CONFIDENTIAL*

ESTABLISHMENT OF OILSEED RAPE 1982

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SUMMARY

A range of establishment techniques to establish oilseed rape was tested in a crop sown on a sandy loam soil in August 1981. Very dry conditions prevailed, but direct drilling produced the most rapid emergence and subsequently the highest yields. Ploughing produced the lowest yields. Yield was not affected by Paraplowing before direct drilling or minimum cultivations or by seedrate.

OBJECT

Winter oilseed rape is drilled at a time of the year when seedbed conditions may be far from ideal. Dry weather at the end of August can hinder the making of ideal seedbeds by conventional means, whilst cultivation or lack of rainfall after drilling may result in insufficient seedbed moisture. Furthermore, oilseed rape is grown mainly on'heavy' soils which are prone to cloddiness if cultivation techniques are not ideal. It was for these reasons that trials at several ADAS Experimental Husbandry Farms were initiated to examine various cultivation methods of establishing the crop; to monitor the seedbeds achieved and subsequently the growth of the oilseed rape. The Norfolk Agricultural Station mounted a trial to complement the ADAS series. It was carried out on a farm which practices minimum cultivation to drill the cereals and oilseed rape in a rotation of four cereals followed by a break of oilseed rape.

TREATMENTS

Main plots

1. Plough followed by appropriate conventional cultivations to obtain the fine seedbed required.

2. Plough and press followed by appropriate cultivations.

3. Deep tine cultivations to 10-15 cm.

4. Shallow cultivation (up to 5 cm deep) based on tines.

5. Shallow cultivation as 4, but preceded by the use of a Paraplow to give loosening to at least normal plough depth.

6. Direct drill

7. Direct drill preceded by the Paraplow, as in 5.

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Sub plots (seed rate)

Low (4 kg/ha), Medium (6 kg/ha), High (8 kg/ha)

The seedrate comparisons were included in the trial to see whether low levels of plant establishment which might be given by any of the cultivation treatments could be compensated for by high seedrates, or vice versa.

METHOD

The trial was laid down in a field of burnt winter barley stubble in early August. The appropriate plots were Paraplowed to a depth of 33-35 cm on 16 August at right angles to the proposed direction of drilling. On 26 August the main cultivations took place under very dry conditions. Treatment 1 was ploughed to 24 cm deep along the line of drilling and subsequently rolled. Treatment 2 was ploughed to a similar depth, but because of the action of the furrow press, rolling was not considered necessary. Treatment 3 was tine cultivated along the length of the plot to 10-15 cm deep and then across the plots at right angles to the first cultivation. The hard dry conditions prevented deeper penetration in spite of the large tractor employed. Treatments 4 and 5 were cultivated to 5 cm deep along the length of the plot and subsequently at right angles to this.

Final seedbed preparation consisted of rolling and then cultivating the ploughed plots (treatment 1) to 10-15 cm across the proposed direction of drilling, whilst treatment 2 was considered to have sufficient tilth without additional cultivation.

In view of the dry conditions the host farmer considered it prudent to drill on the same day as the cultivations to prevent undue drying out of the seedbeds. Drilling commenced with the 'direct drilled' plots and the drilling depth was then reset to accommodate the different conditions on the cultivated plots. The whole of one seedrate was drilled before the drill was changed to another seedrate. The trial area was rolled the following morning using a ribbed Cambridge roll.

Soil physical measurements were taken on 27 August and consisted of soil shear strength at 0-5, 5-10 and 10-15 cm, soil moisture content and soil aggregate size distribution at 0-3 cm depth.

Crop assessments began on 8 September with a seedling emergence score, and 'volunteer' barley and common couch grass populations (stem counts) were assessed on 23 September. An establishment count of the oilseed rape seedlings was carried out on 8 October.

An assessment of the compaction at increasing depth through the soil profile was made on 17 February using a soil penetrometer provided and operated by ADAS Soil Science personnel from Cambridge. A final count of the overwintered oilseed rape population was made on 18 March. The trial was harvested on 29 July and sub-samples were taken for moisture and oil content determinations.

The trial area received Fusilade at 3 l/ha against graninaceous weeds on 3 November and Pradone Plus (carbetamide/dimefuron) at 4 kg/ha was used as the broad-leaved herbicide on 6 November. Manuring consisted of 375 kg/ha 0:25:25 in late August and 125 kg/ha of 34.5% N in early February, followed by 565 kg/ha of 34.5% N in late March. This supplied a total of 238:94:94 kg/ha of N:P:K.

A tank mix of Rovral + Hostathion was applied on 26 April and 4 June against foliar diseases and insect pests and the trial was burnt off using Reglone 40 on 19 July.

RESULTS

Particle size distribution and organic matter of the sandy loam soil at the start of the trial are shown below.

Particle Size Distribution %

C Sand >600μ	Sand 210-600μ	F. Sand 105-210μ	V.F. Sand 60-105μ	Coarse Silt 20-60μ	Silt 2-20μ	Clay <2μ	Organic Matter %
3.2	34.4	19.0	6.8	7.8	8.7	15.2	1.7

Soil shear strength (KPa) and moisture content on 27 August (table 1)

Cultivation treatment	Soil depth (cm) 0-5	5-10	10-15	% moisture at drilling 0-5 cm 0-24
1) Plough	9.2	22.0	39.7	8.23
2) Plough and press	8.9	22.0	26.7	8.43
3) Deep tine cultivation	7.2	43.5	73.3	5.13
4) Shallow cultivation	9.4	79.3	75.7	3.83
5) Shallow cultivation + Paraplow	7.3	60.2	59.0	3.47
6) Direct drill	9.6	72.2	71.0	4.50
7) Direct drill + Paraplow	6.5	52.7	52.0	4.80
	(±0.55)	(±5.04)	(±2.41)	(±0.474)
Standard error per plot (12 d.f.)	±0.96 or 11.5%	±8.73 or 17.4%	±4.18 or 7.4%	±0.821 or 15.0%

At the 0-5 cm depth the deep tine cultivation and the two Paraplow treatments were less compacted than the other treatments. At the 5-10 cm depth the plough and the plough and press showed the least compaction, whilst the deep tine was intermediate in compaction but significantly more compact than the ploughing treatments. The Paraplow showed a significant loosening effect on the two treatments where it was used and the equivalent plots without Paraplowing proved to be very compact. At the lowest depth examined the ploughing treatments were considerably less compact than the other treatments. The deep tine cultivations obviously did not reach this depth, as shown by the similar compactions to the shallow tines and direct drilling. Paraplowing still demonstrated a loosening effect at this lowest depth.

The trial was valuable in that extremely low soil moistures were recorded. The two ploughing treatments had the highest seedbed moisture content whilst shallow cultivations both had less than 4 per cent moisture content.

Seedbed quality assessments on the day after drilling (27 August) (table 2)

	% soil aggregate size distribution in the seedbed					
	>53 mm	53-26.5 mm	26.5-9.5 mm	9.5-4.75 mm	4.75-1.7 mm	<1.7 mm
1) Plough + conventional seedbed cultivations	1.45	21.86	35.04	16.45	13.08	12.12
2) Plough and press	3.96	25.16	34.18	13.90	10.52	12.28
3) Deep tine cultivation	4.81	20.93	30.89	14.00	11.26	18.11
4) Shallow cultivation	1.29	18.05	31.66	15.25	11.86	21.91
5) Shallow cultivation + Paraplow	3.60	16.43	32.19	14.62	11.56	21.60
6) Direct drill	4.51	17.52	32.64	14.57	11.50	19.26
7) Direct drill + Paraplow	7.87 (±1.476)	25.62 (±2.207)	31.57 (±1.296)	11.76 (±0.896)	9.07 (±0.718)	14.12 (±2.255)
Standard error per plot (12 d.f.)	±2.556 or 65.1%	±3.822 or 18.4%	±2.244 or 6.9%	±1.551 or 10.8%	±1.234 or 11.0%	±3.905 or 22.9%

Ploughing + conventional cultivations and the shallow tine cultivations produced significantly less very large aggregates (>53 mm) than the direct drill after Paraplowing.

The action of the Paraplow on the large aggregates (53-26.5 mm) was to increase significantly the percentage recorded over the direct drilling alone, whilst the effect was not observed where shallow tines followed the Paraplow. The shallow tine treatments gave the two lowest recordings for this size fraction and were significantly lower than the direct drilling + Paraplow. Ploughing + seedbed cultivations gave the highest percentage of aggregate size between 4.75 and 1.7 mm (fine soil) whilst direct drilling + Paraplow gave the lowest and was significantly lower than all the treatments except ploughing + pressing and deep tine cultivation. The percentage of very fine soil (<1.7 mm) was lowest with the two ploughing treatments and the direct drilling + Paraplow. The two shallow tine treatments and the direct drilling alone gave a significantly higher level of very fine soil when compared with the two ploughed treatments, whilst direct drilling + Paraplow had significantly lower levels than the two shallow tine treatments. Deep tine cultivation had slightly lower levels of very fine soil than the direct drilled treatment.

Seedbed penetrometer readings table 3

Seedbed treatment	Penetrometer reading Kpa on 17th February 1982 Soil depth cm.											
	0 cm	3.5 cm	7.0 cm	10.5 cm	14.0 cm	17.5 cm	21.0 cm	24.5 cm	28.0 cm	31.5 cm	35.0 cm	38.5 cm
1) Plough	5.5	143.5	259.0	303.5	276.3	233.5	223.2	233.7	532.2	869.2	1185.8	1276.3
2) Plough + Press	5.0	156.7	269.2	236.7	212.5	184.2	153.3	216.7	477.5	877.5	1157.5	1286.7
3) Deep tines	6.1	157.7	300.8	438.3	582.7	630.7	675.7	763.2	1097.3	1277.7	1301.0	1357.5
4) Shallow tines	0.0	124.7	384.0	556.0	642.7	630.7	644.7	818.0	1151.3	1348.0	1374.0	1382.0
5) Shallow t. + Paraplow	0.7	122.7	303.3	440.7	520.7	520.7	499.3	573.3	764.7	998.0	1215.3	1238.0
6) Direct Drilling	2.7	163.3	395.3	517.3	632.0	650.0	692.0	800.0	1018.0	1241.3	1330.7	1381.3
7) Direct D. + Paraplow	8.7	104.7	294.0	412.7	463.3	496.7	493.3	562.7	653.3	1010.0	1296.0	1370.7
	(±4.65)	(±25.04)	(±35.02)	(±37.63)	(±40.04)	(±35.13)	(±31.89)	(±49.00)	(±95.03)	(±92.68)	(±52.48)	(±60.95)
Standard error per plot (12 d.f.)	±8.04 or 196.8%	±43.37 or 31.2%	±60.66 or 19.2%	±65.17 or 15.7%	±69.35 or 14.6%	±60.85 or 12.7%	±55.23 or 11.4%	±84.87 or 15.0%	±164.60 or 20.2%	±160.52 or 14.7%	±90.91 or 7.2%	±105.57 or 8.0%

No SIG Diffs

Soil penetrometer readings showed no significant differences between any of the treatments in effect on surface compaction, but it is interesting to note the extremely low figures obtained by shallow tine cultivation.

At depths of 3.5 and 7.0 cm, no significant differences in resistance to the penetrometer probe were noted between the treatments, but the shallow tine and direct drilling gave figures well above the other treatments. At 10.5 and 14.0 cm the two ploughing treatments gave significantly lower figures than the other treatments. The latter included the deep tine treatment, which did not appear to have penetrated as deep as intended, owing to the dry conditions. At these depths Paraplowing significantly reduced soil resistance when compared with the corresponding treatments without the Paraplow. At 17.5 cm depth the deep tine treatment gave similar readings to the shallow tine and direct drill. Both the ploughing treatments gave relatively low penetrometer readings at 28.0 cm depth but the difference between these and Paraplowing was no longer significant. The loosening effects of ploughing and Paraplowing were still evident at 31.5 cm depth, but the effect of the Paraplow on the direct drilling was not significantly different to the direct drilling alone. At 35.0 cm no significant differences were recorded between cultivation treatments.

Seedling assessments of Oilseed rape emergence and weed populations Table 4

	Seedling emergence on 8 September (10 = complete uniform emergence)	'Volunteer' cereal population '000s/ha on 23 September	Couch grass shoots '000s/ha on 23 September
1) Plough + conventional seedbed cultivations	2.33	22	0.00
2) Plough + Press	2.33	8	0.00
3) Tine cultivation to plough depth	1.00	474	23.9
4) Shallow cultivation by tines	0.00	271	43.9
5) Shallow cultivation + Paraplow	0.00	464	23.9
6) Direct drill	6.33	516	81.7
7) Direct drill + Paraplow	4.33	355	35.9
	(±0.388)	(±97.1)	(±11.60)
Standard error per plot (12 d.f.)	±0.673 or 28.8%	±168.2 or 55.8%	±20.08 or 67.2%

The seedling emergence score on 8 September (13 days after drilling) showed that both the direct drilled treatments were more advanced than the ploughed plots. The deep tine treatment had begun to emerge whilst both the shallow tine cultivation treatments showed no emergence at all at this date.

The advantage given by direct drilling would not have been predicted from the seedbed moisture content measured at 0-5 cm at drilling (table 1) or the soil aggregate size distributions in the seedbeds (table 2). It can only be suggested that the lack of soil disturbance inherent in direct drilling prevented moisture loss after drilling, and possibly that the seed/soil contact and that this movement of water to the seed by capillary action was best with direct drilling.

'Volunteer' cereal numbers were variable, but both the ploughing treatments gave significantly lower populations than the other treatments.

At the assessment date on 23 September neither of ploughing treatments showed any signs of couch regrowth . The deep tine cultivations showed a moderate regrowth of common couch whilst the Paraplow treatments had less common couch than the equivalent treatment without Paraplow. However, this difference was only significant with direct drilling, which had significantly more common couch than any of the other treatments.

Plant population '000s/ha when recorded on 8 October 1981 and 18 March 1982

Table 5

	8 October 1981 Seedrate (kg/ha) 4	6	8	Mean	18 March 1982 Seedrate (kg/ha) 4	6	8	Mean
1) Plough followed by conventional seedbed cultivations	411	666	1132	736	375	574	889	613
2) Plough and Press	574	853	881	769	566	690	674	643
3) Deep tine cultivation	602	670	1088	787	534	877	1001	804
4) Shallow tine cultivation	594	821	1168	861	578	881	1076	845
5) Shallow tine preceded by Paraplow	578	933	1060	857	670	841	1064	858
6) Direct drill	650	833	893	792	658	929	957	848
7) Direct drill preceded by Paraplow	470	415	714	533	530	602	610	581
	(±79.1 VI) (±80.6 H)			(± 43.9)	(±96.7 VI) (±82.2 H)			(±63.1)
Mean	554	742	991		559	771	896	
	(±30.5)				(±31.0)			
Standard error per plot	Main (12 d.f.) ±76.0 or 10.0%		Sub plot (28 d.f.) ±139.7 or 18.3%		Main (12 d.f.) ±109.3 or 14.7%		Sub plot (28 d.f.) ±142.3 or 19.2%	

All treatments gave satisfactory plant populations when assessed in early October, and even though a slight winter loss occurred with some treatments, all appeared to over-winter satisfactorily. Paraplowing reduced the population achieved by direct drilling and this effect was still evident in spring. There was an increase in population with increasing seedrate, but this was less evident with some treatments than others.

Yields when harvested on 29 July 1982 table 6

	Yield of seed (t/ha) at 91% dry matter Seedrate kg/ha 4	6	8	Mean	Yield of oil (t/ha) Seedrate kg/ha 4	6	8	Mean
1) Plough followed by conventional seedbed cultivations.	3.09	3.16	3.16	3.13	1.30	1.32	1.31	1.31
2) Plough + Press	3.39	3.18	3.26	3.28	1.43	1.35	1.36	1.38
3) Deep tine cultivation	3.47	3.57	3.41	3.48	1.45	1.50	1.41	1.45
4) Shallow tine cultivation	3.63	3.49	3.41	3.51	1.55	1.48	1.41	1.48
5) Shallow tine cultivation preceded by Paraplow	3.34	3.39	3.60	3.44	1.39	1.41	1.48	1.43
6) Direct drill	3.57	3.57	3.54	3.56	1.46	1.48	1.49	1.47
7) Direct drill preceded by Paraplow	3.54	3.57	3.60	3.57	1.49	1.51	1.48	1.49
		(±0.160 VI) (±0.095 H)		(±0.072)		(±0.052 VI) (±0.045 H)		(±0.037)
Mean	3.43	3.42	3.42		1.44	1.43	1.42	
		(±0.036)				(±0.017)		
Standard error per plot	Main plot (12 d.f.) ±0.126 or 3.7%		Sub plot (28 d.f.) ±0.165 or 4.8%		Main plot (12.d.f.) ±0.063 or 4.4%		Sub plot (28 d.f.) ±0.077 or 5.4%	

The two direct drilled treatments yielded higher than the other treatments, and the differences were statistically significant when compared with the ploughed plots. Ploughing followed by traditional cultivations yielded significantly less than all the non-ploughed treatments. Seedrate had no effect on yield of seed. Yields of oil generally followed the trends shown by the yield of seed, with the direct drilling and tine cultivation treatments significantly outyielding the ploughing followed by traditional cultivations.

This initial investigation into cultivation for oilseed rape has highlighted the necessity for rapid establishment. August 1981 was particularly dry and not at all conducive to seedling establishment. Nevertheless direct drilling provided the conditions for rapid emergence. This effect must have contributed to the increased yield achieved by this treatment, but future work in differing conditions and seasons is necessary to give further insight into the best method of establishing the crop.

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