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Factors limiting yield of winter oilseed rape

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The first multidisciplinary experiment with Bienvenu winter oilseed rape was completed this year. The rape followed winter barley in an arable rotation on a deep flinty loam. Seven treatments (Table 1) were tested in factorial combination on 64 plots, with 8 extra plots to establish a nitrogen response curve, 8 to complete a replicate of treatments for detailed growth and physiology studies, 8 testing a nematicide, 3 for 15N studies, 2 for root studies, 2 untreated and 1 testing a new growth regulator. Basal treatments were : straw burning and paraquat after barley, shallow cultivation, 50 kg N/ha to the seedbed, 8 kg/ha seed rate, and 17 cm row width "Matrikerb" on 30 October. The experiment was netted from 5 December to 3 April to prevent pigeon damage. Desiccant was applied on 25 July and plots combined on 12 August.

Main features of treatments, growth and development

Sowing date and attack by cabbage stem flea beetle had most effect on growth and development.

Despite emergence within 7 days, early-sown (E) plots established fewer plants than later-sown plots (L). The difference in plant population was maintained up to maturity when L plots had nearly twice the number of plants (45 v. 87 plants/m^2). Rapid early growth on E plots produced a much more dense leaf canopy than on L during autumn (2.7 v. 1.1 leaf area index in November). However, E plots were much more severely damaged than L by adults and larvae of cabbage stem flea beetle (98 v. 37 % plants damaged, 11.5 v. 0.8 larvae/plant where no autumn insecticide had been applied). Autumn insecticide gave good control of larval damage, decreasing the numbers of larvae/plant on E plots from 11.5 to 0.8 and maintaining greater plant population, dry matter and leaf area up to maturity. More plants and more leaf area was lost from E than from L plots over winter. Diseases were slight during autumn and winter, but incidence of downy mildew, light leaf spot, *Botrytis* and *Alternaria* leaf spot was greater on E than L.

During April and early May the growth stage of E plots was more advanced than L and plots given autumn insecticide more advanced than those untreated. However, after a period of rapid growth L plots soon equalled E in development and had greater leaf area. Canopy structure in E plots was distinctly different from L. The fewer plants in E plots developed many more branches than those in L (10.0 v. 4.7/plant on 30 april). More branches developed later in L plots and by June these had 15 % more fertile pods per unit area and by July 15 % greater pod dry weight per unit area than E plots.

Pests were few during flowering and maturation ; the numbers of pollen beetles, seed weevils and pod midge were well below the threshold levels which would have justified the use of summer insecticide. No fungal disease was severe during spring and summer. Light leaf spot eventually became more prevalent on L plots, but all other diseases (downy mildew, *Botrytis, Phoma* leaf spot and canker, beet western yellows virus) were more common on E plots. There were four times as many plants infected with beet western yellows virus on E than on L plots. The autumn and the spring fungicide significantly decreased the incidence of light leaf spot and *Phoma* and plots given the full programme of fungicide sprays had least infection. *Alternaria* was very slight on pods. A few plants were infected by *Sclerotinia sclerotiorum*. Nematodes were numerous but not damaging.

Yield at maturity and at combine harvest

Strong winds and much rain during the interval between crop desiccation on 25 July and combine harvesting on 12 August caused much seed to be shed. Table 1 therefore gives yields obtained from a hand harvest on 22 July before shedding started as well as combine harvest yields so that treatment effects may be compared. The mean hand-harvested yield of all 64 factorial plots was 5.25 t/ha and mean combine yield 3.95 t/ha, indicating a mean yield loss of 1.3 t/ha from shedding. Even the large benefit from insecticides (0.96 t/ha) was lost by the later harvest date. Most loss was on E plots and those given treatments which hastened maturity. Both sets of data show the significant benefit (0.76 t/ha from hand and 0.65 t/ha from combine harvest) from the later sowing date. Best 16-plot mean combine yield was 4.38 t/ha from L plots given 275 kg N/ha. Best single-plot combine yield was 5.27 t/ha. The 2 plots sown

early or later without further treatments yielded 2.71 and 3.27 t/ha respectively.

The greater yield on L plots and those given insecticide came from increased numbers of fertile pods per unit area. Increases in 1000 seed weights were caused by earlier sowing, growth regulator, and by spring and summer fungicides.

Summary

The potential advantages of better growth and increased leaf area from early sowing was counteracted by loss of plant population, much increased damage by cabbage stem flea beetle larvae and increased incidence of disease. A complete analysis and interpretation of yield responses to inputs was complicated by a late harvest under wet conditions with much shedding of seed.

Table 1

Treatments tested and their effects on yield of Bienvenu winter oilseed rape. Yields meaned over all other treatments and for treatments 2-7 analysed to show response on early and later sown crops.
(Hand-harvest yields from 0.85 m^2 per plot on 22 July, combine yields 12 august)

Yield (t/ha)

Harvested by	Hand	Combine	Combine	
			Sown 16 Aug.	Sown 6 Sept.
1. Sowing date				
16 August	4.87	3.63	–	–
6 September	5.63	4.28	–	–
2. Spring nitrogen rate (kg N/ha)				
175	5.00	3.94	3.69	4.18
275	5.50	3.97	3.57	4.38
3. Spring nitrogen timing				
All on 25 February	5.27	3.97	3.72	4.23
1/3 on 25 February + 2/3 on 25 March	5.23	3.94	3.54	4.34
4. Insecticide *				
Without	4.77	3.93	3.64	4.23
With	5.73	3.97	3.62	4.33
5. Autumn fungicide **				
Without	5.22	3.96	3.66	4.26
With	5.28	3.95	3.60	4.30
6. Spring & summer fungicide ***				
Without	4.96	3.95	3.64	4.27
With	5.54	3.95	3.62	4.29
7. Growth regulator ****				
Without	5.19	4.03	3.87	4.19
With	5.31	3.88	3.38	4.37
(SED)	(0.269)	(0.065)	(0.092)	(0.092)

* Deltamethrin as "Decis" on 4 October and 28 November plus triazophos as "Hostathion" on 17 June.
** Fenpropimorph seed dressing and prochloraz as "Sportak" on 26 November.
*** Prochloraz as "Sportak" on 4 April plus iprodione as "Rovral Flo" on 17 June.
**** Ethephon as "Cerone" on 23 May to early sown and 29 May to late sown.