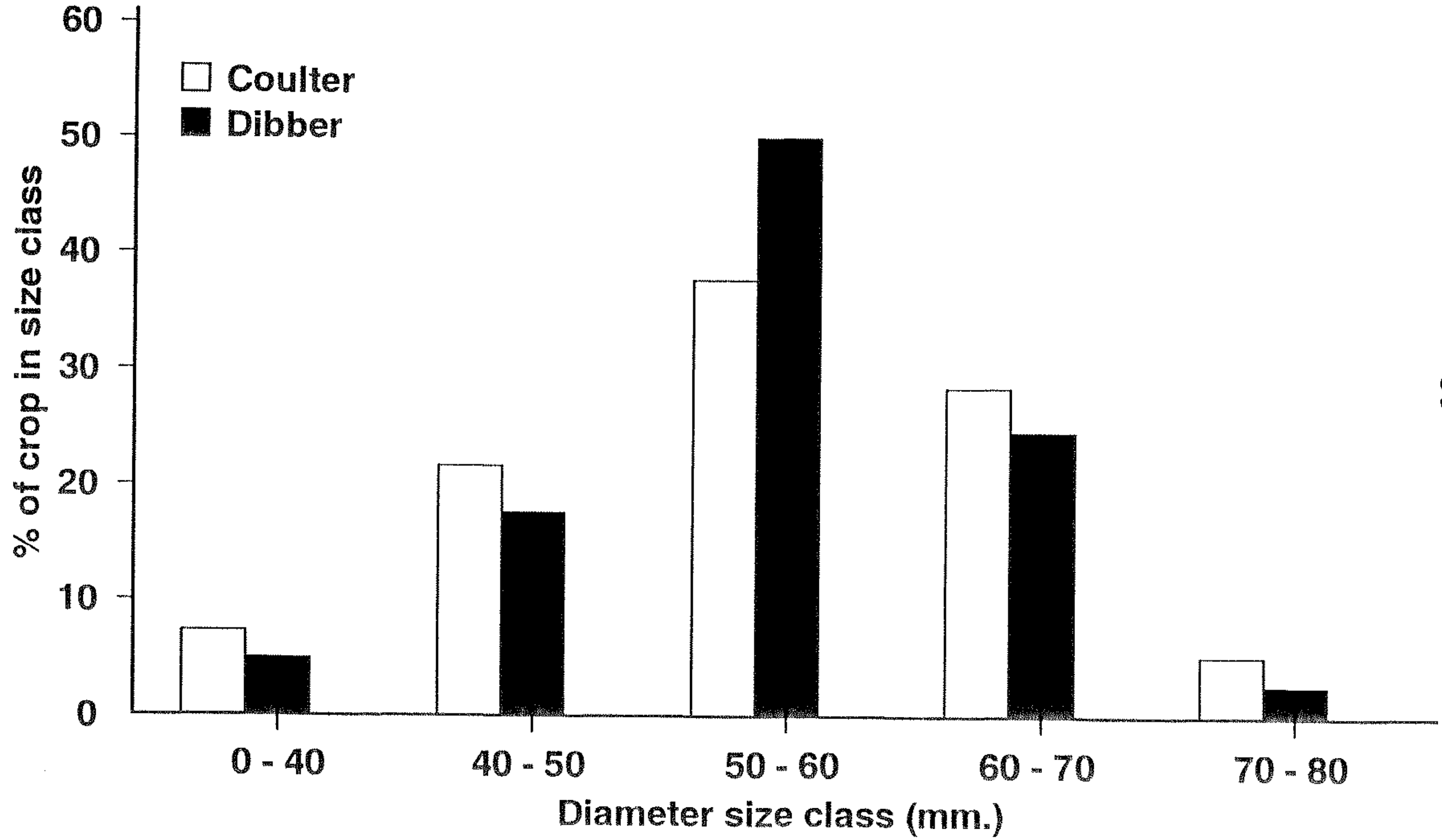
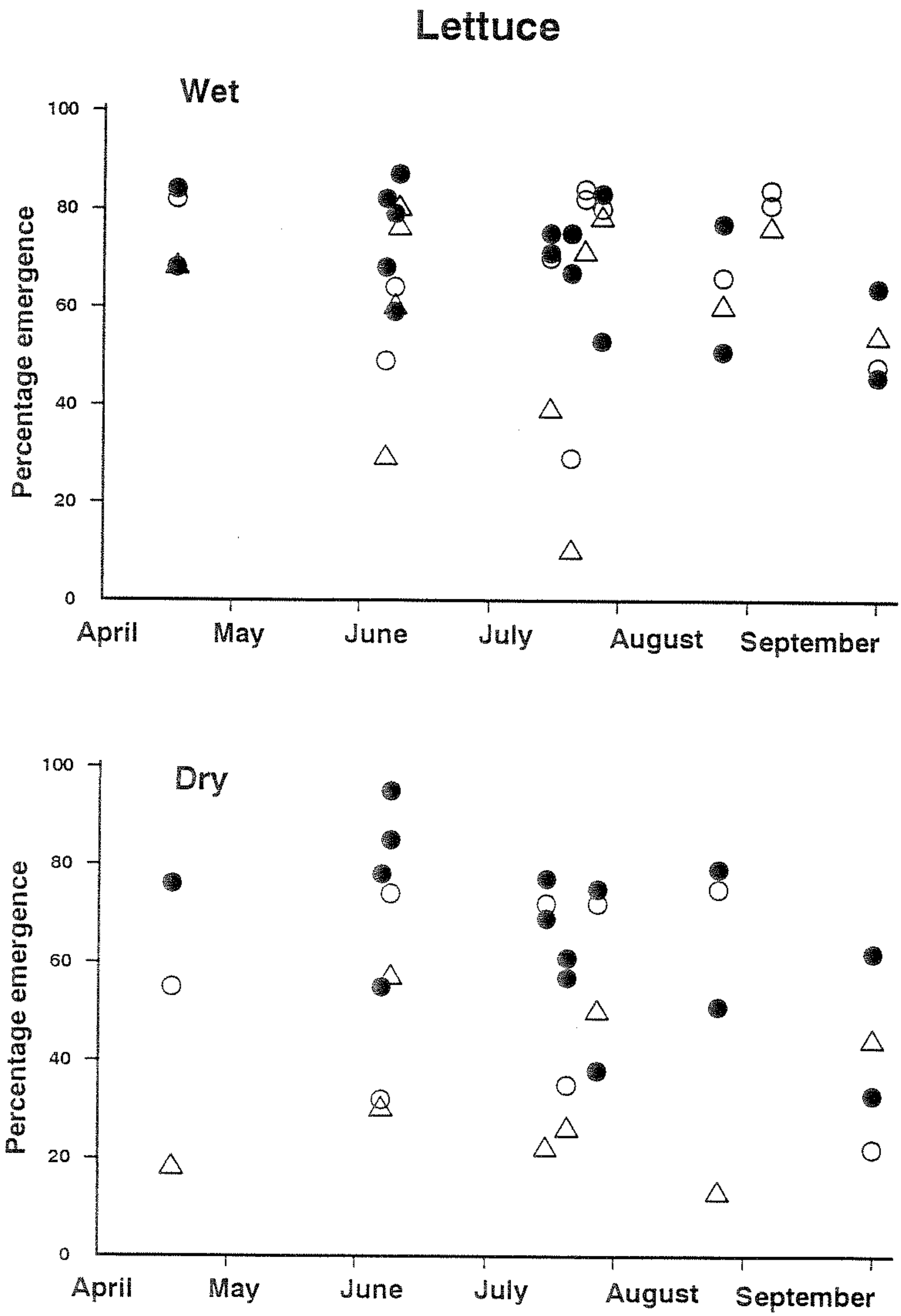

60
50
40
30
20
10
0
% of crop in size class
Coulter
Dibber
0 - 40
40 - 50
50 - 60
60 - 70
70 - 80
Diameter size class (mm.)

Figure 4.


Lettuce
Wet
100
80
60
40
20
0
Percentage emergence
April
May
June
July
August
September
Dry
100
80
60
40
20
0
Percentage emergence
April
May
June
July
August
September

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(Expt. Onion 1/1991)

Crop	Onion
Cultivar	Hysam
Site	Wellesbourne(W) and Kirton(K)
Treatments	
1.Drill	Dibber and Coulter
2.Soil application	+/- Alcosorb (dibber only)
3.Seed	Germination : High(99%) and Low(92%)
Experimental design	Randomised block with 4 replications ; 24 plots ; plots 12m. long (6m.for emergence and first harvest ; 6m. for second harvest) 4 rows/1.5m.bed(W)/1.8m.(K) Seeds 50mm. apart
Sowing date	W - 28 March ; K - 26 March
Fertiliser	Basal @ 240kg ha^{-1} P and K Pre-drilling @ 120kg ha^{-1} N
Pest and disease control	1.Pre-emergence herbicide Albrass @ 9l ha^{-1} + Dacthal @ 6 kg ha^{-1} in 500l. water 2.Insecticide (against Bean seed fly) Hostathion @ 2.5l ha^{-1}
Harvest date	1.August W - 5th ; K - 8th (whole plants) 2.September W - 3rd ; K - 10th (bulbs)
Records taken	1.Seedling emergence(W - plants colour tagged) 2.Soil compaction 3.Harvest 1. Individual plant weights 4.Harvest 2. Bulb weights and size grades

Crop Experiment	Onion 2/1991	Leek 1/1991	Parsnip 1 /1991
Cultivar	Hysam	Javelin	Lancer
Site	Kirton	Wellesbourne	Wellesbourne
Treatments			
1. Drills	Dibber and Coulter	as Onion	as Onion
2. Soil applications	+/- Alcosorb (dibber only)	as Onion	as Onion
3. Seed			
Primed/high germ	93 (91)	97 (97)	70 (79)
" /low "	29 (62)	93 (94)	70 (72)
Natural/high "	79 (92)	95 (99)	41 (72)
" /low "	56 (73)	91 (91)	46 (69)
( ) %germination before pelleting			
Experimental design	Latin square with seed lots as main plots ; split for drills 4 replications ;48 plots, 4 rows/1.8m.bed ;seeds sown 50mm. apart	as Onion except for. bed width = 1.5m.	as Leek
Sowing date	9 May	21 May	7 May
Fertiliser	Basal 240kg ha^{-1} P and K Pre-drilling 120kg ha^{-1} N	as Onion	as Onion
Irrigation (15mm.)	None	21 May	8 & 10 May
Pest and disease control			
Pre-drilling	None	None	Dyston FE10 @ 11kg ha^{-1}
Pre-emergence	Albrass @ 9l ha^{-1} & Dacthal @ 6kg ha^{-1} in 500 l water	as Onion	Linuron @ 1.10l ha^{-1}
Insecticides and fungicides		31 May Bravo @ 2l ha^{-1} in 220-1000l water & Decis @ 300ml. in >400l water (Neck rot and Bean seed fly) 17 July Malathion @ 2.1l ha^{-1} (Thrips and Black fly)	17 July Aphox @280g ha^{-1} in 200-400l water (Black fly)
Harvest date	None	10 September	28 August
Records taken	Seedling emergence	1. Seedling emergence (plants colour tagged) 2. Soil compaction 3.Harvest - individual plant weights	1,2 & 3 as Leek

(Expt. Onion 1/1992)

Crop	Onion
Cultivar	Hysam
Site	Wellesbourne (W) and Kirton (K)
Treatments	
1.Drill	Dibber and Coulter
2.Soil application	+/- Alcosorb (dibber only) +/- Soiltex L1@ 125l ha^{-1} in 1000l water(coulter drills)
3.Seed	Natural and primed
Experimental design (for each species)	Split - plot with seed as main plot ; drill as sub-plot ; 6 replications 48 plots ; plots 7m. long W - 2 rows/1.5m bed K - 2 rows/1.8m bed Seeds 50mm. apart
Sowing date	W - 10 March K - 2 April
Fertiliser	1.Basal @ 240kg ha^{-1} P and K 2.Pre-drilling @ 120kg ha^{-1} N 3.Top dressing (both crops) - 6 May 60kg ha^{-1}
Pest and disease control	1.Pre-emergence herbicide - Albrass @ 9l ha^{-1} + Dacthal @ 6 kg ha^{-1} in 500l. water 2.Herbicide - 5 May - Alicep @ 4.5kg ha^{-1} in 200l. water (both crops) 3. Fungicide - starting 18 May - 6 fortnightly alternating sprays of either Ronilan @ 1.5kg ha^{-1} or Folio @ 2l ha^{-1} in >200l. water
Harvest date	W - 8 September K - 10 September
Records taken	1.Seedling emergence(W-plants colour tagged) 2.Soil compaction 3.Plant survival 4.Harvest - Individual plant weights and size grades

(Expt. Onion 2/1992
Leek 2/1992)

Crop	Onion	Leek
Cultivar	Hysam	King Richard
Site	Wellesbourne	
Treatments		
1.Drill	Dibber,Coulter and Coulter with presswheel	
2.Soil application	+/- Alcosorb (dibber only) +/- Soiltex L1@ 125l ha^{-1} in 1000l water(coulter drills)	
3.Seed	Natural and primed	
Experimental design (for each species)	Split - plot with seed as main plot ; drill as sub-plot ;4 replications 48 plots ; plots 12m. long 3 rows/1.5m. bed Seeds 50mm. apart	
Sowing date	Onion - 22 April Leek - 6 May	
Fertiliser	1.Basal @ 240kg ha^{-1} P and K 2.Pre-drilling @ 120kg ha^{-1} N 3.Top dressing (both crops) - 12 June 60kg ha^{-1} N	
Irrigation	8 May - 15mm. to leeks to produce soil crust (heavy rain after onion drilling)	
Pest and disease control	1.Pre-emergence herbicide - Albrass @ 9l ha^{-1} + Dacthal @ 6 kg ha^{-1} in 500l. water (both crops) 2.Herbicide - 25 June - Alicep @ 4.5kg ha^{-1} in 200l. water (both crops) 3. Fungicide -(Onion only) starting 18 May - 6 fortnightly alternating sprays of either Ronilan @ 1.5kg ha^{-1} or Folio @ 2l ha^{-1} in >200l. water 4. Insecticide (leeks only) Dipterex @ 1.5kg ha^{-1} drench in 1000l water against Cutworms	
Harvest date	Onion - 24 September Leek - 1 September	
Records taken	1.Seedling emergence(plants colour tagged) 2.Sowing depth (leeks only) 3.Soil compaction 4.Plant survival 5.Harvest - Individual plant weights and size grades	

(Expt. Onion 3/1992)
Leek 3/1992)

Species	Onion cv. Hysam Leek cv. King Richard
Site	Wellesbourne (mobile covers)
Treatments	
1.Drill	SRI Dibber Drill and Coulter Drill (Stanhay S766)
2.Soil application	+/- Alcosorb (dibber drill only) +/- Soiltex L1@ 125l ha^{-1} in >1000l water(coulter drills only)
3.Irrigation	1. Timed - 15mm. water @ 90°Cd >1°C. 2. Heavy - 21 mm. water after drilling 3. Regular - 12.5mm. every 50°Cd >1°C.
Sowing date	Onion - 4 March Leek - 6 May
Experimental design	There were separate experiments for each species. Each experiment had a criss-cross latin square design with 4 replicates. There were 48 plots each a 6m. row containing 120 seeds. Plots were sown with a tractor-mounted Stanhay S766 or SRI dibber drill.Seeds 50mm. apart
Pest and disease control	1.Pre-emergence herbicide - Albrass @ 9l ha^{-1} + Dacthal @ 6 kg ha^{-1} in 500l.water (both crops)
Records taken	1.Seedling emergence 2.Soil compaction 4.Soil temperatures @ seed depth 5.Soil moisture contents 6.Seed germination in laboratory Onion 1° - 35°C. , Leek 5° - 35°C. (@ 5° intervals)

(Expt. Onion 4/1992)

Crop	Onion
Cultivar	Hysam
Site	Wellesbourne (mobile covers)
Treatments	
1.Covers	+/- protection from natural rainfall
1.Drill	1.Coulter no presswheel (Stanhay) 2.Coulter + presswheel (Singulaire)
2.Soil application	+/- Soiltex L1@ 125l ha^{-1} in >1000l water
3.Irrigation	1.Pre-drilling irrigation + timed -15mm water @ 90°Cd >1°C. 2.Timed - 15mm water @ 90°Cd >1°C. 3.Heavy - 21 mm. water after drilling 4.Regular - 12.5mm. every 50°Cd >1°C.
Experimental design (for each cover treatment)	The experiment had a split-plot design with covers as main plots. There were 3 replicates to give 48 plots each a 2m. row containing 120 seeds Seeds 17mm. apart
Sowing date	22 July
Pest and disease control	1.Pre-emergence herbicide - Albrass @ 9l ha^{-1} + Dacthal @ 6 kg ha^{-1} in 500l.water
Records taken	1.Seedling emergence(plants colour tagged) 2.Soil compaction 4.Soil temperatures @ seed depth 5.Soil moisture content 6.Seed germination in laboratory 1° - 35°C.(@ 5°C. intervals)

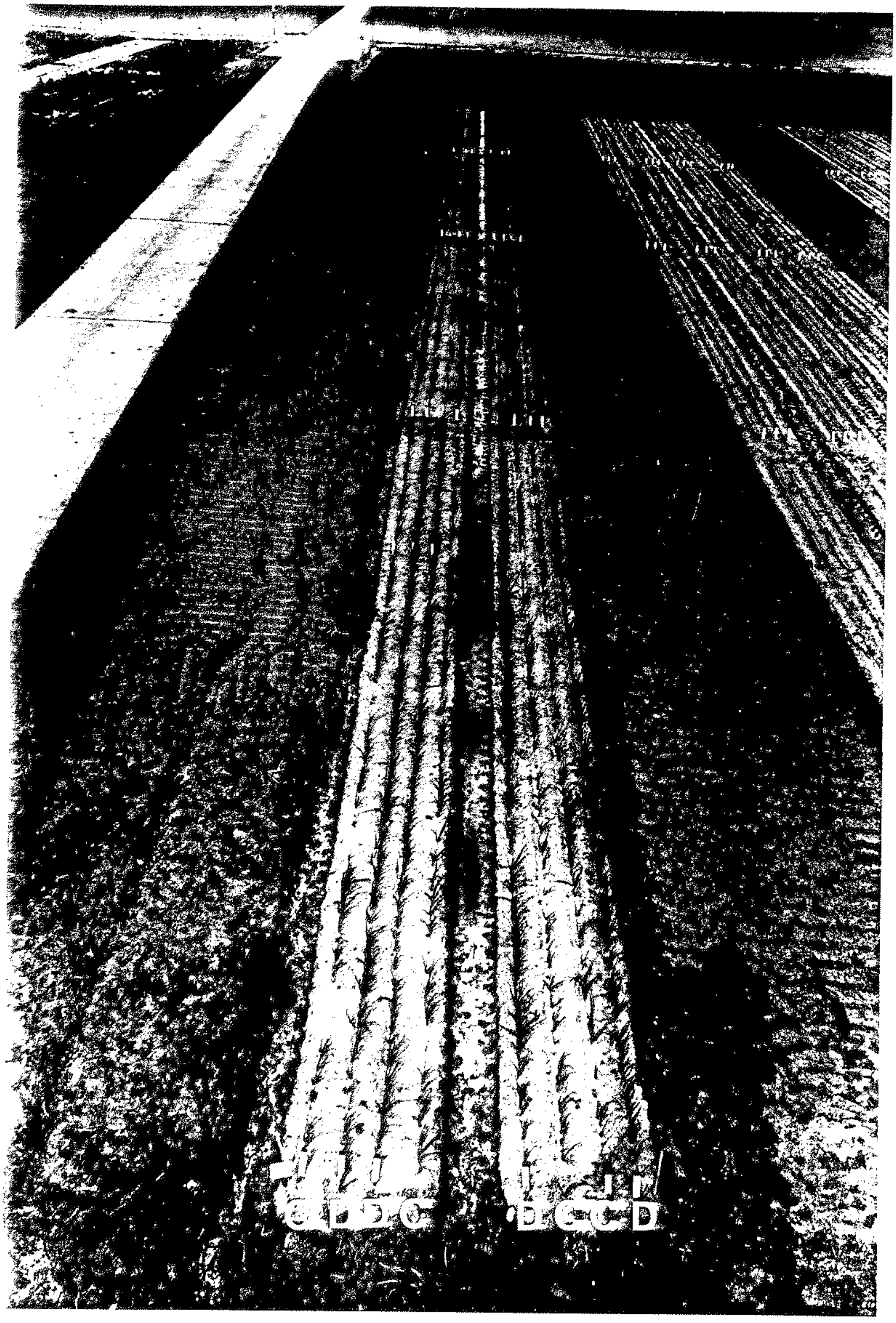
(Expt. Lettuce 1/1992)

Crop	Lettuce
Cultivar	Saladin
Site	Wellesbourne
Treatments	
1.Drill	Dibber,Coulter and Coulter with presswheel
2.Soil application	+/- Alcosorb (dibber only) +/- Soiltex L1@ 125l ha^{-1} in 1000l water(coulter plots)
Experimental design	Randomised block ; 6 replications 36 plots ; plots 8m. long 3 rows/1.5m. bed Seeds 50mm. apart
Sowing date	8 June
Fertiliser	Basal @ 240kg ha^{-1} P and K Pre-drilling @ 120kg ha^{-1} N
Harvest date	8 July
Records taken	1.Seedling emergence(plants colour tagged) 2. Soil compaction 3. Plant survival 4. Plant spacing 5. Harvest - Individual plant weights

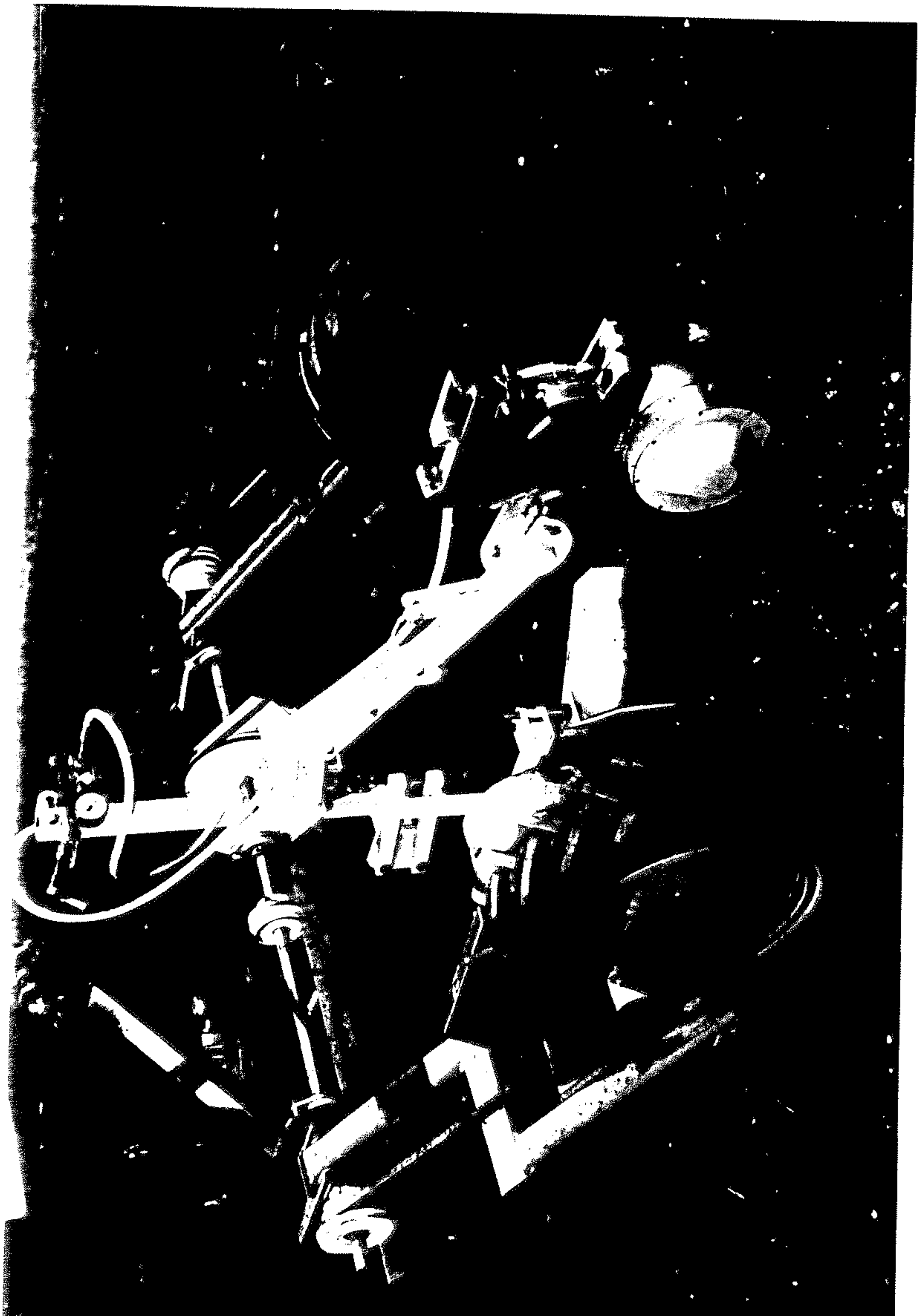
(Expt. Lettuce 1/1993
2/1993)

Crop	Lettuce
Cultivar	Saladin
Site	Wellesbourne
Treatments	
1.Sowing date	S1 - 22 July S2 - 2 September
1.Drill	Dibber MK 1 & 2 Coulter +/- presswheel
2.Soil application	+/- Soiltex L1 @ 125l ha^{-1} in 1000l water
3.Irrigation	1.Heavy immediately after drilling 2.None S1 - 22 July ; S2 - 2 September
Experimental design (for each sowing)	Split - plot with irrigation as main plot ; drill as sub-plots 3 replications ; 48 plots plots 10m. long ; 2 rows/1.5m. bed Seeds 50mm. apart
Fertiliser	Basal @ 240kg ha^{-1} P and K Pre-drilling @ 120kg ha^{-1} N
Pest and disease control	1.Pre-drilling - Dursban 4 @ 2l ha^{-1} in 600-1000l water & Basudin 40wp @ 750g in 1000-1500l water 2.Pre-emergence herbicide - Kerb @ 2.2kg ha^{-1} in 500l water
Records taken	1.Seedling emergence 2.Soil compaction 3.Plant spacing

Dibber drill Mark II and Coulter drill used for sowing Onion 1/1991



Aerial view of experiment Onion 1/1991
D = dibber plots ; C = coulter plots



Dibber drill Mark III used for sowing Lettuce 1/1993

Contract between BSHR and the Institute of Engineering Research (IER) (hereinafter called the "Contractor") and the Horticultural Development Council (hereinafter called the "Council") for a research/development project.

PROPOSAL

1. TITLE OF PROJECT:

Contract No: FV/40

IMPROVING CROP ESTABLISHMENT BY SEED PRIMING AND THE DIBBER DRILL

2. BACKGROUND AND COMMERCIAL OBJECTIVE:

Work at IHR Wellesbourne over the last 10-15 years has demonstrated the close relationship between yield, variation in size of product, time of maturity within a crop and the number of plants established, the time of emergence of seedlings within a crop, and the size of seedlings at emergence. Several surveys by ADAS have shown that target stands of uniformly emerging seedlings are rarely achieved.

Major progress has been made in developiong seed priming techniques to improve seed quality and primed seed is now being made available by seed companies. However, the full potential from the use of primed seed or, indeed, untreated but high quality seed is unlikely to be realised unless drills are used which can create ideal conditions for germination, and which sow seeds at the same depth and space them uniformly along the row. Recently, significant advances have been made in developing working commercial prototypes of the IER dibber drill, which is capable of sowing seeds at accurate depth and spacing. This drill creates a better environment for the seed and germinating seedling yet achieves high rates of sowing and is a significant advance on current drilling technology.

3. POTENTIAL FINANCIAL BENEFIT TO THE INDUSTRY:

Surveys by ADAS have demonstrated that on average plant stands do not exceed 50% of viable seeds sown and furthermore it is difficult to predict plant stands and therefore exert control over plant size. In addition, there are large variations in plant size and time of maturity of plants within a crop as a result of erratic and uneven seedling establishment. These effects are difficult to quantify but the impact of only a 20% increase in reliability of establishment on production practice would be substantial.

There may also be other benefits. The use of primed seed, which emerges earlier than untreated seed coupled with new seed covering materials which can be delivered by the dibber drill and can aid emergence may provide the potential for replacing a proportion of crops now established more expensively by transplanting. There is the additional benefit associated with the rapid rate of work of the dibber drill enabling more of the acreage to be sown in ideal

Discussions are taking place with drill manufacturers for possible commercial manufacture of the drill.

4. SCIENTIFIC/TECHNICAL TARGET OF THE WORK:

The objective of the work will be to identify and quantify the benefits to be obtained from sowing primed seeds of leek, onion, lettuce and brassicas with the IER Dibber drill and to compare the performance of this combination with conventional seed and conventional drilling techniques. Laboratory trials at IER show that the drill works best with pelleted seeds and a further objective will be to trial at least two pelleting materials. Discussions on the compatibility of pelleting and priming have already taken place and protocols worked out following confidential work between IHR Wellesbourne, School of Chemical Engineering - Birmingham University, and seed companies.

Studies will be made of the effects of replacing the soil cover with artificial media. The drill has been designed to apply these as an integral part of the drilling process.

It is also intended to examine the effects of the combined treatments with different cultivation techniques. At a later stage, studies will be made on different soil types eg: Kirton and Stockbridge, in the presence and absence of irrigation to test reliability of the techniques.

5. CLOSELY RELATED WORK - COMPLETED OR IN PROGRESS:

A programme of work on the physiology of seed germination and seedling establishment is funded at IHR-W by CSG in PUs 2 & 3. Earlier work with experimental versions of the dibber drill showed significant improvement in lettuce crop establishment. Work on seed priming technology continues in PUs 2 & 3, with the British Technology Group, seed companies and with the School of Chemical Engineering - Birmingham University. In none of this work is the combined effect of priming and drilling technique being investigated and no attempts have been made to devise methods to optimise seedbed, seed and drill technology.

6. DESCRIPTION OF THE WORK:

In year 1, primed and untreated seeds (possibly pelleted in two ways) will be sown with a conventional Stanhay and a single unit dibber drill. In addition, the holes 'punched' by the dibber drill to receive the seeds will be covered with different materials (which are delivered by the drill). In this first year, work will concentrate on two species, onion and leek and different seedbed conditions will be achieved by irrigation.

Examination of the results from year 1 may indicate that some treatments can be dropped from the trials in years 2 and 3 and in which case studies of the effects of the drilling and seed technology will be combined with seedbed preparation techniques. The studies will be extended to other species, eg; lettuce and

The studies will be extended to other species, eg; lettuce and calabrese and in year 3, the trials will be extended to other sites and soil types.

At each sowing, measurements of seedbed soil moisture and temperature will be made. Seedling emergence counts will be made daily and estimates of uniformity of spacing and uniformity of sowing depth recorded. In the wide-spaced crops effects on plant growth and yield will be recorded.

7. COMMENCEMENT DATE AND DURATION:

1 April 1991 for 3 years.

8. STAFF AND RESPONSIBILITIES:

The project leader will be Dr D Gray. Day to day responsibility will be with Dr D Gray and an HSO. Dr F Brown, IER and a technician will be responsible for the supply and coperation of the dibber drill. Dr H Rowse, BSHR will co-operate on soil cultivation aspects.

9. LOCATION:

BSHR Wellesbourne in years 1 and 2 and at other sites in year 3.

10. COSTS:

Contract between HRI & SRI (hereinafter called the "Contractors") and the Horticultural Development Council (hereinafter called the "Council") for research/development project.

PROPOSAL

1. **TITLE OF PROJECT**

Contract No: FV/40b
Contract date: 2.4.93

IMPROVING CROP ESTABLISHMENT BY THE DIBBER DRILL

2. **BACKGROUND AND COMMERCIAL OBJECTIVE**

Work at HRI Wellesbourne over the last 10-15 years has demonstrated the close relationship between yield, variation in size of product, time of maturity within a crop and the number of plants established, the time of emergence of seedlings within a crop and the size of seedlings at emergence. Several surveys by ADAS have shown that target stands of uniformly-emerging seedlings are rarely achieved and reliability of establishment is a major problem.

In the last two years the value of the SRI dibber drill which is capable of sowing seeds at accurate depth and spacing, which can create a better environment for the seed than a coulter drill and which can achieve high drilling speeds, has been demonstrated for lettuce, onion, leek and parsnips (FV40). It gives particularly impressive results where soil capping is a problem (see results in Project News Spring '92 for 1991 experiments and submitted report to HDC for 1992 experiments).

The research dibber drill currently used is mechanically complex. A programme of extensive drill development has therefore started which will incorporate revolutionary new ideas to simplify the mechanisms for dibbing and seed transfer and enable simultaneous application of very small quantities of granular pesticide.

Design and development work is at an advanced stage, and a new drill will be ready for testing in the Spring of 1993.

3. **POTENTIAL FINANCIAL BENEFIT TO THE INDUSTRY**

Surveys by ADAS have demonstrated that on average plant stands do not exceed 50% of viable seeds sown and furthermore it is difficult to predict plant stands and therefore exert control over plant size. In addition there are large variations in plant size and time of maturity of plants within a crop as a result of erratic and uneven plant establishment. These effects are difficult to quantify but results in 1991 and 1992 and results with earlier prototype dibbers have shown from 5 to 50% increase in plant stand and greater reliability in plant stands compared with conventional coulter drilling techniques.

4. SCIENTIFIC/TECHNICAL TARGET OF THE WORK

The objective of the work is to investigate the benefit of a dibbing system compared with a coulter and a coulter plus seed press wheel. Two dibbers will be used; the experimental drill with internal seed selection employed in the 1991 and 1992 investigations and a modified version using conventional seed selection technology mounted externally on a new dibber wheel.

5. CLOSELY RELATED WORK - COMPLETED OR IN PROGRESS

A programme of work on seed physiology and crop establishment is funded at HRI by MAFF who are also funding research into methods of reducing chemical application at seeding time at SRI. Further trials are required to evaluate the enhanced, simplified dibber drill.

6. DESCRIPTION OF THE WORK

Following a review by the project co-ordinators and HDC for Projects FV39, 40 and 41 it was agreed that an investigation on the new SRI dibber drill would be made at Wellesbourne in 1993. It is proposed that the crop will be lettuce as this has been used in previous research and a good body of past data from various drilling systems is available for comparison.

Four drills will be studied:

1. 'Old' SRI dibber with internal seed selection as in 1991 and 1992.
2. 'New' SRI dibber with external/modified seed selection.
3. Standard coulter and belt selection of seeds as in 1991 and 1992.
4. Standard coulter plus seed press wheel and 'vacuum' seed selection.

Sowings will be made on two occasions into seedbeds either deliberately 'capped' after sowing or left to encounter natural weather conditions. As previous results had shown that the use of granules of Alcosorb applied to the dibbed hole to reduce soil impedance to seedling growth were on average, ineffective, their use in the current experiments is to be abandoned. However, an investigation of an application of Soiltex compound to the dibbed hole and surrounding area to stabilise its surfaces and to the line of the coulter drills compared with no application will be examined. The experiment will be fully randomised and replicated. Numbers of emerging seedlings will be counted daily until emergence is complete and records will be made, as in previous years, of soil moisture, soil water potential, temperature at seed depth, rainfall, soil impedance above and below the seeds, uniformity of seed sowing depth and accuracy of spacing along the row. Seedling emergence patterns will be related to the measured seedbed characteristics and drill types.

7. **COMMENCEMENT DATE AND DURATION**

Start date 1.4.93 for 1 year

8. **STAFF RESPONSIBILITIES**

The project co-ordinators will be DR D GRAY (HRI), MR J REED (SRI). Day-to-day responsibility will be with MRS J STECKEL (HRI), and MR S MILES (SRI) will be responsible for the supply and operation of the dibber drills.

9. **LOCATION**

HRI, Wellesbourne

Contract No: FV/40b

TERMS AND CONDITIONS

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

Signed for the Contractor(s)

Signature...

Position..

Date..

Signed for the Contractor(s)

Signature...

Position..

Date..

Signed for the Council

Signature...

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

Date....2.4.93.....................................