



Horticultural Development Council

Working for Growers

Research Report

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Green Beans: Broad-leaved Weed
Control with Fomesafen

(Jointly funded by HDC and ICI)

PROCESSORS & GROWERS RESEARCH ORGANISATION

Green Beans: Broad-leaved Weed Control with Fomesafen (FD 4276)

ICI Agrochemicals - 1991

Project: GB50-91-H770-S

SUMMARY: Flex W (FD 4276) a formulation of 250 g/l of active ingredient fomesafen was applied post-emergence in a volume of 200 l/ha at a range of rates including split doses to green beans (*Phaseolus vulgaris*) at five sites in the main production areas, and compared with standard herbicide Basagran (bentazone) for crop tolerance and broad-leaved weed control.

FD 4276 was selective at rates up to and including 1.8 l/ha in green beans for early applications from simple leaf stage and later, even at high temperatures. Crop safety was greater than Basagran. The weather was cool after early sowings, growth rate of weeds was faster than green beans. Consequently weeds were large at first application timing and treatments were less effective than in 1990. It was clear that a programme preferably with a pre-sowing (trifluralin) or pre-emergence (monolinuron) herbicide followed by early post-emergence application of FD 4276 is essential and would also control resistant species *Stellaria media* and *Poa annua*. FD 4276 controlled a wide weed spectrum. Doses of less than 0.9 l/ha were inadequate. Split doses of (0.45 & 0.45)l/ha performed better than 0.9 l/ha applied early at some sites, worse at others.

OBJECT:

1. To determine the rate of FD 4276 for optimum weed control and crop safety in green beans.
2. To compare the effect of a split with a single application of FD 4276.
3. To monitor the effect of soil residues on following crops.
4. To obtain samples for residue and taint testing.

TREATMENTS:

Material	Rate product l/ha	Timing (green bean growth stage)
1 Untreated	-	-
2 FD 4276	0.3)
3 "	0.45) T ₁ 1st trifoliolate
4 "	0.70) leaf or after weed
5 "	0.9) emergence
6 "	1.8)
7 " & FD 4276	0.3 & 0.3) T ₁ 1st trifoliolate &
8 " & "	0.45 + 0.45) T ₂ 2nd trifoliolate
9 " & bentazone	0.45 & 2.0)
10 bentazone (Basagran)	3.0) 2nd trifoliolate
#11 trifluralin (Treflan) & FD 4276	1.75 & 0.45) pre-sowing & T ₁
#12 monolinuron (Arresin) & FD 4276	3.0 & 0.45) pre-emergence & T ₁

* at Thornhaugh site only

FD 4276 as formulation Flex W as 250 g/l fomesafen with wetter incorporated in formulation.

LAYOUT: Randomised block, four replications. Plot area 4 m x 8 m at Kirton and Thornhaugh, 4 m x 5 m at Three Holes, Swaffham and Heydon. Harvest area 2 rows per plot 0.5 m x 8 m at Thornhaugh, 0.9 m x 4 m at all other sites.

SITE DETAILS:

Site	Soil type	Sowing date	Seed depth	Plant population pl/m ²	Variety
1 Swaffham, Norfolk	LS	15/5	4 cm	40	Provider
2 Thornhaugh, Cambs	FSL	20/5	3 cm	45	Groffy
3 Three Holes, Cambs	> 15% OM	29/5	4 cm	40	Modus
4 Heydon, Norfolk	LS	8/6	3 cm	40	Labrador
5 Kirton, Lincs	VFSL	10/6	3 cm	40	Nerina

APPLICATION DATA:

1. Pre-sowing, pre-emergence data

Site	Spray date	Crop stage	Seed depth	Seedbed
Thornhaugh tr. 11	16/5 + incorp	pre-sow	-	-
Thornhaugh tr. 1 & 12	24/5	radicle 1cm	3cm	fine, rolled, very dry

2. Post-emergence

Site	Spray date	Crop stage	Weed stage [#]	Weather conditions
1.	1/7	1 trif-L	BILCO 2-3 TL URTUR 4 TL - small plant MAT spp. 6-8 TL SENVU 6 TL POLAV small plant	(6pm) 20°C 62 RH 100% cloud cover (rain overnight >6 hAT)
	10/7	3½ trif-L	all small plant	(4pm) 20°C 48RH thin cloud cover, hazy sun
2.	29/6	1 trif-L (simple L - 1½ trif-L)	CHEAL, POLAV, STEME, POAAN - large plant BILCO Cot - 2-4 TL SOLNI 2-4 TL Vol. Pots 25cm tall	21°C 47 RH sunny, 20% cloud cover
	10/7	2 trif-L	all large plant stage	(6pm) 20°C 58 RH, hazy sun, 60% cloud cover
3.	5/7	most ½ trif-L a few simple L	VERPE 2-4 TL BILCO 2-3 TL MAT 4 TL - small plant CHEAL 6-8 TL small plant POLAV small plant GALAP 3 whorl GALTE 4 TL LAMPU 10 TL - small plant	(5.30am) 17°C 67 RH (24°C later) hazy sun, no cloud
	14/7	1½-2 trif-L	all large plant	(7.30am) 17°C 71 RH sunny, 50% cloud cover
4.	10/7	½-1 trif-L	STEME, POAAN - small plant VERPE, VIOAR 2-4 TL LAMPU, MYOAR 4 TL MAT spp. 6 TL	(10am) 23°C 54 RH sunny, no cloud
	17/7	1½ trif-L	all small plant MAT spp. 6 TL	(8am) 18°C 65 RH (20°C later) sunny, 20% cloud cover
5.	7/7	simple leaf a few ½ trif-L	URTUR, POLPE 4-6 TL CAPBU, FUMOF 6 TL MAT 2TL CHEAL 4 TL SENVU 2-4 TL	(9am) 21°C 66 RH (26°C later) 100% cloud cover, sunny
	14/7	1-1½ trif-L tr. 7,8&9 crop no visible effect	all large plant URTUR above crop height	18°C 60 RH sunny, 40% cloud

[#] Bayer code for weed names

Applied with a Van der Weij plot sprayer, propane gas. Nozzles Lurmark 015 F80 flat fan delivering 200 l/ha water volume, at a pressure of 1.9 bar (190 kPa)

METHOD: Trials were conducted at PGRO and at sites in 4 commercial crops on a range of soil types. At site 1 trifluralin as Treflan @ 1.5 l/ha was applied overall pre-sowing and incorporated. The beans were sown with a Nordsten cereal drill at site 2 and with pneumatic precision drills at the 4 other sites. Normal husbandry for the green bean crop was carried out at all sites. Beans were sown into very dry conditions at Thornhaugh and emergence was uneven, but emergence was very good at the other sites.

The rainfall during May was much less than average, during June rainfall was greater than average. Temperatures following drilling at all sites were lower than average, bean growth was very slow and growth stage of weeds became advanced in comparison. The first sprays were therefore applied early in most cases (see application data).

Crop effects were assessed at intervals. Counts of weed species for $1/3m^2$ quadrats in 3 random positions per plot were made, and scores for overall weed control were recorded.

Site 5 was too weedy to harvest efficiently, all other sites were harvested by hand when the green beans were at canning/quick-freezing stage of maturity. Yields were recorded and maturity of the beans were assessed (per plot, or treatments sampled and bulked for the 4 replicates) by measuring 10 bean seed lengths, the most mature seed taken from the most mature pods as a random sample of 10 per plot. Yield and maturity data were statistically analysed.

Separate samples of treatments 1 and 5 were taken at sites 1, 2, 3 and 4 for residue analysis. Samples of treatments 1 and 6 were quick-frozen and canned and sent to CFDR for taint testing.

RESULTS:

1. Crop Effects

Scores for crop damage are shown in Table 1.

At site 2 there were no differences between untreated green beans and those treated with Arresin or Treflan pre-sowing.

Crop safety with FD 4276 was excellent at all sites where green bean growth stages ranged from simple-leaf at sites 2 & 3 to 2-3 $\frac{1}{2}$ trifoliolate leaf stage at the latest timing, even when applications were at, or prior to, high temperatures. Only slight leaf crinkling was observed from the 1.8 l/ha rate and at two sites from the 0.91/ha rate, and the crop soon recovered. Basagran on the other hand at normal rate at 3 l/ha was more damaging under these conditions and caused severe scorch at some sites.

RESULTS:

1. Crop Effects

Table 1

Treatment	Rate product 1/ha	Site	Crop Score					Date:	Date:	Crop Score								
			1	2	3	4	5			1	2	3	4	5				
1. Untreated	-	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
2. FD 4276	0.30	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
3. FD 4276	0.45	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
4. FD 4276	0.70	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
5. FD 4276	0.90	10	10	8.5	9.8	10	10	10	10	10	10	10	10	10	10	10	10	10
6. FD 4276	1.80	10	8.5	7.9	9.5	9.5	10	8.75	10	10	9.5	10	10	10	10	10	10	10
7. FD 4276																		
& FD 4276	0.3&0.3	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
8. FD 4276 &																		
FD 4276	0.45&0.45	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
9. FD 4276 &																		
Basagran	0.45&2.0	10	10	10	10	10	10	8.5	9.5	9	9.2	8.5	8.5	9.5	10	10	10	10
10. Basagran	3.0	-	-	-	-	-	-	7.75	8.25	8	8.8	7	8.8	9	10	10	10	10
#11. Treflan &																		
FD 4276	1.75&0.45	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
#12. Arresin &																		
FD 4276	3.0&0.45	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Crop Score 10 - no damage; 7 - acceptable damage; 0 - completely killed
 # 11 & 12 at site 2 only

2. Weed Control

Site 1 - Swaffham

Treatment	Date:	No. Weed Species/m ²								*Weed Score	
		POLAV	BILCO	URTUR	VIOAR	§MAT spp.	CHEAL	SENVU	Total	Overall	1/8
1.	6	1.75	25.0	6.25	56.5	4.0	7.0	103.25	0	0	
2.	2	-	1.75	7.5	2.75	1.5	-	15.5	7.2	6.6	
3.	3	0.5	1.75	2.75	2.25	2.5	-	10.25	7.4	7.5	
4.	2.25	-	-	0.75	2.0	1.25	-	6.25	8.6	8.5	
5.	1.75	0.5	0.5	-	0.5	0.75	-	4.0	9.6	9.4	
6.	1.25	-	-	-	-	-	-	1.25	9.9	9.9	
7.	5.25	-	1.75	1.0	7.25	2.75	-	15.25	6.8	6.5	
8.	0.25	-	-	0.5	3.75	1.25	-	4.5	9.4	9.0	
9.	3.75	-	0.25	3.25	-	2.25	-	9.5	8.9	8.8	
10.	3.25	1.5	4.25	5.0	-	3.25	1.0	18.25	7.0	6.8	

* Weed Score 0 = complete kill; 7 = acceptable control; 0 = no control

§ MAT spp. = mainly *Matricaria matricarioides* pineapple mayweed (not controlled by treatments) and *Tripleurospermum inodorum*

The trial area was sprayed with trifluralin pre-sowing and incorporated, but at the low rate (1.5 l/ha) used weed control was incomplete. *Polygonum aviculare* was at small plant stage at T₁ and was not controlled by any treatment. Other weeds were also at an advanced stage when sprayed (although the crop was only at 1 trifoliate leaf stage) but FD 4276 achieved excellent control of *Urtica urens*, and good control of *Matricaria* spp., *Senecio vulgaris* and *Bilderdykia convolvulus* at most rates. Higher rates were needed for *Chenopodium album* and *Viola arvensis*. Bentazone alone, which was applied late was ineffective on *V. arvensis* and *P. aviculare* and less effective than FD 4276 on *U. urens* and gave unacceptable level of control.

Control with FD 4276 at 0.3 l/ha single and repeat dose was poor, and 0.45 l/ha at single dose was only just acceptable. At this site the best treatments were FD 4276 @ 0.9 l/ha (and 1.8 l/ha) and the repeat dose of 0.45 l/ha.

Site 2 - Thornhaugh

Treatment	No. Weed Species/m ²											*Weed Score Overall	
	VERPE	CHEAL	CAPBU	STEME	MAT Spp. ‡	POLAV	POAAN	SOLNI	BILCO	SENVU	TOTAL	20/7	8/8
1.	1.25	11.7	3.5	5.0	2.25	10.0	22.25	8.0	1.25	5.0	70.2	0	0
2.	3.75	10.5	0.25	6.0	1.5	7.5	12.0	-	3.25	2.0	46.75	1.0	1.0
3.	-	8.0	-	5.5	1.5	10.75	14.0	-	1.25	0.75	41.75	2.0	2.5
4.	-	2.75	-	4.0	-	9.0	11.25	-	2.0	0.75	29.75	3.75	3.0
5.	-	4.25	-	5.25	-	7.0	13.5	-	-	0.5	30.5	4.0	3.5
6.	-	3.0	-	4.0	-	7.0	10.0	-	-	-	21.0	5.0	6.0
7.	-	3.25	-	5.25	-	11.0	13.75	-	1.5	0.5	34.25	2.25	2.0
8.	-	5.5	-	3.0	0.75	9.25	16.0	-	0.5	0.25	35.25	3.0	3.0
9.	1.25	6.25	-	-	-	8.75	12.0	-	-	-	28.25	3.7	2.5
10.	1.0	6.75	-	-	-	11.0	11.0	-	-	-	29.75	1.75	1.0
(11.	-	-	12.0	1.75	4.75	1.0	1.25	12.0	-	4.0	36.75)	3.0	
(12.	-	-	-	-	0.25	12.75	0.75	3.0	0.75	-	17.5)	3.0	
11.	-	-	-	-	1.0	-	-	-	-	0.5	0.5	-	8.0
12.	-	-	-	-	-	11.0	0.75	-	-	-	11.75	-	7.0

* Weed score 0 = complete kill; 7 = acceptable control; 0 = no control

() Weed counts on 2/7 before FD 4276 application

‡ MAT spp. = *Tripleurospermum inodorum*

The best weed control was with programme of trifluralin pre-sowing which gave excellent control of *P. aviculare*, but poor control of *Capsella bursa-pastoris* and *Solanum nigrum*, which were susceptible to a follow-up treatment with 0.45 l/ha of FD 4276. The programme with monolinuron pre-emergence followed by FD 4276 @ 0.45 l/ha was not effective because *P. aviculare* which escaped control by monolinuron was too large to control with FD 4276 @ 0.45 l/ha. FD 4276 @ 1.8 l/ha gave a similar level of control to the programme with Treflan, the predominant weed remaining was *Poa annua* with some *P. aviculare* and a few *C. album*. Basagran, applied at the T₂ timing gave very poor weed control since the predominant species were resistant and the *C. album* was too large.

FD 4276 at rates lower than 0.7 l/ha was ineffective, and the split dose of 0.45 & 0.45 l/ha was not as effective as the 0.9 l/ha dose applied early. *S. media* and *P. annua*, both resistant and *C. album* and *P. aviculare* were not controlled by FD 4276 at any rate. These last two weeds became very advanced, whilst green bean growth was slow. FD 4276 appeared to achieve better control of *B. convolulus*, *Senecio vulgaris*, but rates of 0.7 l/ha and above were generally needed, and good control of *Solanum nigrum* and *Capsella-bursa-pastoris*.

There was a random distribution of volunteer potatoes at this site and FD 4276 at doses of 0.7 l/ha and above caused severe damage and stunting, but effects were only temporary.

Site 3 - Three Holes

Treatment	MAT Spp.	GALAP	VERPE	BILCO	SENVU	MYOAR	CHEAL	No. Weeds/m ²				TOTAL	#Weed Score Overall			
								LAMPU	POLPE	EUPPE	GALTE		POLAV	21/7	28/7	4/8
1.	17.25	2.0	5.25	4.5	1.5	2.0	4.75	10.25	3.0	0.5	1.25	1.0	52.25	0		
2.	10.25	-	2.25	3.0	-	1.75	3.0	10.00	0.5	-	0.25	1.0	33.0	1.75		
3.	9.75	-	-	3.0	0.25	3.5	2.5	8.75	0.5	-	0.75	1.0	30.0	2.5		
4.	6.75	-	-	2.0	0.25	1.75	0.25	10.0	-	-	0.5	0.5	22.0	3.75		
5.	6.75	-	-	1.0	0.25	1.75	0.75	7.25	-	-	-	-	17.75	4.75		
6.	3.5	-	0.5	0.75	-	1.5	0.25	7.25	0.25	-	-	0.5	14.5	6.25		
7.	13.0	0.75	-	2.0	0.75	1.25	3.0	8.0	-	-	-	0.5	29.25		3.25	
8.	7.5	1.0	-	1.25	0.5	1.5	0.75	6.0	-	-	0.25	0.75	19.5		4.75	
9.	0.5	-	1.25	0.5	-	0.25	2.5	1.25	-	0.5	1.25	1.75	9.75		7.0	
10.	0.5	-	4.0	0.75	0.25	0.25	3.5	-	-	1.0	1.0	1.25	12.5		6.25	

Weeds score 10 - complete kill; 7 - acceptable control; 0 - no control

§ MAT spp. - mainly *Tripleurospermum inodorum* (scentless mayweed) (not controlled by treatments)

Although weed numbers were low, the fertile soil and irrigation resulted in vigorous growth and crop suppression. At this site weed growth was too advanced (*C. album* 6-8TL and *Lamium purpureum* 10 TL small plant) at the time of first application for control with any treatment. At low doses FD 4276 did not control *T. inodorum*, *C. album* or *B. convolvulus*, but was effective on *P. persicaria*. *P. aviculare* was not controlled by any treatment. FD 4276 scorched but did not kill large *L. purpureum*. Basagran applied at T₂ did not control large *B. convolvulus* and *C. album*, but controlled *T. inodorum* and *L. purpureum*. Repeat doses 7 & 8 performed a little better than single doses 2 & 3; there was not much difference in overall control between treatment 5 FD 4276 0.9 l/ha and treatment 8 FD 4276 @ 0.45 followed by 0.45 l/ha. Low doses less than 0.9 l/ha were ineffective on large weeds. Treatment 9, 10 & 6 were the best treatments but none gave an acceptable level of weed control.

The following species were present at low populations:- *Myosotis arvensis* appeared resistant to FD 4276 (and moderately resistant to Basagran); *Euphorbia pepilus* appeared susceptible to FD 4276 but resistant to Basagran. *Galium aparine* was severely stunted, and sometimes killed by rates of 0.9 l/ha of FD 4276 and above. FD 4276 seemed slightly more effective than Basagran on *Galeopsis tetrahit* which was killed by the higher dose rates, but only stunted by Basagran.

There was an uneven population of volunteer wheat at this site but it was noted that FD 4276 caused severe stunting and plant death at 1.8 l/ha and severe stunting at 0.9 l/ha; there was little effect on black grass. On 5/7 additional plots were sprayed with a tank-mix of (a). FD 4276 + Laser + Actipron (0.9 + 1.25 + 1.8)l/ha or (b) FD 4276 + Fusilade 5 (0.9 + 1.5)l/ha + Agral at 0.1% final volume. Both treatments completely controlled volunteer cereals, broad-leaved weed control was similar to FD 4276 alone and there did not appear to be antagonistic effects. There were slight crop effects from both treatments in the form of leaf crinkling. Crop scores 5 DAT were (a) 8 and (b) 9, but by 16 DAT the crop recovered.

Site 4 - Heydon

Treatment	Date:	No. Weed Species/m ²							*Weed Score Overall			
		STEME	LAMPU	POAAN	§MAT	spp.	VIOAR	VERPE	MYOAR	Total	17/7	29/7
1.	23.5	9.25	58.5	23.5	3.25	9.0	2.0	129.0	0		0	
2.	25.0	6.25	16.6	8.3	0.25	0.25	0.5	56.65	2.0		1.0	
3.	16.0	5.25	46.25	3.5	-	-	0.25	71.25	3.25		2.25	
4.	16.0	3.5	33.5	0.75	-	-	-	53.75	4.25		3.4	
5.	10.0	3.75	26.25	5.25	-	-	-	45.25	5.5		4.5	
6.	14.25	1.75	3.25	0.75	-	-	-	20.0	6.0		4.9	
7.	8.0	9.25	23.75	8.5	0.25	-	0.5	50.25		4.6	4.0	
8.	12.5	4.5	18.75	6.75	-	-	0.5	43.0		5.0	4.8	
9.	-	9.25	25.5	-	1.25	-	-	36.0		7.5	7.25	
10.	-	14.5	24.25	-	4.25	2.0	-	45.0		6.8	6.75	

Weed Score 10 = complete kill; 7 = acceptable control; 0 = no control
 § MAT spp. = mainly *Tripleurospermum inodorum* (scentless mayweed) and *Matricaria matricarioides* (pineapple mayweed)

At this site the farm crop adjacent to the trial was treated with Arresin (monolinuron) applied to moist soil pre-emergence and nearly 100% weed control was achieved.

The weed species on the untreated control were not tall and did not shade the crop, but *Stellaria media* became very large and competed for moisture. None of the treatments in the trial performed as well as the farm treatment and level of control was only acceptable from FD 4276 at 0.45 l/ha followed by Basagran at 2 l/ha which controlled *Stellaria media* and also *Matricaria* spp. Repeat applications of 0.45 l/ha did not perform much better than 0.9 l/ha applied early.

FD 4276 did not control *Stellaria media*, and no treatment, with the exception of FD 4276 at 1.8 l/ha, controlled *Poa annua* (and possibly the *Myosotis arvensis* present in low numbers). FD 4276 gave good control of *Veronica persica* and *Viola arvensis*, which was present at low populations, better than Basagran. Control of both *Matricaria* spp. was variable with FD 4276 and only reliable at 1.8 l/ha, whilst Basagran gave complete control. Control of *Lamium purpureum* was poor with Basagran at this site, and with FD 4276 except at 1.8 l/ha.

There was a low and uneven distribution of rye grass at this site, about 5 plants/m², these were severely stunted by treatments with FD 4276 at 0.9 l/ha and stunted and killed by 1.8 l/ha.

Patches of *Hippuris vulgaris* were severely scorched by treatments 5 & 6.

Site 5 - Kirton

Treatment	Date:	No. Weed Species/m ²								#Weed Score Overall			
		URTUR	STEME	§ MAT Spp.	CHEAL	SENVU	POLPE	POLAV	FUMOF	TOTAL	20/7	1/8	9/8
1.		127.75	15.0	74.75	12.75	10.75	4.75	2.25	5.75	253.75	0		0
2.		80.0	12.0	42.5	5.25	7.5	0.5	0.25	1.25	149.5	1.5	1.7	1.0
3.		45.0	14.0	37.25	5.75	6.25	3.75	0.75	1.0	113.75	2.5	3.0	1.6
4.		34.75	12.5	36.25	7.5	7.25	2.0	0.25	-	100.5	3.2	3.75	2.0
5.		5.5	11.25	44.75	4.0	3.25	1.5	-	0.5	70.75	4.2	4.0	2.6
6.		4.5	11.25	27.25	1.0	0.5	1.25	0.5	-	46.25	5.8	6.0	4.2
7.		2.0	14.0	21.0	0.5	2.5	0.25	-	-	40.25		3.5	3.5
8.		-	12.5	21.0	-	0.75	0.25	-	-	34.5		4.75	4.5
9.		4.5	-	-	6.25	0.25	-	-	2.0	13.0		5.25	4.1
10.		6.25	-	-	13.75	-	-	-	2.0	22.0		3.5	4.8

* Weed Score 10 = complete kill; 7 = acceptable control; 0 = no control

§ MAT spp. - mainly *Matricaria matricarioides* pineapple mayweed and some *Tripleurospermum inodorum* (scentless mayweed)

The most predominant weed species *U. urens* was well controlled by FD 4276 at 9.0 + 1.8 l/ha applied at T₁, repeat doses even 0.3 l/ha and by Basagran. *Stellaria media* was completely resistant to even 1.8 l/ha of FD 4276 but Basagran at 2 l/ha gave complete control. Basagran did not control large *C. album* but repeat doses and high rates of FD 4276 applied early achieved control, the lower doses causing severe stunting. At this site control of *S. vulgaris* with FD 4276 was poor except with high rates. Control of *Matricaria* spp. at 2 true leaf stage was poor at this site with all treatments except Basagran.

Weed growth was very vigorous and populations high. No treatment achieved an acceptable level of control, but Basagran was the most effective treatment. The repeat split doses performed better than single full doses of FD 4276.

There was an uneven distribution of volunteer potatoes at this site. FD 4276 damaged shoots, severely in the case of higher rates and caused stunting. Repeat dose applications 7 & 8 prevented flower and berry formation.

3. Yield & Maturity Data

Treatment	Rate l/ha Site: Harvest Date:	Yield as % Untreated				Maturity				
		1 [§]	2	3	4	10 1*	Seed length mm	2	3	4
		7/8	8/8	15/8	22/8	7/8	8/8	15/8	22/8	
1 Untreated	-	100	100	100	100	109	84	75	96	
2 FD 4276	0.3	133	200	219	128	115	92	79	95	
3 "	0.45	140	184	247	148	119	92	89	103	
4 "	0.70	140	193	275	184	114	97	84	99	
5 "	0.90	147	229	306	196	113	96	84	96	
6 "	1.80	147	257	322	191	121	98	92	100	
7 " & FD 4276	0.3 & 0.3	128	175	246	169	111	92	87	99	
8 " "	0.45 & 0.45	148	229	298	156	117	95	86	105	
9 " & Basagran	0.45 & 2.0	132	197	312	195	121	97	86	98	
10 Basagran	3.0	135	168	320	191	120	92	88	99	
#11 Treflan	1.75		333				97			
#12 Arresin	3.0		323				94			
Yield untreated t/ha		5.93	2.32	2.61	4.08					
Significance @ P = 0.05		SD	SD	SD	SD	SD	SD	NSD		
LSD @ P = 0.05		24.1	66.74	65.4	23.87	5.9	5.6	-		
CV %		12.3	21.5	17.1	9.9	4.4	4.6	6.8		

at Thornhaugh site 2 only

§ site 1 sprayed overall with Treflan pre-sowing

* treatments bulked from 4 reps (not analysed)

As in the 1990 trials, weeds on untreated plots caused severe yield reduction. Yield loss was up to 60% at sites 1, 2, 3 & 4. Site 5, where the population of weeds including tall nettles, could not be harvested and would probably have shown even greater effects.

All treated plots yielded significantly better than untreated plots. To some extent treatment yields were a reflection of the level of weed control achieved with lower yields for low dose rates of FD 4276 at sites 1, 3 & 4, and where weeds removed late with Basagran sites 1 & 2. Plots harvested with Basagran yielded well at site 4, however where it controlled *S. media* and also at site 3. The highest yielding treatments were 6, 5 & 8 at sites 1 & 2, and treatment 6 at site 3.

Maturity of beans was not influenced by herbicide treatment at site 3 but was significantly less where tall weeds on untreated shaded the crops at sites 2 & 3 and possibly site 1.

CONCLUSIONS: FD 4276 applied up to 1.8 l/ha to green beans at growth stages from simple leaf to 1 trifoliate leaf stage and at temperatures up to 23°C caused very little crop damage, only slight leaf crinkling. Under hot conditions FD 4276 had a wider margin of crop safety than Basagran which was applied at a later growth stage.

Four sites were harvested and all treated plots yielded significantly better than untreated controls where yields were reduced by up to 69% and could have been greater than this at site 5. To some extent yields of green beans were a reflection of level of weed control achieved.

Weather conditions were different from 1990. Trials were sown between 15th May and 10th June. Temperatures were low, May was an exceptionally dry month and there was little significant rainfall until the second half of June. Green beans suffered from delayed emergence and poor growth, but weeds were affected less and growth stages were advanced at the time of treatment. Some treatments were therefore applied before the beans reached the 1st trifoliolate leaf stage.

Levels of weed control achieved with FD 4276 alone were lower than last season and none were acceptable. It is clear than in the UK, where conditions after early sowings are sometimes cold, a programme is essential preferably using a pre-sowing or pre-emergence treatment, although this would not be possible on a soil with high organic matter. Where trifluralin was applied pre-sowing at site 1, acceptable weed control was just achieved with 0.45 l/ha of FD 4276 applied as a single dose. Acceptable control was also achieved at site 4 where 0.45 l/ha FD 4276 was followed by Basagran at 2.0 l/ha to remove *S. media*. FD 4276 at 0.3 l/ha single or 0.3 l/ha was insufficient at all sites. Depending on the weed and growth stage for the later application, control with the split dose (0.45 & 0.45) l/ha FD 4276 was sometimes better (sites 4 & 5) and sometimes worse (sites 1, 2 & 3) than the single dose 0.9 l/ha applied early.

A higher volume of application (as used in France) could have improved control.

Trial programmes for 1990 and 1991 suggest the following species are susceptible (S)/resistant (R) to FD 4276 at 0.9 l/ha (225 g a.i./ha) post-emergence:-

<u>S</u>	<u>MS</u>
<i>Urtica urens</i> *	<i>Senecio vulgaris</i>
<i>Chenopodium album</i> #	<i>Lamium purpureum</i>
<i>Bilderdykia convolvulus</i>	<i>Galium aparine</i> (severely stunted)
<i>Polygonum persicaria</i>	
<i>Veronica persica</i>	<u>MR</u>
<i>Solanum nigrum</i>	
<i>Atriplex patula</i> ?	<i>Fumaria officinalis</i>
<i>Capsella bursa-pastoris</i>	(<i>Matricaria matricarioides</i>)
<i>Polygonum aviculare</i> §	
(<i>Tripleurospermum inodorum</i> #)	<u>R</u>
<i>Papaver rhoeas</i>	
<i>Galeopsis tetrahit</i> ?	<i>Stellaria media</i>
<i>Euphorbia</i> spp.?	<i>Poa annua</i>
Volunteer potatoes severely stunted	<i>Myosotis arvensis</i> ?

? Limited data

* This does not agree with ICI published data

Up to 4 TL

§ Small

() Control of *Matricaria* spp. was variable between sites and *Matricaria matricarioides* (pineapple) seemed less susceptible.

C.M. Knott
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