HALOXYFOP (193)

IDENTITY

ISO common name: haloxyfop

Chemical name:

IUPAC: (*RS*)-2-[4-[(3-chloro-5-trifluoromethyl-2-pyridyloxy)phenoxy]propionic acid

CA: (±)-2-[4-[[3-chloro-5-trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoic acid

haloxyfop-etotyl (haloxyfop ethoxyethyl ester)

IUPAC: Ethoxyethyl (*RS*)-2-[4-(3-chloro-5-trifluoromethyl-2-pyridyloxy)phenoxy]propionate

CA: (±)-2-[4-[[3-chloro-5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoic acid 2-ethoxyethyl ester

haloxyfop-methyl (haloxyfop methyl ester)

IUPAC: Methyl (*RS*)-2-[4-(3-chloro-5-trifluoromethyl-2-pyridyloxy)phenoxy]propionate

CA: (±)-2-[4-[[3-chloro-5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoic acid methyl ester

haloxyfop-R-methyl (methyl ester of (R)- isomer of haloxyfop)

IUPAC: Methyl (*R*)-2-[4-(3-chloro-5-trifluoromethyl-2-pyridyloxy)phenoxy]propionate

CA: (+)-2-[4-[[3-chloro-5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoic acid methyl ester

CAS No:
87237-48-7 (haloxyfop-etotyl)
069806-40-2 (haloxyfop-methyl)
072619-32-0 (haloxyfop-R-methyl)

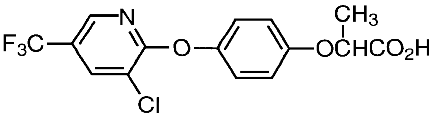
CIPAC No: Numbers have not been assigned

Synonyms: "Gallant" (haloxyfop-etotyl), "Gallant Super" (haloxyfop-R-methyl), "Verdict" (haloxyfop-methyl), "Zelleck", "Eloge", "Bastional", "Mirage"

haloxyfop

Structural formulae: I haloxyfop; II haloxyfop ethoxyethyl ester; III haloxyfop methyl ester; IV haloxyfop-R methyl ester.

I



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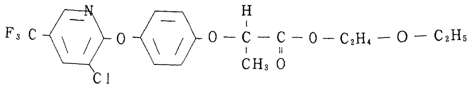

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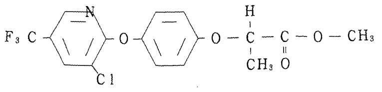

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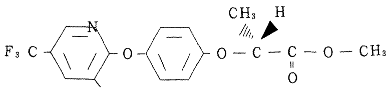


Molecular formula: $C_{15}H_{11}ClF_3NO_4$

haloxyfop-etotyl $C_{19}H_{19}ClF_3NO_5$

haloxyfop-methyl and haloxyfop-R-methyl $C_{16}H_{13}ClF_3NO_4$

Molecular weight: 361.7

haloxyfop-etotyl 433.7

haloxyfop-methyl and haloxyfop-R-methyl 375.5

Physical and chemical properties

haloxyfop-etotyl

Pure compound

Appearance: white crystalline solid
Vapour pressure: 1.64×10^{-5} hPa at 20°C
Melting point: 56-58°C
Density 1.3489 g/cm^3 at 20°C
Partition coefficient: Log P_{ow} 4.33 at 20°C
Solubility: Water, mg/l at 20°
0.58 Purified water
1.91 pH 5.0
1.28 pH 9.2

haloxyfop

Solubility:			g/l at 21°C
(contd.)	Hexane		44
		Toluene	>1000
		Xylene	>1000
		Dichloromethane	>1000
		Acetone	>1000
		Ethyl acetate	>1000
		Methanol	233
		Propan-2-ol	52

Hydrolysis: Unstable in alkaline conditions

Half-life at 22°C:

pH 5	26 days
pH 7	10 days
pH 9	<1 day

Photolysis: on soil

No degradation over 28 days at 25°C.

in water

First order half-life approximately one month in sterile buffer (pH 5) subjected to artificial light (simulating 40° latitude midday in midsummer)

Technical material

Appearance:	Pale brown solid
Purity:	97.8%
Melting range:	58-61°C
Stability:	No decomposition after 15 days at 70°C; 2% loss after one month at 90°C

haloxyfop-methyl

Pure compound

Appearance:	white crystalline solid	
Vapour pressure:	4.9×10^{-7} hPa at 25°C	
Melting point:	55-57°C	
Density	$1.3\ g/cm^3$ at 20°C(technical material)	
Partition coefficient:	Log P_{ow} 3.52 at 20°C	
Solubility:	water	9.3 mg/l at 25°C
	Acetone	355g/100g solvent at 20°C
	Acetonitrile	400g/100g solvent at 20°C
	Dichloromethane	300g/100g solvent at 20°C
	Xylene	127g/100g solvent at 20°C

Hydrolysis: Unstable in alkaline conditions

Half-life at 25°C:

pH 5	141 days
pH 7	18 days
pH 9	2 hours

Photolysis: on soil
No degradation during 28 days at 25°C
in water
First order half-life approximately one month in sterile buffer (pH 5) subjected to artificial light (simulating 40° latitude midday in midsummer)

Technical material

Appearance: White crystalline solid
Purity: 99%
Melting range: 55-57°C
Stability: Haloxyfop-methyl is very stable to heat. No decomposition after 88 hours at 200°C.

haloxyfop-R-methyl

Pure compound

Appearance: Clear colourless liquid
Vapour pressure: 2.6 x 10^{-5} hPa at 20°C
Boiling point: >280°C
Density 1.372 g/cm^3 at 20°C
Partition coefficient: Log P_{ow} 4.00 at 20°C
Solubility: water 9.08 mg/l at 20°C, purified water
6.93 mg/l at 20°C, pH 5.0
acetone, cyclohexanone, dichloromethane, ethanol, ethyl acetate, hexane, isopropyl alcohol, methanol, toluene, xylene >1000g/l at 20 ± 5°C

Hydrolysis: Unstable in alkaline conditions
Half-life at 22°C:

pH 5	161 days
pH 7	16 days
pH 9	<1 day

Photolysis: Not determined

Technical material

Appearance: Clear brown liquid
Purity: 98.6%-91.7%
Boiling range: >280°C estimated value >437°C
Stability: No significant isomerization after one month at 38°C or 50°C, or in contact with metals after one month at 50°C. The assay was above 98% of the initial value in all cases after one month.

Formulations

Haloxyfop-etotyl	EC 104 g/l (acid equivalent)
Haloxyfop-methyl	EC 240 g/l (acid equivalent)
Haloxyfop-R-methyl	EC 104-260 g/l (acid equivalent)

METABOLISM AND ENVIRONMENTAL FATE

Animal metabolism

Animal metabolism studies have been conducted in rats, mice, dogs, monkeys and humans.
Pharmacokinetic and metabolic studies in rats and humans demonstrated that haloxyfop-etotyl and haloxyfop-methyl once absorbed were rapidly hydrolyzed to haloxyfop (parent acid). Haloxyfop is a racemic mixture of (S)- and (R)- enantiomers. In animal systems, haloxyfop-S undergoes rapid and nearly complete inversion to haloxyfop-R.

Rats. In a study on Fischer 344 rats, orally administered ^{14}C-labelled haloxyfop was rapidly absorbed from the gastrointestinal tract (Smith *et al.*, 1982). Both male and female rats excreted over 90% of an oral dose within 5 days. In male rats 70% of the dose was eliminated in the faeces and approximately 20% in the urine. In contrast, female rats eliminated only 20% in the faeces and 70% in the urine. Clearance from the plasma was faster in females, with a half-life of 1.2 days compared with 5.6 days in males. The excreted material was identified as haloxyfop or its conjugates.

The pharmacokinetics of both [^{14}C]haloxyfop-etotyl and [^{14}C]haloxyfop-methyl were evaluated in Fischer 344 rats following oral dosing (Smith *et al*., 1983; Waechter *et al*., 1982). The time course for absorption and elimination of ^{14}C was similar for haloxyfop and these esters. Chromatographic analysis of blood from rats dosed with the esters revealed the presence of haloxyfop at levels to be expected from an equimolar dose of haloxyfop. These findings indicated that haloxyfop and its ethoxyethyl and methyl esters have similar pharmacokinetic profiles and equivalent biological effects may be anticipated since systemic exposure would be to the parent acid, irrespective of whether the acid or an ester was administered.

Mice. A study on $B_6C_3F_1$ mice with ^{14}C-labelled haloxyfop showed no marked sex differences, and a mean half-life of 1.8 days in plasma was established following oral dosing. The faeces was the major route of excretion via the biliary system. As in rats, excretion was as the parent compound and its conjugates (Smith *et al*., 1984).

Dogs. A pharmacokinetic study was conducted on male beagle dogs following the oral administration of ^{14}C-labelled haloxyfop (Nolan *et al*., 1987). The study showed a biphasic rate of clearance from plasma with half-lives of 1-2 hours and 34 hours. Almost 80% of the excretion was in the faeces, presumably via the biliary system. Excretion was mostly of unchanged haloxyfop.

Monkeys. The pharmacokinetic profile of haloxyfop was also determined in a male cynomolgus monkey following nasogastric administration (Gerbig *et al*., 1985). ^{14}C-labelled haloxyfop was rapidly absorbed from the gastrointestinal tract with peak ^{14}C plasma levels 1-2 hours after dosing. Plasma clearance was biphasic with half-lives of 2.5 hours and 3 days. The urine was the major route of excretion and, as in the other species, excretion was mainly of unchanged haloxyfop and conjugates.

haloxyfop

Metabolic pathways are shown in Figure 1.

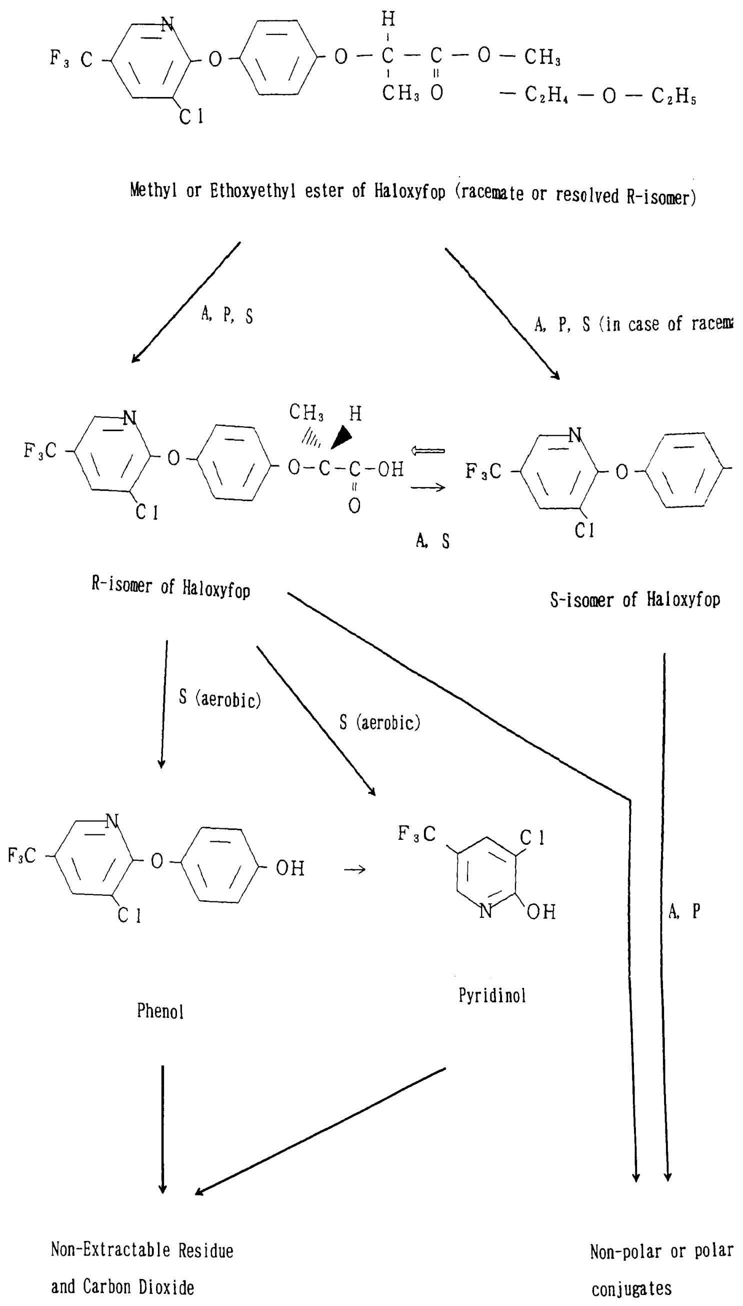
The following abbreviation are used.

A: in animals	S: in soils under aerobic and anaerobic conditions
P: in plants	S (aerobic): in soils only under aerobic conditions

Phenol: 4-(3-chloro-5-trifluoromethyl-2-pyridyloxy)phenol

Pyridinol: 3-chloro-5-trifluoromethylpyridin-2-ol

Figure 1. Metabolic pathways of haloxyfop in plants, animals and soils.



haloxyfop

Humans. The pharmacokinetics of haloxyfop, haloxyfop-etotyl and haloxyfop-methyl were examined in male volunteers by oral and dermal routes (Nolan, 1985: Nolan *et al*., 1985). The sodium salt of haloxyfop was rapidly absorbed following an oral dose of 0.2 mg/kg bw. One excretion half-life was about 6 days. As in the male monkey and female rat excretion was mostly in the urine and, as in all other species, as unchanged haloxyfop or its conjugates; no metabolic breakdown was apparent (Nolan, 1985). In male humans, dermal absorption of haloxyfop-methyl was slow and minimal. Only 3% of a topically applied dose was absorbed (Nolan, 1985).

In a separate study on humans, formulated haloxyfop-etotyl herbicide containing 12.5% of active ingredient was applied to the forearm of male volunteers (Nolan *et al*., 1985). Only 1.1% of the applied ester was absorbed.

The disposition of haloxyfop in the volunteers given haloxyfop-etotyl (i.e. its clearance from plasma and excretion in the urine) was indistinguishable from its previously reported fate in volunteers given either a single oral dose of haloxyfop or a single dermal dose of haloxyfop-methyl. This indicated that haloxyfop-etotyl was rapidly hydrolyzed to the parent acid and that, once absorbed, its fate was independent of whether haloxyfop or its ethoxyethyl ester had been administered.

Inversion of haloxyfop-S to haloxyfop-R in animals. 2-Arylpropionates are known to undergo stereochemical inversion in several animal species (Wecher *et al*., 1974). A study on rats to determine the stereochemical inversion of haloxyfop was carried out by Bartels and Smith (1989). Groups of Fischer 344 rats, four per sex, were gavaged with approximately 11 mg/kg bw of racemic [*phenyl*-^{14}C]haloxyfop. Urine and faeces samples were analysed for haloxyfop-R. The results showed that haloxyfop-S undergoes rapid and nearly complete inversion to haloxyfop-R. Nearly all of the haloxyfop recovered from the urine and faeces was haloxyfop-R.

Plant metabolism

The fate and metabolism of various esters of haloxyfop have been studied in whole plants, leaves and tissues in a range of plant types covering sugar beet, oilseed rape, cabbages, potatoes, cotton, the legumes soya bean and white dry bean, peanuts and several gramineous species. There is rapid absorption of the esters into treated leaves after application with subsequent hydrolysis to the acid. Isomerization does not occur in plant systems and only haloxyfop-R has herbicidal activity.

Early metabolic fate

Studies of metabolism during the first week after treatment have been carried out on several species: rapid ester hydrolysis and translocation were observed (Bauriedel and Miller, 1981; Buhler *et al*., 1985). Aqueous solutions of [^{14}C]haloxyfop as its n-butyl ester, methyl ester, ethoxyethyl ester or tri-isopropanolamine salt were applied to soya bean leaf surfaces in the greenhouse (Bauriedel and Miller, 1982). Metabolism and translocation were studied up to 8 days after application. The plants were harvested at intervals, separated into treated leaves and untreated remainder, and washed or extracted. The determination of radioactivity and characterization of metabolites were by LSC and chromatographic techniques respectively. The results indicate that the three esters and amine salt of haloxyfop are rapidly absorbed into the leaves after application. Subsequently the esters are hydrolyzed to haloxyfop in the treated leaves, then metabolized to polar metabolites or translocated to the untreated parts as shown in Tables 1 and 2.

Table 1. Distribution of radioactivity in extracts of treated soya bean leaves as determined by HPLC and LSC.

Days after treatment	Ester applied	% of extracted radioactivity		
		Polar fraction	Haloxyfop	Ester of haloxyfop
2	Methyl	34	66	0
	n-Butyl	29	60	11
	Ethoxyethyl	25	58	17
4	Methyl	52	48	0
	n-Butyl	51	43	6
	Ethoxyethyl	52	39	9
8	Methyl	58	40	2
	n-Butyl	62	38	0
	Ethoxyethyl	65	34	1

Table 2. Distribution of radioactivity in extracts of the untreated portions of soya bean plants as determined by HPLC and LSC.

Days after treatment	Ester applied	% of extracted radioactivity		
		Polar fraction	Haloxyfop	Ester of haloxyfop
2	Methyl	17	83	0
	n-Butyl	18	82	0
	Ethoxyethyl	22	78	0
4	Methyl	28	72	0
	n-Butyl	27	73	0
	Ethoxyethyl	25	75	0
8	Methyl	36	64	0
	n-Butyl	39	61	0
	Ethoxyethyl	35	65	0

The polar fractions of the untreated portions of the plants were subjected to mild alkaline hydrolysis (9-ml aliquots of aqueous concentrates were made basic with 1 ml 10N NaOH and heated at 50°C for 2 hours). A proportion of the polar metabolites was converted to free haloxyfop, indicating that the polar fraction consists in part of conjugates of the acid. The equivalence of phenyl- and pyridyl-labelled haloxyfop demonstrated that the ether linkage remained intact.

Long-term fate

Cotton. Aqueous solutions of formulated [*phenyl*-^{14}C]haloxyfop butyl ester were applied to plots of immature, field-grown cotton 32 days after planting by a shrouded plot sprayer, at a rate equivalent to 0.56 kg/ha (Stafford and Miller, 1983). Samples of lint and seed were taken at normal harvest 78 and 105 days after application, together with the remainder of the plant and soil at the last sampling. Oil was extracted from the seed with hexane and all plant materials were extracted with aqueous acetonitrile. The total radioactivity was determined by combustion and LSC and, in extracts, by LSC. Qualitative analyses of the various extracts were by HPLC and GC-MS-RAM. The extracts were also subjected to alkaline hydrolysis or lipase action to determine the nature of the fractionated components.

The concentration of ^{14}C in mature cotton seed was 0.78 mg/kg haloxyfop equivalent 78 days after application and 0.20 mg/kg at 105 days. Residues in cotton lint were 0.19 mg/kg and 0.04 mg/kg at 78 and 105 days after application respectively. Field trash and soil (top 4 cm) at 105 days after application contained 1.09 and 0.73 mg/kg respectively.

Enzymatic or alkaline hydrolysis of the oil (which contained 26 and 55% of the total radioactivity 78 and 105 days after application respectively) indicated that the major product (>91%) was haloxyfop, present as triglyceride conjugates. The radioactivity remaining in the seed coat was mainly from polar conjugates which released haloxyfop under mild alkaline hydrolysis. The major radioactive component in the lint (88%) was free haloxyfop, whilst that in field trash was either free haloxyfop or its polar metabolites.

Sugar beet. Sugar beets at the 6-inch stage of growth were treated with aqueous solutions of (*phenyl*-^{14}C]haloxyfop as the methyl ester at the rate of 0.28 kg acid equivalent per ha, 104 days before normal commercial harvest (Yackovich and Miller, 1984). Samples of mature beet were harvested and separated into tops and roots. The total radiolabelled residues in the samples were determined by combustion and LSC, with a detection limit of 0.004 mg/kg haloxyfop equivalents. Samples were extracted with 50% aqueous acetonitrile and residues in the extracts were identified by HPLC. Residue levels were very low, averaging 0.01 mg/kg in the roots and 0.04 mg/kg in the green leafy portions. Most of the radioactivity (88% of that in the roots and 83% in the tops) was extractable with aqueous acetonitrile, and HPLC analysis indicated that most of the residue (80% roots and 72% tops) was present as free haloxyfop.

Peanut plants. Aqueous solutions of formulated [*phenyl*-^{14}C]haloxyfop-methyl were applied pre-blossom to immature peanut plants(3-4 vines, 5-7 inches long) 113 days before the normal commercial harvest, at a rate equivalent to 0.28 kg/ha acid equivalent (Yackovich and Miller, 1985a). Samples of peanuts, peanut shells and vines were analysed for total radioactivity by combustion and LSC with a determination limit of 0.004 mg/kg as haloxyfop equivalent. Oil was extracted from peanuts with hexane and the remaining cake extracted with 50% aqueous acetonitrile. Qualitative analysis of the extracts was by HPLC, with alkaline hydrolysis of the peanut oil to characterize the non-polar conjugates.

The residues at harvest averaged 0.04 mg/kg in peanuts, 0.07 mg/kg in shells and 0.01 mg/kg in vines. The residue in the extracted oil was 0.06 mg/kg, indicating a 1.5-fold concentration. All the radioactive material in the oil could be hydrolyzed to free haloxyfop with alkali. The remaining meal contained residues of 0.032 mg/kg, 90% of which was extractable by acetonitrile and was mainly free haloxyfop.

Soya beans. Aqueous solutions of a formulated [^{14}C]phenyl-labelled butyl ester of haloxyfop were applied to plots of soya bean plants, either pre-blossom (89 days pre-harvest) or post-blossom (61 days pre-harvest). Additional plots were treated post-blossom with aqueous solutions of formulated [^{14}C]pyridinol-labelled haloxyfop at a rate equivalent to 0.56 kg/ha acid (Yackovich and Miller, 1983). Samples of either whole green plant or new (i.e. post-application) foliage were taken from plants which had had the highest rate pre-blossom treatment 14 days after application. Samples of mature plants were also taken at the normal commercial harvest, air-dried indoors for a week and the beans separated from the straw. The total radioactivity was determined by combustion and LSC or direct LSC of extracts, with a limit of detection of 0.01 mg/kg haloxyfop equivalents. Oil was extracted with hexane and the extract hydrolysed with lipase to determine the nature of the residue. Qualitative analysis of the various extracts was by HPLC and GC-MS-RAM techniques. Mild alkali was used to hydrolyse the extractable polar conjugates.

The total radioactivity in the various plant tissues increased with higher application rate and later timing of application. Levels from post-blossom application in straw were approximately twice, and in beans four times, those from pre-blossom treatment. The residues in the oil were equivalent to those in the beans, demonstrating that no concentration occurred during extraction. More than 90% of the residue in immature plants 14 days after application was extractable with acetonitrile and comprised approximately one-third free haloxyfop acid and two-thirds polar conjugates. The latter yielded haloxyfop under alkaline hydrolysis. Approximately 5% of the residue present in the whole plant samples was identified as the butyl ester, whilst the new growth contained only haloxyfop or its polar conjugates.

The residues in soya beans at harvest were shown to be extractable into hexane (average 18%) or acetonitrile (average 77%). All the radioactivity from the non-polar conjugates in the hexane extract of the oil was released as free haloxyfop by lipolysis. The acetonitrile extract of the defatted meal contained about 75% of the radioactivity as free haloxyfop and 25% as polar conjugates which gave rise to haloxyfop under alkaline hydrolysis.

More than 93% of the residue in the straw was extractable with acetonitrile and comprised about two-thirds free haloxyfop and one-third polar conjugates which gave rise to haloxyfop under alkaline hydrolysis.

Throughout the study, no differences were apparent in either the level or the nature of the residues from the phenyl- and pyridinol-labelled material and hence no evidence of ring cleavage.

Rape. Aqueous solutions of formulated [*phenyl*-^{14}C]haloxyfop-methyl were applied to immature oilseed rape at a rate equivalent to 0.14 kg/ha acid (Yackovich and Miller, 1985b). Nearly mature rape plant samples were taken and air-dried in a greenhouse before separation into seed and plant remainder (trash). The total ^{14}C in the various fractions was determined by combustion and LSC and corrected for the weight lost on drying. Rape seed oil was extracted with hexane and an aliquot subjected to mild alkaline hydrolysis. The defatted cake was extracted with 50% aqueous acetonitrile and the various extracts analysed by LSC and HPLC. The residual radioactivity was 0.92, 0.52, 1.1 and 1.31 mg/kg haloxyfop equivalents in the seed, oil, cake and trash respectively. The residues in the oil were a very complex mixture of non-polar lipids, which under mild alkaline hydrolysis yielded free haloxyfop. The ^{14}C remaining in the meal after extraction of the oil was mainly in free haloxyfop.

Summary

The experiments demonstrated rapid absorption and assimilation of the esters into treated leaves after application. Subsequent hydrolysis to the parent acid occurred at slightly different rates, in the order methyl > butyl > ethoxyethyl. Since the fate of the three esters is essentially similar, data from studies of the butyl ester are relevant. No data on plant metabolism studies with the R-isomer of haloxyfop were provided, but are not thought to be necessary since the data on racemic haloxyfop demonstrated that the major metabolites are free haloxyfop and its conjugates, all of which are included in residue analysis.

Conjugation of the parent acid to form more polar components, probably glycosides, occurred within treated leaf tissue, with different patterns of conjugates exhibited by different species. The conjugates yield haloxyfop under mild alkaline hydrolysis.

The main compound translocated to untreated aerial parts and roots was shown to be haloxyfop, but whether the polar conjugates are translocated or formed *in situ* from translocated acid was not established.

Crop components with a high oil content, e.g. rape seed, cotton seed, soya beans and peanuts, accumulated haloxyfop as non-polar triglyceride conjugates, which were hydrolysed to free haloxyfop by lipase or alkali. Defatted seed residues, e.g. meal, seed coats, cotton lint or peanut shells, contained either free haloxyfop or polar conjugates. The aqueous acetonitrile extraction procedures used in most of the studies where a mass balance of a sample was attempted indicated that a small proportion of the haloxyfop residue was unextractable.

Herbicidal activity. In soil and mammalian systems rapid hydrolysis of esters to free haloxyfop is followed by conversion of the (*S*)- to the (*R*)- isomer, but this conversion does not occur in plants (Gerwich *et al*., 1988). In a study with known mixtures of (*R*)- and (*S*)-haloxyfop-methyl applied to annual grasses, samples enriched with the (*S*)- isomer were found to be less herbicidally active than the (*R*)- isomer in laboratory petri dish evaluations. The pure (*S*)- isomer was estimated by regression to have 1/1000 or less of the activity of the (*R*)- isomer. However, the (*S*)- and (*R*)- isomers were equally active following pre-emergence soil application, and subsequent isolation of treated soil indicated inversion of the (*S*)- to the (*R*)- isomer within seven days. These results were confirmed in field trials. The conclusion that the (*S*)- isomer is herbicidally inactive is also supported by the observation that only half the foliar application rate of haloxyfop-R formulations is needed compared with racemic formulations to obtain the same degree of efficacy. The inability of plants to isomerize enantiomers has also been demonstrated for other aryloxyphenoxypropionate herbicides, e.g. diclofop, fluazifop and quizalofop (Sakata *et al*., 1985).

Environmental fate in soil

The degradation of haloxyfop has been extensively studied under laboratory and field conditions. Recent studies have mainly been with haloxyfop-R-methyl, but are valid for evaluating the environmental fate of other esters and of racemic haloxyfop since ester hydrolysis and stereochemical inversion occur rapidly in soil.

Aerobic degradation. The degradation of haloxyfop-R methyl was investigated in four soils (Hale and Trigg, 1994). Three UK soils (Marcham sandy clay loam, Marcham loamy sand and Highworth loamy clay) and a standard German soil (Speyer 2.2 sandy loam) were adjusted to 40% of their moisture holding capacities with water in biometer flasks. The soils were then treated with haloxyfop-R methyl at a rate equivalent to 104 g acid/ha and the flasks connected to a low pressure oxygen supply and CO_2 trap and maintained at 20°C in the dark for periods up to 182 days. Samples taken at intervals were extracted sequentially with three organic solvent mixtures and purified for analysis by HPLC. Selected samples were also analysed by TLC to confirm the results. The amount of $^{14}CO_2$ evolved during the degradation was also determined.

The methyl ester was hydrolysed rapidly to haloxyfop in all four soils with only 1.3-5.0% of the applied radioactivity (AR) remaining as ester 1 day after treatment, when maximum levels of the acid (72.6-90.7% AR) were observed. Thereafter the acid was degraded to 4-(3-chloro-5-trifluoromethyl-2-pyridyloxyphenol (hereafter referred to as as the phenol) which was in turn degraded to 3-chloro-5-trifluoromethylpyridin-2-ol (the pyridinol). The phenol reached a mean maximum of 7.0-12.6% AR between 3 and 14 days after treatment, depending on the soil. The maximum levels of the pyridinol ranged between 35.5 and 52.4% AR and were observed at 91 days after treatment. Three further unidentified metabolites were observed, but only one of these exceeded 1% AR: it was present at levels between 2.0% and 9.3% AR (mean) at 182 days after treatment.

The production of $^{14}CO_2$ was slow during the first 28 days of the incubation, but 91 days after treatment 2-3.3% of the applied radioactivity was present as $^{14}CO_2$ in the three UK soils, with a mean of 19.6% AR in the Speyer 2.2 soil. These levels increased to 6.5-11.2% AR in the UK soils and 24.0% AR (mean) in the Speyer 2.2 soil after 182 days. The levels of unextractable residues increased throughout the incubation period to reach a maximum of 23.3-34.7% AR 182 days after treatment. The mass balance for all the soil samples ranged from 83.5 to 103.9% AR (mean 94.0%, standard deviation 5.4).

Half-lives of haloxyfop acid ranged from 9 days in the two Marcham soils to 20 days in the Speyer 2.2 sandy loam. The mass balances are shown in Table 3.

Table 3. Mass balances for the aerobic degradation of haloxyfop-R-methyl in 4 soils.

Fraction	% AR at days after treatment							
	0	1	3	7	14	28	91	182
Haloxyfop-R-methyl	70-83	1-4	0.5-2	0-2	0-8	0-3	0-1	0.4-0.5
CO_2[1]	0	0	0	0-0.1	0.1-0.8	0.5-3	2.5-19.5	6.5-24
Haloxyfop-R	6-18	73-91	61-82	19-56	21-40	18-28	9-15	6-10
Pyridinol	0	0.5-3	1-6	5-14	14-30	23-35	36-53	18-46
Phenol	0-6	2-6	4-12	4-12	6-13	2-7	0.5-4	1-3
Unextractable	0.4-1	1-7	3-17	6-29	11-30	14-33	22-35	23-35
Total	92-94	100-103	85-99	90-99	86-101	87-91	94-101	97-98

[1] Other volatiles were not collected

Anaerobic degradation. The decomposition of the methyl ester of haloxyfop in soil under anaerobic conditions was studied in two soils (from Mississippi and Illinois, USA) at a temperature of 25°C and a concentration of 0.5 mg/kg (Swann and Hertel, J.A. 1983). The ester was hydrolysed very rapidly (half-life <1 day) to haloxyfop. Haloxyfop once formed showed no apparent degradation after 300 days of incubation.

Stereochemical inversion. The aerobic degradation of the methyl esters of racemic haloxyfop, haloxyfop-R, and haloxyfop-S were investigated in Catlin silt loam, Commerce silt loam and Cecil sandy loam soils with specific regard to the stereochemical inversion process (Racke, 1990). The soils were treated with the [3,4,5,6-^{14}C]pyridyl esters at 0.5-0.59 mg/kg and incubated at 26°C for 6 or 12 days. During the incubation period, $^{14}C0_2$ production was monitored with a sodium hydroxide trap. After the incubation soil samples were extracted with a mixture of methyl *tert*-butyl ether (MTBE) and 1.5 M phosphoric acid. All the methyl esters were converted in nearly quantitative yields to a mixture of unextractable ^{14}C and the (*R*)- and (*S*)- isomers of haloxyfop acid. The stereochemical inversion, which followed ester hydrolysis, resulted in the preferential formation of the (*R*)- isomer of haloxyfop from both the racemate and the (*S*)- isomer. It was concluded that the inversion was mediated by micro-organisms, because it did not occur in sterilized soil and was slow at a high application rate and low incubation temperature. The results found with the Catlin soil are shown in Table 4.

Table 4. Recovery and distribution of ^{14}C from Catlin loam soil treated with the mehyl ester of racemic haloxyfop, haloxyfop-R or haloxyfop-S after 6 or 12 days of incubation.

Ester of	% of applied ^{14}C							R/S ratio
	$^{14}CO_2$	Acid phase	MTBE phase	Haloxyfop (*R*)-	(*S*)-	Unextractable	Total[1]	
6 days								
Racemic haloxyfop	0.38	1.62	90.7	68.6	11.8	7.86	100.6	5.81
Haloxyfop-R	0.27	1.66	92.2	83.8	4.5	8.14	102.2	18.6
Haloxyfop-S	0.18	1.92	90.9	71.9	12.4	8.93	101.9	5.79
12 days								
Racemic haloxyfop	0.41	1.92	85.3	77.3	7.35	12.8	100.4	10.51
Haloxyfop-R	0.08	1.48	88.05	82.9	3.7	11.9	101.5	22.41
Haloxyfop-S	0.15	1.89	87.6	70.9	11.4	13.09	102.7	6.22

[1] Sum of CO_2, acid phase, MTBE [methyl *tert*-butyl ether] phase and unextractable

Field studies. The behaviour of formulated haloxyfop-R-methyl has been studied in lysimeter experiments (Yon, 1993). Two sandy soil lysimeters (68% sand, 25% silt, 1.5% organic carbon were sown with sugar beet in April 1989 and treated with labelled haloxyfop-R-methyl at rates equivalent to 112g and 212g ai/ha in the following June. Leachate was collected throughout the experiment and analysed for the total radioactivity. In total, 0.29-0.71% of the applied radioactivity was found in 956-960 l of leachate. Chromatographic analysis showed that haloxyfop-methyl, haloxyfop acid and the pyridinol were all absent. The radioactive component of the leachate consisted almost entirely of a polar unknown in concentrations of 0.03-0.15 ì g/l haloxyfop-methyl equivalents. Soil samples (0-10 cm) were taken from both lysimeters at the end of the first growing season and analysed for total radioactivity after combustion: 39-58% of the applied radioactivity was still present in the top 10 cm. At the end of the experiment soil samples taken to a depth of 1.2 m still contained 25-39% of the applied radioactivity and the majority of this (24-33%) was in the top 30 cm. Less than 1% of the radioactivity had moved to depths greater than 60 cm. Extraction and chromatographic analysis of the 0-10 cm and 10-20 cm horizons showed that both haloxyfop-methyl and haloxyfop were below the detection limit for the GC-MS determination (0.09 ì g/kg). The pyridinol was present at 0.27-1.9 ì g/kg. The total radioactivity in the plants at harvest was 0.01-1.0% of that applied.

Environmental fate in water/sediment systems

The degradation of [*pyridyl*-^{14}C]haloxyfop-etotyl in aerobic ditch waters and their associated sediments (silty clay loam and sandy loam) were studied by Yon and Cresswell (1990) over a period of 26 weeks. Samples were maintained at 16-25°C in the dark and the waters kept aerobic by drawing air through them continuously. The mean recoveries of radioactivity for the silty clay loam and sandy loam were 93.9% and 94.6% respectively. Immediately after treatment of the sediment/water systems most of the radioactivity was in the water, with maximum levels reached 3 and 7 days after application of 78.5% and 79.3% in the silty clay loam and sandy loam respectively. These decreased steadily to 27.7% and 29.8% (after 26 and 21 weeks respectively) with a concomitant increase in the radioactivity associated with the sediment. Carbon dioxide production reached 3.0% and 4.9% and unextractable residues in the soil 3.2% and 4.6% respectively after 26 weeks.

Chromatographic analysis of the water samples and sediment extracts showed that the ester was rapidly hydrolyzed to haloxyfop acid, the concentrations of which were highest after 1 week and then decreased exponentially. At the same time the concentration of the pyridinol increased for 2-4 weeks and then decreased steadily.

METHODS OF RESIDUE ANALYSIS

Analytical methods

Variations of a basic analytical method have been developed for high-moisture low-fat crops, low-moisture high-fat crops and products of animal origin. The analytical procedure constists in extraction and hydrolysis of the ester with alkaline methanol, partitioning into an acid organic phase, alkaline aqueous extraction, acid organic extraction, derivatization to produce the methyl or butyl ester, and column clean-up. In the most used method 10 g of homogenized sample, 1 ml of 20% sodium hydroxide solution and 50 ml methanol are shaken for 2 hours or overnight, when esters or conjugates are hydrolyzed to produce free haloxyfop acid. After centrifugation at 2000 rpm for several minutes, an aliquot of the supernatant is acidified with sulfuric acid and partitioned with an organic solvent such as ethyl ether, toluene or dichloromethane. The organic layer is then partitioned with aqueous sodium bicarbonate, which is acidified again and extracted with a solvent such as ethyl ether. The organic solvent is evaporated and the haloxyfop converted to its butyl or methyl ester by reaction with butanol and sulfuric acid at 100°C for 30 minutes, boron trifluoride and methanol on a steam bath for 2 minutes, or diazomethane. Further clean-up of the sample is achieved on a Florisil column before quantification by gas chromatography with an electron-capture detector. In some cases a silica gel column clean-up or treatment with potassium permanganate is applied before derivatization.

The limits of determination are normally between 0.01 and 0.05 mg/kg.

Stability of pesticide residues in stored analytical samples

The stability of haloxyfop residues in soya beans, green peas and cabbage stored under frozen conditions has been studied (Gardner, 1983a; Hastings and Butcher, 1993a,b). Samples were fortified with haloxyfop-methyl (soya beans) or haloxyfop (green peas and cabbage) at 0.05-0.20 mg/kg and stored deep frozen (<-16°C or -20°C) until analysis after 16-17 months. No losses were found in any of the studies. It was concluded that haloxyfop is stable during storage under frozen conditions and this conclusion was supported by other metabolic studies.

Residue definition

Plant metabolism studies showed that esters of haloxyfop are rapidly metabolized to haloxyfop acid at the treated site and translocated to other parts of the plant. Haloxyfop is further metabolized in some plants to conjugated products. In high-fat crops such as rape seed, cotton seed, soya beans and peanuts, haloxyfop accumulated as non-polar triglyceride conjugates. In animals, esters of haloxyfop are again rapidly hydrolyzed and excreted as haloxyfop or its conjugates in the urine or faeces. Esters and polar and non-polar conjugates of haloxyfop are easily hydrolyzed to haloxyfop under mild alkaline conditions. No other major metabolites have been found. It is concluded that residues should be defined as the sum of haloxyfop esters, haloxyfop and its conjugates, expressed as haloxyfop.

USE PATTERN

Haloxyfop has been developed as a selective herbicide for the control of grass weeds in broad leaf crops. The first formulations were based on either the ethoxyethyl or methyl ester of racemic haloxyfop. Once applied to plants, the esters are rapidly hydrolysed to the acid which is herbicidally active. As it has been demonstrated that it is the (*R*)- isomer of haloxyfop which is herbicidally active, with essentially no activity associated with the (*S*)- isomer, a resolved methyl ester has been developed which is approximately 98% (*R*)- isomer. Formulations containing haloxyfop ethoxyethyl ester (haloxyfop-etotyl) have been developed primarily for the European, Middle East/African regions and Australia. Formulations of haloxyfop-methyl were developed mainly for the North and South American regions. Haloxyfop-R-methyl has been developed for world-wide use and will gradually replace the racemates. Registered use patterns are shown in Tables 5-12, where application rates are expressed as free haloxyfop acid equivalents.

The following abbreviations are used in the Tables.

<u>Active ingredient</u>	
SR:	racemic haloxyfop
R:	resolved (*R*)- isomer of haloxyfop
Me:	methyl ester
EE:	ethoxyethyl ester
Bt:	butyl ester
<u>Application method</u>	
Aer:	aerial
Ap:	broadcast
Gr:	directed at ground below trees or vines
<u>PHI</u>	
BF:	before fruit appears
CC:	up to closing of canopy
ET:	up to early tillering
GC75%:	up to 75% ground cover
HC40 or HC60:	up to 40 or 60 cm height of crop
PE:	application after weed emergence
PE 2-4, PE 3-5 or PE 4-6:	application after weed emergence with weeds at 2-4, 3-5 or 4-6 leaf stage respectively
ST:	to start of tillering

Table 5. Registered uses of haloxyfop on fruit. All single applications of EC.

Crop	Country	Application				PHI, days, or growth stage
		ai	Method	kg ai/ha	kg ai/hl	
Apples	Hungary	R-Me	Gr	0.042-0.21	0.014-0.1	90
	Romania	R-Me	Gr	0.16	0.052-0.078	PE
Berry fruit	Poland	R-Me	Gr	0.078-0.16	0.02-0.078	CC
	Romania	R-Me	Gr	0.16	0.052-0.078	PE
Citrus	Argentina	SR-Me	Gr	0.084-0.3	0.056-0.3	PE 2-4
	Bolivia	SR-Me	Gr	0.06-0.084	0.04-0.084	PE 2-4
	Paraguay	SR-Me	Gr	0.072-0.18	0.048-0.18	PE 2-4
	Peru	SR-Me	Gr	0.11-0.15	0.028-0.038	PE 2-4
Grapes	Argentina	SR-Me	Gr	0.084-0.3	0.056-0.3	PE 2-4
	Bolivia	SR-Me	Gr	0.06-0.084	0.04-0.084	PE 2-4
	Czech repub.	R-Me	Gr	0.052-0.16	0.013-0.078	CC
	France	R-Me	Gr	0.078-0.31	0.02-0.16	ET

Crop	Country	Application				PHI, days, or growth stage
		ai	Method	kg ai/ha	kg ai/hl	
	France	SR-EE	Gr	0.16-0.62	0.039-0.31	ET
	Hungary	R-Me	Gr	0.042-0.21	0.014-0.1	90
	Paraguay	SR-Me	Gr	0.072-0.18	0.048-0.18	PE 2-4
	Peru	SR-Me	Gr	0.11-0.15	0.028-0.038	PE 2-4
	Romania	R-Me	Gr	0.16	0.052-0.078	PE
	Slovakia	R-Me	Gr	0.052-0.16	0.013-0.078	CC
	South Africa	SR-EE	Gr	0.1-0.31	0.035-0.16	PE 4-6
Orchards	Australia	R-Me	Gr	0.10-0.21	0.069-0.42	ET
	Australia	R-Me	Aer	0.10-0.21	>0.35	BF
	Australia	SR-EE	Gr	0.21-0.83	0.14-1.7	ET
	Australia	SR-EE	Aer	0.21-0.83	>0.69	BF
	Czech repub.	R-Me	Gr	0.052-0.16	0.013-0.078	CC
	Poland	R-Me	Gr	0.078-0.13	0.02-0.065	CC
	Slovakia	R-Me	Gr	0.052-0.16	0.013-0.078	CC
Pome fruit	Argentina	SR-Me	Gr	0.084-0.3	0.056-0.3	PE 2-4
	Bolivia	SR-Me	Gr	0.06-0.084	0.04-0.084	PE 2-4
	Paraguay	SR-Me	Gr	0.072-0.18	0.048-0.18	PE 2-4
	South Africa	SR-EE	Gr	0.1-0.31	0.035-0.16	PE 4-6
Stone fruit	Argentina	SR-Me	Gr	0.084-0.3	0.056-0.3	PE 2-4
	Bolivia	SR-Me	Gr	0.06-0.084	0.04-0.084	PE 2-4
	Paraguay	SR-Me	Gr	0.072-0.18	0.048-0.18	PE 2-4
	South Africa	SR-EE	Gr	0.1-0.31	0.035-0.16	PE 4-6

Table 6. Registered uses of haloxyfop on vegetables (except sugar beet and legumes). All single EC applications.

Crop	Country	Application				PHI, days, or growth stage
		ai	Method	kg ai/ha	kg ai/hl	
Cabbage	Poland	R-Me	Ap	0.052-0.13	0.013-0.065	120
Carrots	Poland	R-Me	Ap	0.052-0.13	0.013-0.065	60
	Uzbekistan	R-Me	Ap	0.1-0.21	0.021-0.069	PE 5
Garlic	Spain	SR-EE	Ap	0.1-0.21	0.026-0.1	PE 2-4
Onions	Argentina	SR-Me	Ap	0.084-0.3	0.056-0.3	PE 2-4
	Argentina	SR-Me	Aer	0.084-0.3	0.17-2	PE 2-4
	Chile	R-Me	Ap	0.03-0.15	0.02-0.15	30
	Chile	SR-Me	Ap	0.24-0.3	0.16-0.3	30
	Hungary	R-Me	Ap	0.042-0.21	0.014-0.1	54
	Poland	R-Me	Ap	0.052-0.13	0.013-0.065	60
	Spain	SR-EE	Ap	0.1-0.21	0.026-0.1	PE 2-4
	Uzbekistan	R-Me	Ap	0.1-0.21	0.021-0.069	PE
Potatoes	Argentina	SR-Me	Ap	0.084-0.3	0.056-0.3	PE 2-4
	Argentina	SR-Me	Aer	0.084-0.3	0.17-2	PE 2-4

Crop	Country	Application				PHI, days, or growth stage
		ai	Method	kg ai/ha	kg ai/hl	
	Bolivia	SR-Me	Ap	0.06-0.084	0.04-0.084	PE 2-4
	Bolivia	SR-Me	Aer	0.06-0.084	0.12-0.56	PE 2-4
	Czech repub.	R-Me	Ap	0.052-0.13	0.013-0.065	CC
	Ireland	SR-EE	Ap	0.21	0.052-0.1	HC 60
	Hungary	R-Me	Ap	0.042-0.21	0.014-0.1	60
	Paraguay	SR-Me	Ap	0.072-0.18	0.048-0.18	PE 2-4
	Paraguay	SR-Me	Aer	0.072-0.18	0.14-1.2	PE 2-4
	Poland	R-Me	Ap	0.052-0.13	0.013-0.065	120
	Romania	R-Me	Ap	0.16	0.052-0.078	HC 40
	Slovakia	R-Me	Ap	0.052-0.13	0.013-0.065	CC
	Spain	SR-EE	Ap	0.1-0.42	0.026-0.21	PE 2-4
	Uruguay	SR-Me	Ap	0.084-0.3	0.056-0.3	PE 2-4
	Uruguay	SR-Me	Aer	0.084-0.3	0.17-2.0	PE 2-4
	Uzbekistan	R-Me	Ap	0.1-0.21	0.021-0.069	PE
Tomatoes	Hungary	R-Me	Ap	0.042-0.21	0.014-0.1	21
	Poland	R-Me	Ap	0.052-0.13	0.013-0.065	60
Vegetables	Colombia	SR-Me	Ap	0.038-0.11	0.025-0.11	PE 2-4

Table 7. Registered uses of haloxyfop on sugar beet. All single applications of EC.

Crop	Country	Application				PHI, days, or growth stage
		ai	Method	kg ai/ha	kg ai/hl	
Sugar beet	Belarus	R-Me	Ap	0.052-0.1	0.01-0.035	PE 3-5
	Chile	R-Me	Ap	0.045-0.12	0.03-0.12	30
	Chile	SR-Me	Ap	0.09-0.24	0.06-0.24	30
	Croatia	R-Me	Ap	0.052-0.16	0.013-0.078	98
	Czech repub.	R-Me	Ap	0.052-0.13	0.013-0.065	CC
	Denmark	SR-EE	Ap	0.1-0.21	0.042-0.21	90
	Ireland	SR-EE	Ap	0.078-0.21	0.02-0.13	GC75%
	Ireland	SR-EE	Ap	0.034	0.034-0.043	GC75%
	France	R-Me	Ap	0.052-0.1	0.13-0.052	ET
	France	SR-EE	Ap	0.1-0.21	0.026-0.1	ET
	Germany	SR-EE	Ap	0.16-0.21	0.039-0.1	90
	Greece	SR-EE	Ap	0.1-0.13	0.026-0.13	90
	Hungary	R-Me	Ap	0.042-0.21	0.014-0.1	100
	Poland	R-Me	Ap	0.052-0.13	0.013-0.065	CC
	Romania	R-Me	Ap	0.1-0.16	0.035-0.078	HC 40
	Russia	R-Me	Ap	0.052-0.1	0.013-0.035	PE 3-5
	Slovakia	R-Me	Ap	0.052-0.13	0.013-0.065	CC
	Spain	SR-EE	Ap	0.1-0.42	0.026-0.21	PE 2-4
	The Netherlands	SR-EE	Ap	0.1-0.31	0.026-0.1	ST

Crop	Country	Application				PHI, days, or growth stage
		ai	Method	kg ai/ha	kg ai/hl	
	Ukraine	R-Me	Ap	0.052-0.1	0.01-0.035	PE 3-5
	Uruguay	SR-Me	Ap	0.084-0.3	0.056-0.3	PE 2-4
	Uruguay	SR-Me	Aer	0.084-0.3	0.17-2.0	PE 2-4
	Uzbekistan	R-Me	Ap	0.1-0.21	0.021-0.069	PE 3-5

Table 8. Registered uses of haloxyfop on legumes except soya beans. All single applications of EC.

Crop	Country	Application				PHI, days, or growth stage
		ai	Method	kg ai/ha	kg ai/hl	
Beans	Bolivia	SR-Me	Ap	0.06-0.084	0.04-0.084	PE 2-4
	Bolivia	SR-Me	Aer	0.06-0.084	0.12-0.56	E 2-4
	Nicaragua	SR-Me	Ap	0.18-0.24	0.072-0.12	PE 2-4
	South Africa	SR-EE	Ap	0.1-0.31	0.035-0.16	PE 4-6
Broad beans	Poland	R-Me	Ap	0.052-0.13	0.013-0.065	60
Chickpeas	Australia	R-Me	Ap	0.04-0.052	0.027-0.104	98
	Australia	R-Me	Aer	0.04-0.052	>0.13	98
	Australia	SR-EE	Ap	0.052-0.1	0.035-0.21	98
	Australia	SR-EE	Aer	0.052-0.1	>0.17	98
Faba beans	Australia	R-Me	Ap	0.04-0.052	0.027-0.104	147
	Australia	R-Me	Aer	0.04-0.052	>0.13	147
	Australia	SR-EE	Ap	0.052-0.1	0.035-0.21	147
	Australia	SR-EE	Aer	0.052-0.1	>0.17	147
Field peas	Australia	R-Me	Ap	0.04-0.078	0.027-0.16	91
	Australia	R-Me	Aer	0.04-0.078	>0.13	91
	Australia	SR-EE	Ap	0.052-0.16	0.035-0.31	91
	Australia	SR-EE	Aer	0.052-0.16	>0.17	91
Legumes	Spain	SR-EE	Ap	0.1-0.21	0.026-0.1	PE 2-4
Lentils	Australia	R-Me	Ap	0.04-0.052	0.027-0.104	119
	Australia	R-Me	Aer	0.04-0.052	>0.13	119
	Australia	SR-EE	Ap	0.052-0.1	0.035-0.21	119
	Australia	SR-EE	Aer	0.052-0.1	>0.17	119
	Spain	SR-EE	Ap	0.1-0.21	0.026-0.1	PE 2-4
Lupins	Australia	R-Me	Ap	0.04-0.052	0.027-0.104	119
	Australia	R-Me	Aer	0.04-0.052	>0.13	119
	Australia	SR-EE	Ap	0.052-0.1	0.035-0.21	119
	Australia	SR-EE	Aer	0.052-0.1	>0.17	119
	Poland	R-Me	Ap	0.052-0.13	0.013-0.065	60
Navy beans	Australia	R-Me	Ap	0.04-0.078	0.027-0.16	91
	Australia	R-Me	Aer	0.04-0.078	>0.13	91
	Australia	SR-EE	Ap	0.052-0.16	0.035-0.31	91
	Australia	SR-EE	Aer	0.052-0.16	>0.17	91
Peas	Czech repub.	R-Me	Ap	0.052-0.16	0.013-0.078	CC

Crop	Country	Application				PHI, days, or growth stage
		ai	Method	kg ai/ha	kg ai/hl	
	Poland	R-Me	Ap	0.052-0.13	0.013-0.065	60
	Slovakia	R-Me	Ap	0.052-0.16	0.013-0.078	CC

Table 9. Registered uses of haloxyfop on soya beans. All single applications.

Country	Formulation		Application			PHI, days, or growth stage
	Type	ai	Method	kg ai/ha	kg ai/hl	
Argentina	EC	R-Me	Ap	0.042-0.15	0.028-0.15	PE 2-4
Argentina	EC	R-Me	Aer	0.042-0.15	0.084-1.0	PE 2-4
Argentina	EC	SR-Me	Ap	0.084-0.3	0.056-0.3	PE 2-4
Argentina	EC	SR-Me	Aer	0.084-0.3	0.17-2	PE 2-4
Australia	EC	R-Me	Ap	0.052-0.078	0.035-0.16	119
Australia	EC	R-Me	Aer	0.052-0.078	>0.17	119
Australia	EC	SR-EE	Ap	0.1-0.16	0.069-0.31	119
Australia	EC	SR-EE	Aer	0.1-0.16	>0.35	119
Bolivia	EC	SR-Me	Ap	0.06-0.084	0.04-0.084	PE 2-4
Bolivia	EC	SR-Me	Aer	0.06-0.084	0.12-0.56	PE 2-4
Brazil	EC	R-Me	Ap	0.096-0.12	0.024-0.06	98
Colombia	EC	R-Me	Ap	0.02-0.08	0.013-0.08	PE 2-4
Colombia	EC	SR-Me	Ap	0.038-0.19	0.025-0.19	PE 2-4
Croatia	EC	R-Me	Ap	0.052-0.16	0.013-0.078	HC 40
Ecuador	EC	SR-Me	Ap	0.06-0.075	0.02-0.038	30
El Salvador	EC	SR-Me	Ap	0.18-0.24	0.072-0.12	PE 2-4
France	EC	R-Me	Ap	0.052-0.1	0.013-0.052	ET
France	EC	SR-EE	Ap	0.052-0.1	0.13-0.052	ET
Guatemala	EC	SR-Me	Ap	0.18-0.24	0.072-0.12	PE 2-4
Honduras	EC	SR-Me	Ap	0.18-0.2	0.072-0.1	PE 2-4
Hungary	EC	R-Me	Ap	0.042-0.21	0.014-0.1	120
Paraguay	LPU	R-Me	Aer	0.045-0.11	0.09-0.7	PE 2-4
Paraguay	EC	SR-Me	Ap	0.072-0.18	0.048-0.18	PE 2-4
Paraguay	EC	SR-Me	Aer	0.072-0.18	0.14-1.2	PE 2-4
Romania	EC	R-Me	Ap	0.1-0.16	0.035-0.078	HC 40
Uruguay	EC	SR-Me	Ap	0.084-0.3	0.056-0.3	PE 2-4
Uruguay	EC	SR-Me	Aer	0.084-0.3	0.17-2.0	PE 2-4

Table 10. Registered uses of haloxyfop on rice. All single applications of EC.

Country	Application				PHI, days, or growth stage
	ai	Method	kg ai/ha	kg ai/hl	
Argentina	SR-Me	Ap	0.075-0.09	0.05-0.09	PE 3
Argentina	SR-Me	Aer	0.075-0.09	0.15-0.6	PE 3
Colombia	SR-Me	Ap	0.06-0.09	0.02-0.045	PE 2-4
Colombia	SR-Me	Aer	0.06-0.09	0.12-0.6	PE 2-4
Ecuador	SR-Me	Ap	0.075-0.11	0.025-0.057	PE 2-4
Uruguay	SR-Me	Ap	0.026-0.038	0.017-0.038	PE 2-4
Uruguay	SR-Me	Aer	0.026-0.038	0.052-0.25	PE 2-4

Table 11. Registered uses of haloxyfop on oil seeds and hops. All single applications of EC.

Crop	Country	Formulation, ai	Application			PHI, days, or growth stage
			Method	kg ai/ha	kg ai/hl	
Cotton	Australia	R-Me	Ap	0.052-0.078	0.035-0.16	119
	Australia	R-Me	Aer	0.052-0.078	>0.17	119
	Australia	SR-EE	Ap	0.1-0.16	0.069-0.31	119
	Australia	SR-EE	Aer	0.1-0.16	>0.35	119
	Bolivia	SR-Me	Ap	0.06-0.084	0.04-0.084	PE 2-4
	Bolivia	SR-Me	Aer	0.06-0.084	0.12-0.56	PE 2-4
	Colombia	R-Me	Ap	0.02-0.08	0.013-0.08	PE 2-4
	Colombia	SR-Me	Ap	0.038-0.11	0.025-0.11	PE 2-4
	Ecuador	SR-Me	Ap	0.045-0.06	0.018-0.03	PE 2-4
	El Salvador	SR-Me	Ap	0.12-0.18	0.048-0.09	PE 2-4
	Guatemala	SR-Me	Ap	0.12-0.3	0.048-0.15	PE 2-4
	Honduras	SR-Me	Ap	0.12-0.3	0.048-0.15	PE 2-4
	Paraguay	SR-Me	Ap	0.072-0.18	0.048-0.18	PE 2-4
	Paraguay	SR-Me	Aer	0.072-0.18	0.14-1.2	PE 2-4
	Peru	SR-Me	Ap	0.11-0.15	0.028-0.038	PE 2-4
	Russia	R-Me	Ap	0.052-0.1	0.013-0.035	PE 3-5
	Spain	SR-EE	Ap	0.1-0.42	0.026-0.21	PE 2-4
Palm, African	Costa Rica	SR-Me	Gr	0.29-0.38	0.072-0.096	BF
Palm, oil	Ecuador	SR-Me	Gr	0.06-0.09	0.024-0.045	PE 2-4
Peanuts	Argentina	SR-Me	Ap	0.084-0.3	0.056-0.3	PE 2-4
	Argentina	SR-Me	Aer	0.084-0.3	0.17-2	PE 2-4
	Australia	R-Me	Ap	0.052-0.078	0.035-0.16	119
	Australia	R-Me	Aer	0.052-0.078	>0.17	119
	Australia	SR-EE	Ap	0.1-0.16	0.069-0.31	119
	Australia	SR-EE	Aer	0.1-0.16	>0.35	119
Rape seed	Australia	R-Me	Ap	0.04-0.052	0.027-0.104	119
	Australia	R-Me	Aer	0.04-0.052	>0.13	119

Crop	Country	Formulation, ai	Application			PHI, days, or growth stage
			Method	kg ai/ha	kg ai/hl	
	Australia	SR-EE	Ap	0.052-0.1	0.035-0.21	119
	Australia	SR-EE	Aer	0.052-0.1	>0.17	119
	Chile	R-Me	Ap	0.03-0.06	0.02-0.06	30
	Chile	SR-Me	Ap	0.06-0.12	0.04-0.12	30
	Croatia	R-Me	Ap	0.052-0.16	0.013-0.078	HC 40
	Czech repub.	R-Me	Ap	0.052-0.13	0.013-0.065	CC
	Denmark	SR-EE	Ap	0.1-0.21	0.042-0.21	210
	Ireland	SR-EE	Ap	0.078-0.21	0.02-0.1	end of Dec.
	France	R-Me	Ap	0.052-0.1	0.13-0.052	ET
	France	SR-EE	Ap	0.1-0.21	0.026-0.1	ET
	Germany	SR-EE	Ap	0.1-0.21	0.026-0.052	PE
	Hungary	R-Me	Ap	0.042-0.21	0.014-0.1	80
	Poland	R-Me	Ap	0.052-0.13	0.013-0.065	CC
	Slovakia	R-Me	Ap	0.052-0.13	0.013-0.065	CC
	Spain	SR-EE	Ap	0.1-0.42	0.026-0.21	PE 2-4
	The Netherlands	SR-EE	Ap	0.1-0.31	0.026-0.1	ST
Sunflower	Argentina	R-Me	Ap	0.042-0.15	0.028-0.15	PE 2-4
	Argentina	R-Me	Aer	0.042-0.15	0.084-1.0	PE 2-4
	Argentina	SR-Me	Ap	0.084-0.3	0.056-0.3	PE 2-4
	Argentina	SR-Me	Aer	0.084-0.3	0.17-2	PE 2-4
	Australia	R-Me	Ap	0.052-0.078	0.035-0.16	119
	Australia	R-Me	Aer	0.052-0.078	>0.17	119
	Australia	SR-EE	Ap	0.1-0.16	0.069-0.31	119
	Australia	SR-EE	Aer	0.1-0.16	>0.35	119
	Bolivia	SR-Me	Ap	0.06-0.084	0.04-0.084	PE 2-4
	Bolivia	SR-Me	Aer	0.06-0.084	0.12-0.56	PE 2-4
	Chile	R-Me	Ap	0.045-0.12	0.03-0.12	30
	Chile	SR-Me	Ap	0.09-0.24	0.06-0.24	30
	Croatia	R-Me	Ap	0.052-0.16	0.013-0.078	98
	Czech repub.	R-Me	Ap	0.052-0.16	0.013-0.078	CC
	France	R-Me	Ap	0.052-0.1	0.13-0.052	ET
	France	SR-EE	Ap	0.1-0.21	0.026-0.1	ET
	Greece	SR-EE	Ap	0.1-0.13	0.026-0.13	PE
	Hungary	R-Me	Ap	0.042-0.21	0.014-0.1	90
	Paraguay	SR-Me	Ap	0.072-0.18	0.048-0.18	PE 2-4
	Paraguay	SR-Me	Aer	0.072-0.18	0.14-1.2	PE 2-4
	Romania	R-Me	Ap	0.1-0.16	0.035-0.078	HC 40
	Slovakia	R-Me	Ap	0.052-0.16	0.013-0.078	CC
	Uruguay	SR-Me	Ap	0.084-0.3	0.056-0.3	PE 2-4
	Uruguay	SR-Me	Aer	0.084-0.3	0.17-2.0	PE 2-4
Hops	Czech repub.	R-Me	Gr	0.052-0.13	0.013-0.065	CC
	Slovakia	R-Me	Gr	0.052-0.13	0.013-0.065	CC

Table 12. Registered uses of haloxyfop on animal feed crops. All EC formulations.

Crop	Country	Application					PHI, days, or growth stage
		ai	Method	kg ai/ha	kg ai/hl	No.	
Alfalfa	Australia	R-Me	Ap	0.04-0.078	0.027-0.16	1	21
	Australia	R-Me	Aer	0.04-0.078	>0.13	1	21
	Australia	SR-EE	Ap	0.052-0.16	0.035-0.31	1	21
	Australia	SR-EE	Aer	0.052-0.16	>0.17	1	21
	Czech repub.	R-Me	Ap	0.052-0.16	0.013-0.078	1	CC
	Peru	SR-Me	Ap	0.11-0.15	0.028-0.038	1	PE 2-4
	Poland	R-Me	Ap	0.052-0.13	0.013-0.065	1	CC
	Slovakia	R-Me	Ap	0.052-0.16	0.013-0.078	1	CC
Fodder beet	Belarus	R-Me	Ap	0.052-0.1	0.01-0.035	1	PE 3-5
	Ireland	SR-EE	Ap	0.078-0.21	0.02-0.13	1	GC75%
	Ireland	SR-EE	Ap	0.034	0.034-0.043	3	GC75%
	France	SR-EE	Ap	0.1-0.21	0.026-0.1	1	ET
	Germany	SR-EE	Ap	0.16-0.21	0.039-0.1	1	90
	Poland	R-Me	Ap	0.052-0.13	0.013-0.065	1	60
	Russia	R-Me	Ap	0.052-0.1	0.013-0.035	1	PE 3-5
	The Netherlands	SR-EE	Ap	0.1-0.31	0.026-0.1	1	ST
	Ukraine	R-Me	Ap	0.052-0.1	0.01-0.035	1	PE 3-5
	Uzbekistan	R-Me	Ap	0.1-0.21	0.021-0.069	1	PE 3-5
Fodder peas (spring)	France	R-Me	Ap	0.052-0.1	0.13-0.052	1	ET
Fodder peas (winter)	France	R-Me	Ap	0.052-0.1	0.13-0.052	1	ET
Forage legumes	Uruguay	SR-Me	Ap	0.084-0.3	0.056-0.3	1	PE 2-4
	Uruguay	SR-Me	Aer	0.084-0.3	0.17-2.0	1	PE 2-4
Pasture	Australia	R-Me	Ap	0.04-0.052	0.027-0.104	1	7
	Australia	R-Me	Aer	0.04-0.052	>0.13	1	7
	Australia	SR-EE	Ap	0.052-0.1	0.035-0.21	1	7
	Australia	SR-EE	Aer	0.052-0.1	>0.17	1	7
Vetch	Australia	R-Me	Ap	0.04-0.052	0.027-0.104	1	91
	Australia	R-Me	Aer	0.04-0.052	>0.13	1	91
	Australia	SR-EE	Ap	0.052-0.1	0.035-0.21	1	91
	Australia	SR-EE	Aer	0.052-0.1	>0.17	1	91

RESIDUES RESULTING FROM SUPERVISED TRIALS

Supervised trials were carried out on fruits, vegetables, legume crops, oil seed, rice and animal feed crops with ethoxyethyl, butyl or methyl esters of haloxyfop.

Underlined residues in the Tables are from treatments according to GAP.

Application rates are expressed as free haloxyfop acid equivalents and residues have not normally been corrected for recoveries.

The following abbreviations are used in the Tables.

Active ingredient

SR:	racemic haloxyfop
R:	resolved (*R*)- isomer of haloxyfop
Me:	methyl ester
EE:	ethoxyethyl ester
Bt:	butyl ester

Residues in crops

Fruits

Citrus fruit. Eight supervised trials were carried out on oranges, lemons and grapefruit in Brazil, Italy and New Zealand with 0.16-1.9 kg ai/ha of racemic haloxyfop and haloxyfop-R. All residues were below the LODs of 0.01-0.1 mg/kg at PHIs of 28-206 days (Table 13).

Table 13. Residues of haloxyfop in citrus fruits. All single applications.

Crop, Country, Year	Application			PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound Form.	kg ai/ha	kg ai/hl				
Oranges	SR-Me	0.24	N.S.[1]	67	N.S.	<0.1	GHB-P040
Brazil	EC	0.48	N.S.	67		<0.1	(N136)
1986		0.72	N.S.	67		<0.1	
		0.96	N.S.	67		<0.1	
		1.4	N.S.	67		<0.1	
		1.9	N.S.	67		<0.1	
Oranges	SR-Me	0.24	0.08	206	N.S.	<0.1	GHB-P040
Brazil	EC	0.48	0.16	206		<0.1	(N136)
1986		0.72	0.24	206		<0.1	
		0.96	0.32	206		<0.1	
		1.4	0.48	206		<0.1	
		1.9	0.64	206		<0.1	
Oranges	R-Me	0.16	0.031	56	fruit diameter 6.5 cm	<0.02[2]	GHE-P-2771
Italy, 1991	EC			56		<0.02[3]	(N140)
Oranges	R-Me	0.16	0.031	56	fruit diameter 5.5 cm	<0.02[2]	GHE-P-2771
Italy, 1991	EC			56		<0.02[3]	(N140)
Lemons	SR-EE	0.42	0.042	28	beginning to	<0.03	GHF-P1147
New Zealand, 1991	EC	0.83	0.083	28	ripen	<0.03	(N135)
Lemons	R-Me	0.21	0.021	28	beginning to	<0.03	GHF-P1147
New Zealand, 1991	EC	0.42	0.042	28	ripen	<0.03	(N135)
Lemons	R-Me	0.21	0.021	28	beginning to	<0.03	GHF-P1147
New Zealand, 1991	WDG[4]	0.42	0.042	28	ripen	<0.03	(N135)
Grapefruit	SR-EE	0.21	0.1	29	N.S.	<0.01	GHF-P-515
New Zealand, 1985	EC	0.42	0.21	29		<0.01	(N137)

[1] Not specified in report

[2] Peel

[3] Pulp

[4] Water dispersible granule

Apples. Three supervised trials were carried out in Italy and New Zealand with single applications of haloxyfop-etotyl EC at 0.1- 0.42 kg ai/ha. Residues were <0.01 or <0.02 mg/kg at all application rates with PHIs of 29-132 days (Table 14).

Table 14. Residues of haloxyfop in apples.

Country, year	Application		PHI, days	Growth at last treatment	Residues, mg/kg	Reference
	kg ai/ha	kg ai/hl				
Italy 1987	0.1	N.S.[1]	132	fruit setting	<0.02	GHE-P-1965 (N96)
	0.21	N.S.	132		<0.02	
	0.42	N.S.	132		<0.02	
Italy 1987	0.1	N.S.	126	fruit setting	<0.02	GHE-P-1965 (N96)
	0.21	N.S.	126		<0.02	
	0.42	N.S.	126		<0.02	
New Zealand 1986	0.21	0.1	29	N.S.	<0.01	GHF-P-584 (N97)
	0.42	0.21	29		<0.01	

[1] Not specified in report

Grapes. Six supervised trials were carried out in Australia and France with 0.21-1.7 kg ai/ha of racemic haloxyfop-etotyl. Residues were below or near the LOD of 0.01 or 0.03 mg/kg at PHIs of 21-119 days. In three supervised trials in Italy with 0.21 kg ai/ha of haloxyfop-R-methyl residues were <0.05 mg/kg (Table 15).

Table 15. Residues of haloxyfop in grapes. All EC formulations.

Country Year	Application[1]				PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	No	kg ai/ha	kg ai/hl				
Australia 1990	SR-EE	1	0.21	0.21	21	21:bunches almost full	<0.03	GHF-P-1150 (N102A)
					49		<0.03	
		1	0.42	0.42	21		<0.03	
					49	49:bunches half filled	<0.03	
		1	0.83	0.83	21		<0.03	
					49		<0.03	
Australia 1990	SR-EE	1	0.21	0.21	29	29:bunches almost full	<0.03	GHF-P-1150 (N102A)
					56		<0.03	
		1	0.42	0.42	29		<0.03	
					56	56: start of bunching	<0.03	
		1	0.83	0.83	29		0.03	
					56		<0.03	
France 1983	SR-EE	2	0.1	0.016	93	N.S.	<0.01	GHE-P-1148 (N101)
		2	0.21	0.032	93		<0.01	
		2	0.42	0.064	93		<0.01	
		2	0.83	0.13	93		<0.01	
		2	1.7	0.26	93		<0.01	
France 1985	SR-EE	1	0.42	N.S.	119	N.S.	<0.01	GHE-P-1532 (N102)
		1	0.83	N.S.	119		<0.01	
France 1985	SR-EE	1	0.42	0.1	115	N.S.	<0.01	GHE-P-1532 (N102)
		1	0.83	0.21	115		<0.01	
France 1985	SR-EE	1	0.42	0.14	86	N.S.	<0.01	GHE-P-1532 (N102)
		1	0.83	0.28	86		<0.01	
Italy 1989	R-Me	1	0.21	0.052	67	small pea size	<0.05	GHE-P-2115 (N70)
Italy 1989	R-Me	1	0.21	0.052	63	small pea size	<0.05	GHE-P-2115 (N70)
Italy 1989	R-Me	1	0.21	0.052	51	small pea size	<0.05	GHE-P-2115 (N70)

[1] Not specified in report

Bananas. Two supervised trials were carried out in Australia, one with 0.83 kg ai/ha of racemic haloxyfop-etotyl and the other with 0.42 kg ai/ha of haloxyfop-R-methyl. Residues were <0.05 mg/kg at PHIs of 7-14 days (Table 16).

Table 16. Residues of haloxyfop in bananas in Australia, 1991. All single applications.

Compound, form.	Application		PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	kg ai/ha	kg ai/hl				
SR-EE	0.83	0.5	14	bunching	<0.05	GHF-P-1149
EC						(N133)
R-Me	0.42	0.25	7	bunching	<0.05	GHF-P-1149
WDG			14		<0.05	

Vegetables (Table 17)

Garlic. Two supervised trials were carried out in Spain at application rates of 0.078 or 0.16 kg ai/ha of haloxyfop-R-methyl with PHIs of 53 and 88 days.

Onions. Four supervised trials were carried out in Greece, The Netherlands, New Zealand and the UK at application rates of 0.052-0.83 kg ai/ha with PHIs of 15-121 days.

Cabbage. Two supervised trials were carried out in the UK and New Zealand at application rates of 0.052-0.42 kg ai/ha with PHIs of 14-65 days.

Brussels sprouts. Two supervised trials in the UK were with haloxyfop-etotyl at 0.21 and 0.42 kg ai/ha, both with a PHI of 147 days.

Cauliflower. Two UK trials were at application rates of 0.21 and 0.42 kg ai/ha with PHIs of 48 days.

Melons. Two supervised trials were carried out in Italy at an application rate of 0.052 kg ai/ha with haloxyfop-R-methyl with PHIs of 46 and 60 days.

Tomatoes. Four trials were carried out in Australia with racemic haloxyfop-etotyl at application rates of 0.1 and 0.2 kg/ha, and 6 in Italy with 0.052 and 0.1 kg ai/ha of haloxyfop-R-methyl. PHIs were 41-74 days.

Fennel. Only one supervised trial was reported to the Meeting, which was in Italy with haloxyfop-R-methyl at an application rate of 0.062 kg ai/ha. Samples were taken at 72 and 165 days.

Lettuce. Two supervised trials were carried out in Spain at application rates of 0.052-0.16 kg ai/ha with haloxyfop-R-methyl, with PHIs of 40 and 50 days.

Spinach. Two trials were carried out in Italy at an application rate of 0.062 kg ai/ha with haloxyfop-R-methyl. The PHIs were 28 and 32 days.

Carrots. Three supervised trials in Italy were with haloxyfop-R-methyl at an application rate of 0.052 kg ai/ha and PHIs of 38-138 days.

Artichokes. Two trials with haloxyfop-R-methyl in Spain were at application rates of 0.052 and 0.078 kg ai/ha with PHIs of 0-42 days.

Asparagus. Two supervised trials in Italy were at an application rate of 0.062 kg ai/ha with haloxyfop-R-methyl with PHIs of 21 and 28 days.

Table 17. Residues of haloxyfop in vegetables. All single applications of EC.

Crop, Country, Year	Compound	Application		PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
		kg ai/ha	kg ai/hl				
Garlic	R-Me	0.078	0.022	88	6-7 leaves	<0.02	GHE-P-2066
Spain 1989		0.16	0.045	88	20 cm height	<0.02	(N40)
Garlic	R-Me	0.078	0.022	53	7-8 leaves	<0.02	GHE-P-2066
Spain 1989		0.16	0.045	53	40 cm height	0.02	(N40)
Onions	SR-EE	0.1	N.S.[1]	33		<0.02	GHE-P-1497
Greece		0.21	N.S.	33	25-30 cm	0.04	(N88)
1985		0.42	N.S.	33	height	0.05	
		0.83	N.S.	33		0.11	
Onions	SR-EE	0.21	N.S.	121		<0.02	GHE-P-1498
Netherlands		0.31	N.S.	121	20 cm height	<0.02	(N87)
1984		0.42	N.S.	121		<0.02	
Onions	SR-EE	0.1	0.052	80	2-3 leaves	<0.02	GHE-P-1499
UK		0.21	0.1	80	10-15 cm	<0.02	(N86)
1985		0.42	0.21	80	height	0.03	
Onions	SR-EE	0.052	0.026	15	15:mature	<0.005	GHF-P-633
New Zealand				30	bulbs,tops	0.008	(N89)
1987		0.1	0.052	15	beginning to	0.013	
				30	collapse	0.023	
		0.21	0.1	15	30: mature	0.029	
				30	bulbs, green leaves	0.058	
Cabbage	SR-EE	0.21	N.S.	65	4 expanded	<0.02(H)[2]	GHE-P-2738
UK				65	true leaves	<0.02(O)[3]	(N91A)
1991		0.42	N.S.	65		<0.02(H)	
				65		<0.02(O)	
Cabbage	SR-EE	0.052	0.026	14		0.113	GHF-P-632
New Zealand				29	N.S.	0.132	(N91)
1987		0.1	0.052	14		0.131	
				29		0.168	
		0.21	0.1	14		0.311	
				29		0.231	
Brussels	SR-EE	0.21	0.1	147		0.06(B)[4]	GHE-P-2738
sprouts				147	stem	0.07(T)[5]	(N91A)
UK		0.42	0.21	147	extension	0.16(B)	
1991				147		0.1(T)	
Cauliflower	SR-EE	0.21	0.1	48		0.29(C)[6]	GHE-P-2738
UK				48	button	0.18(O)	(N91A)
1991		0.42	0.21	48	formation	0.48(C)	
				48		0.41(O)	
Melon Italy 1990	R-Me	0.052	N.S.	60	flowering	<0.02	GHE-P2410 (N110)
Melon Italy 1990	R-Me	0.052	N.S.	46	flowering	<0.02	GHE-P-2410 (N110)
Tomato	SR-EE	0.1	N.S.	74	15 cm height	<0.02	PAU-3312-156
Australia 1984		0.2	N.S.	74	first flower formed	0.02	(N117)
Tomatoes	R-Me	0.052	0.013	41	fruit setting	0.03	GHE-P-2116

Crop, Country, Year	Compound	Application		PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
		kg ai/ha	kg ai/hl				
Italy 1989		0.1	0.026	41		0.07	(N60)
Tomatoes	R-Me	0.052	0.013	52	fruit setting	<0.02	GHE-P-2116
Italy 1989		0.1	0.026	52		<0.02	(N60)
Tomatoes	R-Me	0.052	0.013	52	fruit setting	0.02	GHE-P-2116
Italy 1989		0.1	0.026	52		0.03	(N60)
Fennel	R-Me	0.062	0.016	72	4 leaves	<0.02	GHE-P-2796
Italy 1992				165	2 leaves	<0.02	(N45)
Lettuce	R-Me	0.052	N.S.	40		0.06	GHE-P-2184
Spain		0.1	N.S.	40	13 leaves	0.07	(N90)
1990		0.16	N.S.	40		0.14	
Lettuce	R-Me	0.052	N.S.	50		0.08	GHE-P-2184
Spain		0.1	N.S.	50	15-16 leaves	0.1	(N90)
1990		0.16	N.S.	50		0.13	
Spinach Italy 1992	R-Me	0.062	0.016	28	2 leaves	0.05	GHE-P-3038 (N95)
Spinach Italy 1992	R-Me	0.062	0.016	32	3 leaves	0.04	GHE-P-3038 (N95)
Carrots Italy 1991	R-Me	0.052	N.S.	65	4 leaves	<0.02	GHE-P-2539 (N130)
Carrots Italy 1991	R-Me	0.052	N.S.	138	6 leaves	<0.02	GHE-P-2539 (N130)
Carrots Italy 1991	R-Me	0.052	N.S.	38	6 leaves	<0.02	GHE-P-2539 (N130)
Artichoke	R-Me	0.052	N.S.	0		0.06	GHE-P-2185
Spain				7	all leaves	0.07	(N100)
1990				14	open-full	0.1	
				30	florescence	0.1	
				42		0.05	
		0.078	N.S.	0		0.09	
				7		0.1	
				14		0.15	
				30		0.14	
				42		0.04	
Artichokes	R-Me	0.052	N.S.	0		0.07	GHE-P-2185
Spain				7	all leaves	0.06	(N100)
1990				14	open-full	0.08	
				30	florescence	0.06	
				42		0.03	
		0.078	N.S.	0		0.13	
				7		0.12	
				14		0.15	
				30		0.11	
				42		0.08	
Asparagus Italy 1992	R-Me	0.062	0.016	21	3 cm length	<0.02	GHE-P-2800
Asparagus Italy 1992	R-Me	0.062	0.016	28	4 cm length	<0.02	GHE-P-2800

[1] Not specified
[2] Heart
[3] Outer leaves
[4] Buttons

[5] Plant tops
[6] Curd

Peas (pods and succulent seeds). Four supervised trials in France with racemic haloxyfop-etotyl were at 0.1 or 0.21 kg ai/ha with PHIs of 36-68 days. Three others in France and four in Germany were with haloxyfop-R-methyl at 0.052 or 0.1 kg ai/ha with PHIs of 36-60 days (Table 18).

Table 18. Residues of haloxyfop in peas. All single EC applications.

Country, year	Application			PHI, days	Growth stage at last treatment[1]	Residues, mg/kg	Reference
	Compound	kg ai/ha	kg ai/hl				
France 1984	SR-EE	0.1	0.016	68	15-20 cm height	0.07	GHE-P-1671 (N66)
France 1988	SR-EE	0.1	N.S.[1]	39	8-9 leaves	<0.05	GHE-P-1956
		0.21	N.S.	39		0.11	(N30)
France 1989	SR-EE	0.1	0.021	36	5-6 leaves	0.03	GHE-P-2057
		0.21	0.042	36		0.06	(N31)
France 1989	SR-EE	0.1	0.042	36	flower buds	0.04	GHE-P-2057
		0.21	0.084	36	hidden by top leaves	0.07	(N31)
France 1988	R-Me	0.052	N.S.	39	8-9 leaves	<0.05	GHE-P-1956
		0.1	N.S.	39		0.06	(N30)
France 1989	R-Me	0.052	0.01	36	5-6 leaves	0.03	GHE-P-2057
		0.1	0.021	36		0.04	(N31)
France 1989	R-Me	0.052	0.021	36	flower buds hidden by top leaves	0.03	GHE-P-2057
		0.1	0.042	36		0.05	(N31)
Germany 189	R-Me	0.1	0.035	43	3 leaves	<0.02[2]	GHE-P-2154
				56		<0.02	(N36)
Germany 1989	R-Me	0.1	0.035	38	4 leaves	<0.02[2]	GHE-P-2154
				53		<0.02	(N36)
Germany 1989	R-Me	0.1	0.026	42	10 leaves	0.07[2]	GHE-P-2154 (N36)
Germany 1989	R-Me	0.1	0.026	42	6-7 leaves	0.03[2]	GHE-P-2154
				60		<0.02	(N36)

[1] Not specified [2] Pod

Field beans. Eight supervised trials were conducted in Germany with haloxyfop-R-methyl at application rates of 0.052 or 0.1 kg ai/ha with PHIs of 42-80 days (Table 19).

Table 19. Residues of haloxyfop in field beans in Germany. All single EC applications of haloxyfop-R-methyl.

Year	Application		PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	kg ai/ha	kg ai/hl				
1989	0.1	0.035	55	4 leaves	0.02[1]	GHE-P-2155 (N35)

Year	Application		PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	kg ai/ha	kg ai/hl				
1989	0.1	0.035	46	4 leaves	0.03[1]	GHE-P-2155 (N35)
1989	0.1	0.026	71	6 leaves	<0.02[1]	GHE-P-2155 (N35)
1989	0.1	0.026	42	6 leaves	0.03[1]	GHE-P-2155 (N35)
1990	0.052	0.013	76 76	6 leaves	<0.02 <0.02[1]	GHE-P-2444 (N37)
	0.1	0.026	76 76		<0.02 <0.02[1]	
1990	0.052	0.013	70	4-5 leaves	<0.02	GHE-P-2444 (N37)
			70		<0.02[1]	
	0.1	0.026	70		<0.02	
			70		<0.02[1]	
1990	0.052	0.013	80	4 leaves	<0.02	GHE-P-2444 (N37)
			80		<0.02[1]	
	0.1	0.026	80		<0.02	
			80		<0.02[1]	
1990	0.052	0.013	62	beginning of flowering	0.06	GHE-P-2444 (N37)
			62		<0.02[1]	
	0.1	0.026	62		0.16	
			62		0.02[1]	

[1] Pod

Broad beans (dry). Four supervised trials were carried out in Australia, France and Greece with racemic haloxyfop-etotyl at 0.078-0.26 kg ai/ha with PHIs of 16-171 days (Table 20).

Table 20. Residues of haloxyfop in broad beans (dry). All single EC applications of haloxyfop-etotyl.

Country, year	Application		PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	kg ai/ha	kg ai/hl				
Australia 1986	0.078	N.S.[1]	171	43 days after planting	<0.05	PAU-3313-269
	0.16	N.S.	171		<0.05	(N63)
Australia 1988	0.1	0.065	103	6-8 leaves 55 days after planting	<0.05	GHF-P-834
	0.21	0.13	103		<0.05	(N65A)
France 1984	0.21	0.032	46	24 days after planting	0.03	GHE-P-1693 (N61)
Greece 1983	0.16	N.S.	16	maturing beans	0.37	GHE-P-1694
	0.26	N.S.	16		0.73	(N62)

[1] Not specified

Chick-peas and pigeon peas (dry). Three supervised trials were carried out in Australia on chick-peas with haloxyfop-etotyl at 0.1-0.42 kg ai/ha and two on pigeon peas with etotyl at 0.16 or 0.31 kg ai/ha and with haloxyfop-R-methyl at 0.038 or 0.075 kg ai/ha. PHIs were 52-137 days (Table 21).

Table 21. Residues of haloxyfop in chick-peas (dry) and pigeon peas (dry) in Australia. All single EC applications.

Crop, year	Application			PHI days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	kg ai/ha	kg ai/hl				
Chick-peas	SR-EE	0.1	0.095	52	52:full	0.3	PAU-3313-254
				65	bloom	0.09	(N70)
1986				79	65:mid to	0.03	
		0.21	0.19	52	late	0.65	
				65	tillering	0.18	
				79	79:3-5	0.05	
		0.42	0.38	79	leaves	0.06	
Chick-peas	SR-EE	0.1	0.095	65	65:full	0.11	PAU-3313-254
				78	bloom	0.04	(N70)
1986				137	78:mid to	<0.03	
		0.21	0.19	65	late	0.16	
				78	tillering	0.05	
				137	137:3-5	<0.03	
		0.42	0.38	137	leaves	<0.03	
Chick-peas	SR-EE	0.1	0.095	65	65:full	0.19	PAU-3313-254
				78	bloom	0.06	(N70)
1986				99	78:mid to	<0.03	
		0.21	0.19	65	late	0.24	
				78	tillering	0.09	
				99	99:3-5	<0.03	
		0.42	0.38	99	leaves	0.06	
Pigeon peas	SR-EE	0.16	0.14	85	43 days	0.03	GHF-P-895
1989		0.31	0.28	85	after planting	0.06	(N70A)
Pigeon peas	R-Me	0.038	0.035	85	43 days	<0.01	GHF-P-895
1989		0.075	0.068	85	after planting	0.02	(N70A)

Common beans (dry). Five supervised trials were carried out in Australia, Brazil and the UK with 0.12-0.48 kg ai/ha of racemic haloxyfop methyl and etotyl esters, with PHIs of 24-104 days.

Nine supervised trials in Germany and the UK at 0.052-0.21 kg ai/ha were with haloxyfop-R-methyl with PHIs, of 72-120 days (Table 22).

Table 22. Residues of haloxyfop in common beans (dry). All single EC applications.

Country, year	Application			PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	kg ai/ha	kg ai/hl				
Australia 1986	SR-EE	0.16	0.14	24	24:mature	0.07	PAU-3313-249
				64	pod	0.05	(N80C)

				75	64:early	0.03	
		0.31	0.3	24	bloom	0.04	
				64	75:6 leaves	0.13	
				75		0.05	
Australia 1989	SR-EE	0.16	0.14	85	early	0.41	GHF-P-919
		0.31	0.28	85	budding	0.87	(N64)
Brazil 1987	SR-Me	0.12	0.052	68		<0.05	GHB-P072
		0.24	0.1	68	2 trifoliate	<0.05	(N145)
		0.48	0.21	68		<0.05	
Brazil 1987	SR-Me	0.12	0.048	76	16 days	<0.05	GHB-P072
		0.24	0.96	76	post	<0.05	(N145)
		0.48	0.19	76	emergence	<0.05	
UK 1991	SR-EE	0.21	N.S.[1]	104	end of	0.2	GHE-P-2654
		0.42	N.S.	104	flowering	0.31	(N65)
Germany 1989	R-Me	0.1	0.035	89	4 leaves	<0.02	GHE-P-2155 (N35)
Germany 1989	R-Me	0.1	0.035	91	4 leaves	0.04	GHE-P-2155 (N35)
Germany 1989	R-Me	0.1	0.026	120	6 leaves	<0.02	GHE-P-2155 (N35)
Germany 1989	R-Me	0.1	0.026	105	6 leaves	0.03	GHE-P-2155 (N35)
Germany 1990	R-Me	0.052	0.013	91	6 leaves	<0.02	GHE-P-2444
		0.1	0.026	91		0.02	(N37)
Germany 1990	R-Me	0.052	0.013	98	4-5 leaves	<0.02	GHE-P-2444
		0.1	0.026	98		<0.02	(N37)
Germany 1990	R-Me	0.052	0.013	106	4 leaves	<0.02	GHE-P-2444
		0.1	0.026	106		<0.02	(N37)
Germany 1990	R-Me	0.052	0.013	72	beginning	0.11	GHE-P-2444
		0.1	0.026	72	of flowering	0.3	(N37)
UK 1991	R-Me	0.1	N.S.	104	end of	0.1	GHE-P-2654
		0.21	N.S.	104	flowering	0.18	(N38)

[1] Not specified

Field peas (dry). Ten supervised trials in Australia and France were with racemic haloxyfop-etotyl at 0.06-0.21 kg ai/ha, and 12 in Australia, France, and Germany were with haloxyfop-R-methyl at 0.052-0.1 kg ai/ha. PHIs were 68-168 days (Table 23).

Table 23. Residues of haloxyfop in field peas (dry). All single EC applications.

Country, year	Application			PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	kg ai/ha	kg ai/hl				

Country, year	Application			PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	kg ai/ha	kg ai/hl				
Australia 1984	SR-EE	0.06	0.038	168	6-8 weeks after planting	<0.02	PAU-3313-200 (N68)
		0.12	0.075	168		<0.02	
Australia 1984	SR-EE	0.062	0.12	151	2-3 leaves	<0.01	PAU-3313-211 (N69)
		0.13	0.25	151		<0.01	
		0.062	0.12	132	early tillering	<0.01	
		0.13	0.25	132		<0.01	
Australia 1989	SR-EE	0.1	0.1	94	14 cm height	<0.01	GHF-P-1003 (N70C)
		0.21	0.21	94		<0.01	
Australia 1989	SR-EE	0.1	0.1	93	2-3 nodes, 6-10 cm height	<0.01	GHF-P-1003 (N70C)
		0.21	0.21	93		<0.01	
(Winter) France 1989	SR-EE	0.1	0.032	68	5-6 spread out leaves	0.04	GHE-P-2058 (N32)
		0.21	0.064	68		0.06	
(Winter) France 1989	SR-EE	0.1	0.031	99	6-7 spread out leaves	<0.02	GHE-P-2058 (N32)
		0.21	0.062	99		<0.02	
(Winter) France 1989	SR-EE	0.1	0.031	99	6 leaves	<0.02	GHE-P-2058 (N32)
		0.21	0.062	99		<0.02	
(Spring) France 1989	SR-EE	0.1	0.026	80	6 spread out leaves	<0.02	GHE-P-2055 (N33)
		0.21	0.052	80		<0.02	
(Spring) France 1988	SR-EE	0.1	0.035	92		0.07	GHE-P-1966 (N34)
		0.21	0.07	92	9-10 leaves	0.14	
(Spring) France 1988	SR-EE	0.1	N.S.[1]	109	4 leaves	<0.05	GHE-P-1966 (N34)
		0.21	N.S.	109		<0.05	
Australia 1989	R-Me	0.052	0.052	94	14 cm height	<0.01	GHF-P-1003 (N70C)
		0.1	0.1	94		<0.01	
Australia 1989	R-Me	0.052	0.052	93	2-3 nodes, 6-10 cm height	<0.01	GHF-P-1003 (N70C)
		0.1	0.1	93		<0.01	
(Winter) France 1989	R-Me	0.052	0.016	68	5-6 spread out leaves	0.04	GHE-P-2058 (N32)
		0.1	0.032	68		0.06	
(Winter) France 1989	R-Me	0.052	0.016	99	6-7 spread out leaves	<0.02	GHE-P-2058 (N32)
		0.1	0.032	99		<0.02	
(Winter) France 1989	R-Me	0.052	0.016	99	6 leaves	<0.02	GHE-P-2058 (N32)
		0.1	0.032	99		<0.02	
(Spring)	R-Me	0.052	0.013	80	6 spread	<0.02	GHE-P-2055

Country, year	Application			PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	kg ai/ha	kg ai/hl				
France 1989		0.1	0.026	80	out leaves	<0.02	(N33)
(Spring) France 1988	R-Me	0.052	0.017	92	9-10 leaves	<0.05	GHE-P-1966
		0.1	0.035	92		0.1	(N34)
(Spring) France 1988	R-Me	0.052	N.S.	109	4 leaves	<0.05	GHE-P-1966
		0.1	N.S.	109		<0.05	(N34)
Germany 1989	R-Me	0.1	0.035	76	3 leaves	<0.02	GHE-P-2154 (N36)
Germany 1989	R-Me	0.1	0.035	77	4 leaves	<0.02	GHE-P-2154 (N36)
Germany 1989	R-Me	0.1	0.026	60	10 leaves	0.03	GHE-P-2154 (N36)
Germany 1989	R-Me	0.1	0.026	80	6-7 leaves	0.03	GHE-P-2154 (N36)

[1] Not specified

Lupins (dry). Ten supervised trials were carried out in Australia, 18 with racemic haloxyfop-etotyl at 0.06-0.24 kg ai/ha and one with haloxyfop-R-methyl at 0.052-0.1 kg ai/ha, with PHIs of 92-192 days (Table 24).

Table 24. Residues of haloxyfop in lupins (dry) in Australia. All single EC applications.

Year	Application			PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	kg ai/ha	kg ai/hl				
1984	SR-EE	0.06	0.067	157	2-3 pairs	0.05	PAU-3313-202
				172	of leaves	0.04	(N81)
1984	SR-EE	0.06	0.067	154	2-3 pairs	0.03	PAU-3313-202
				169	of leaves	0.03	(N81)
1984	SR-EE	0.06	N.S.[1]	127	3-4 pairs	<0.02	PAU-3313-203
				141	of leaves	<0.02	(N82)
1984	SR-EE	0.06	N.S.	156	2-3 nodes	<0.02	PAU-3313-203
		0.12	N.S.	156		<0.02	(N82)
1984	SR-EE	0.24	0.12	167	8 leaves	<0.02	PAU-3313-203 (N82)
1986	SR-EE	0.078	0.078	99	N.S.	<0.05	PAU-3313-264
				139	N.S.	<0.05	(N83)
				154	12 cm height	<0.05	
				181	2-3	<0.05	
		0.16	0.16	99	leaves	0.04	
				139		<0.05	
				154		<0.05	
1986	SR-EE	0.078	0.078	179	4-6 leaves	<0.05	PAU-3313-264
		0.21	0.21	179	10 cm height	<0.05	(N83)

haloxyfop

Year	Application			PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	kg ai/ha	kg ai/hl				
1986	SR-EE	0.078	0.078	115	11-12 leaves	<0.05	PAU-3313-264 (N83)
		0.16	0.16	115	15 cm height	<0.05	
		0.1	0.1	135		<0.05	
		0.21	0.21	135		<0.05	
1985	SR-EE	0.06	0.079	110	8 leaves	<0.03	PAU-3313-250 (N85A)
		0.12	0.16	110		0.03	
		0.24	0.32	110		0.03	
1989	SR-EE	0.1	0.1	92	50 cm height, just before flowering	0.11	GHF-P-1004 (N84)
				154		0.01	
				192		<0.01	
		0.21	0.21	92		0.2	
				154		0.01	
				192		<0.01	
1989	R-Me	0.052	0.052	92		0.05	GHF-P-1004 (N84)
				154	10-15 cm height	<0.01	
				192		<0.01	
		0.1	0.1	92		0.116	
				154		<0.01	
				192	6 leaves 7-10 cm height	<0.01	

[1] Not specified

Soya beans (dry). Thirty three supervised trials were carried out in Australia, Brazil and the USA with the methyl, butyl and ethoxyethyl esters of racemic haloxyfop at 0.06-0.48 kg ai/ha with PHIs of 55-142 days. In 20 trials in France and Italy haloxyfop-R-methyl was applied at 0.052-0.1 kg ai/ha. PHIs were 76-133 days (Table 25).

Table 25. Residues of haloxyfop in soya beans (dry).

Country, Year	Application				PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound, Form.	No	kg ai/ha	kg ai/hl				
Australia 1986	SR-EE	1	0.16	0.16	55	bloom/early pod	0.16	PAU-3313-249
	EC				102	pre-bloom	<0.03	(N80C)
		1	0.31	0.31	55		0.03	
					102		0.03	
Australia 1986	SR-EE	1	0.16	0.17	105	4 leaves	<0.03	PAU-3313-249
	EC							(N80C)
Australia 1986	SR-EE	1	0.16	0.14	110	4 leaves	<0.03	PAU-3313-249
	EC				122	1-2 leaves	<0.03	(N80C)
		1	0.31	0.29	110		<0.03	
					122		<0.03	
Australia 1986	SR-EE	1	0.21	0.19	94	3 leaves	<0.03	PAU-3313-249
	EC	1	0.31	0.29	94		0.03	(N80C)
		1	0.42	0.38	94		0.03	
		2	0.12	0.095	43	early to pod	.33	
		2	0.16	0.14	43		0.43	
		2	0.2	0.19	43		0.46	
Brazil 1984	SR-Me	1	0.12	0.05	105	pre-bloom,	<0.05	GHB-P024
	EC	1	0.24	0.1	105	3rd trifoliate	<0.05	(N79)
		1	0.36	0.14	105		0.13	
Brazil 1984	SR-Me	1	0.12	0.05	60	in bloom	1.02	GHB-P024
	EC	1	0.24	0.1	60		0.8	(N79)
		1	0.36	0.14	60		1.46	
Brazil 1984	SR-Me	1	0.12	0.04	99	pre-bloom,	0.06	GHB-P024
	EC	1	0.36	0.12	99	20-30 cm height	0.15	(N79)
Brazil 1984	SR-Me	1	0.12	0.04	79	in bloom,	0.41	GHB-P024
	EC	1	0.36	0.12	79	50-60 cm height	0.45	(N79)
Brazil 1984	SR-Me	1	0.12	0.04	103	pre-bloom,	<0.05	GHB-P024
	EC	1	0.24	0.08	103	30 cm height	<0.05	(N79)
		1	0.36	0.12	103		0.05	
Brazil 1984	SR-Me	1	0.12	0.04	78	in bloom	0.15	GHB-P024

Country, Year	Application				PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound, Form.	No	kg ai/ha	kg ai/hl				
	EC	1	0.24	0.08	78		0.35	(N79)
		1	0.36	0.12	78		0.52	
Brazil 1982	SR-Bt	1	0.06	0.02	110	4th	<0.05	GHB-P015
	EC	1	0.12	0.04	110	trifoliate,	<0.05	(N80D)
		1	0.18	0.06	110	20 cm height	<0.05	
		1	0.06[1]	0.02	110		<0.05	
		1	0.12[1]	0.04	110		<0.05	
		1	0.18[1]	0.06	110		<0.05	
Brazi 1982	SR-Bt	1	0.06	0.02	97	6th	<0.05	GHB-P015
	EC	1	0.12	0.04	97	trifoliate,	<0.05	(N80D)
		1	0.18	0.06	97	30 cm height	<0.05	
		1	0.06[1]	0.02	97		<0.05	
		1	0.12[1]	0.04	97		<0.05	
		1	0.18[1]	0.06	97		<0.05	
Brazil 1982	SR-Bt	1	0.12	0.04	142	4th	<0.05	GHB-P015
	EC	1	0.24	0.08	142	trifoliate,	<0.05	(N80D)
		1	0.12	0.04	142	20 cm height	0.06	
		1	0.24	0.08	142		0.06	
		1	0.12	0.04	142		<0.05	
		1	0.24	0.08	142		0.06	
		1	0.12	0.04	142		<0.05	
		1	0.24	0.08	142		0.06	
Brazil 1982	SR-Bt	1	0.12	0.036	132	8th	0.06	GHB-P015
	EC	1	0.24	0.072	132	trifoliate,	0.08	(N80D)
		1	0.12	0.036	132	45 cm height	0.07	
		1	0.24	0.072	132		0.08	
		1	0.12	0.036	132		<0.05	
		1	0.24	0.072	132		0.07	
		1	0.12	0.036	132		0.05	
		1	0.24	0.072	132		0.11	
Brazil	SR-Me	1	0.12	0.06	131	40 cm height	<0.05	GHB-P015
	EC	1	0.24	0.12	131		0.06	(N80D)
		1	0.36	0.18	131		0.06	
		1	0.48	0.24	131		0.8	
		1	0.3	0.15	131		<0.05	
		1	0.36	0.18	131		0.06	
USA 1983	SR-Me	1	0.28	N.S.[2]	84	in bloom	0.22	
					94	pre-bloom	0.067	(N73)
USA 1983	SR-Me	1	0.28	N.S.	86	in bloom	0.37	
					95	pre-bloom	0.11	(N73)
USA 1983	SR-Me	1	0.28	N.S.	69	in bloom	0.49	
					91	pre-bloom	0.023	(N73)

Country, Year	Application				PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound, Form.	No	kg ai/ha	kg ai/hl				
USA 1983	SR-Me	1	0.28	N.S.	109	pre-bloom	0.2	(N73)
USA 1983	SR-Me	1	0.28	N.S.	82	in bloom	2.21	
					84	in bloom	2.06	(N73)
USA 1983	SR-Me	1	0.28	N.S.	90	in bloom	0.4	
					98	pre-bloom	0.06	(N73)
USA 1983	SR-Me	1	0.28	N.S.	89	in bloom	<0.05	
					122	pre-bloom	<0.05	(N73)
USA 1983	SR-Me	1	0.28	N.S.	106	in bloom	0.43	
					125	pre-bloom	0.05	(N73)
USA 1983	SR-Me	1	0.28	N.S.	69	in bloom	1.42	
					91	pre-bloom	0.21	(N73)
USA 1983	SR-Me	1	0.28	N.S.	86	in bloom	0.96	
					98	pre-bloom	0.3	(N73)
USA 1983	SR-Me	1	0.28	N.S.	73	in bloom	2.32	
								(N73)
USA 1983	SR-Me	1	0.28	N.S.	74	in bloom	3.08	
					86	in bloom	2	(N73)
USA 1983	SR-Me	1	0.28	N.S.	82	in bloom	1.24	
					96	pre-bloom	0.22	(N73)
USA 1983	SR-Me	1	0.28	N.S.	157	in bloom	0.16	
					167	pre-bloom	0.1	(N73)
USA 1983	SR-Me	1	0.28	N.S.	99	in bloom	0.34	
					127	pre-bloom	0.05	(N73)
USA 1983	SR-Me	1	0.28	N.S.	77	in bloom	0.25	
					118	pre-bloom	<0.05	(N73)
USA 1983	SR-Me	1	0.28	N.S.	75	in bloom	0.6	
					96	pre-bloom	0.08	(N73)
USA 1983	SR-Me	1	0.28	N.S.	76	in bloom	0.82	
					104	pre-bloom	0.08	(N73)
France 1990	R-Me	1	0.052	0.016	133	3 knots	<0.02	GHE-P-2515
	EC	1	0.1	0.032	133		<0.02	(N81)
France 1990	R-Me	1	0.052	0.016	132	3 knots	<0.02	GHE-P-2515
	EC	1	0.1	0.032	132		<0.02	(N81)
France 1990	R-Me	1	0.052	0.012	92	3-4 knots	0.04	GHE-P-2515
	EC				92		<0.05[3]	(N81)
		1	0.1	0.024	92		0.07	
					92		0.06[3]	
France 1990	R-Me	1	0.052	0.01	123	3 knots	<0.02	GHE-P-2515
	EC				123		<0.05[3]	(N81)
		1	0.1	0.021	123		<0.02	
					123		<0.05[3]	
Italy 1989	R-Me	1	0.052	N.S.	76	6th trifoliate	0.05	GHE-P-2175
	EC	1	0.1	N.S.	76		0.09	(N80)

Country, Year	Application				PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound, Form.	No	kg ai/ha	kg ai/hl				
Italy 1989	R-Me	2	0.039	N.S.	76	6th trifoliate	0.04	GHE-P-2175
	EC	2	0.078	N.S.	76		0.08	(N80)
Italy 1989	R-Me	1	0.052	N.S.	93	6th trifoliate	<0.02	GHE-P-2175
	EC	1	0.1	N.S.	93		<0.02	(N80)
Italy 1989	R-Me	2	0.039	N.S.	93	6th trifoliate	<0.02	GHE-P-2175
	EC	2	0.078	N.S.	93		<0.02	(N80)
Italy 1989	R-Me	1	0.052	N.S.	98	6-7th	<0.02	GHE-P-2175
	EC	1	0.1	N.S.	98	trifoliate	<0.02	(N80)
Italy 1989	R-Me	2	0.039	N.S.	93	6-7th	<0.02	GHE-P-2175
	EC	2	0.078	N.S.	93	trifoliate	<0.02	(N80)

[1] Spray included oil
[2] Not specified
[3] Straw

Potatoes. Twenty two supervised trials in Australia, Belgium, Germany, The Netherlands, Norway, Sweden and the UK with racemic haloxyfop-etotyl at 0.1-0.42 kg ai/ha with PHIs of 20-153 days, and twelve in Germany with haloxyfop-R-methyl at 0.1 kg ai/ha with PHIs of 2-123 days (Table 26).

Table 26. Residues of haloxyfop in potatoes. All single applications of EC formulation.

Country, year	Application			PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	kg ai/ha	kg ai/hl				
Australia 1983	SR-EE	0.1	N.S.	147	7-10 true leaves	0.01	PAU-3313-159
		0.2	N.S.	147	30cm height	0.039	(N60B)
Belgium 1983	SR-EE	0.21	0.035	89	flowering	0.06	GHE-P-1226
		0.42	0.07	89		0.14	(N54)
Germany 1983	SR-EE	0.21	0.042	20	40 cm height,	0.02	GHE-P-1266
				30	first contact	0.02	(N55)
				55	with adjacent	0.01	
				62	plants	0.01	
				69		<0.01	
				83	normal harvest	<0.01	
The Netherlands 1982	SR-EE	0.21	0.035	96	N.S.[1]	0.03	GHE-P-1229 (N56)
The Netherlands 1983	SR-EE	0.21	N.S.	87		0.07	GHE-P-1228
		0.31	N.S.	87	30-35 cm	0.16	(N57)
		0.21	N.S.	93	height	0.05	
		0.31	N.S.	93		0.06	
Norway 1982	SR-EE	0.21	N.S.	89	4-5 cm height	0.02	GHE-P-1227
		0.42	N.S.	89		0.04	(N58)
Norway 1982	SR-EE	0.21	N.S.	77	10-15 cm	0.04	GHE-P-1227

		0.42	N.S.	77	height	0.11	(N58)
Norway 1982	SR-EE	0.21	N.S.	84	30 cm height	0.04	GHE-P-1227
		0.42	N.S.	84		0.1	(N58)
Norway 1982	SR-EE	0.21	N.S.	102	15-20 cm	0.05	GHE-P-1227
		0.42	N.S.	102	height	0.1	(N58)
Norway 1982	SR-EE	0.21	N.S.	71	10-15 cm	0.03	GHE-P-1227
		0.42	N.S.	71	height	0.05	(N58)
Norway 1983	SR-EE	0.21	N.S.	56	50 cm height	0.04	GHE-P-1225 (N59)
Norway 1983	SR-EE	0.21	N.S.	83	3-5 cm height	<0.01	GHE-P-1225 (N59)
Norway 1983	SR-EE	0.21	N.S.	89	25 cm height	0.01	GHE-P-1225 (N59)
Norway 1983	SR-EE	0.21	N.S.	104	0-5 cm height	<0.01	GHE-P-1225 (N59)
Sweden 1983	SR-EE	0.21	0.052	96	30 cm height	0.03	GHE-P-1224
		0.31	0.078	96		0.06	(N60)
UK 1982	SR-EE	0.21	N.S.	138	15-20 cm	0.04	GHE-P-1137
		0.42	N.S.	138	height	0.05	(N51)
UK 1982	SR-EE	0.1	N.S.	132	60 cm height	0.02	GHE-P-1137
		0.21	N.S.	132		0.04	(N51)
UK 1984	SR-EE	0.21	N.S.	153	13 cm height	0.01	GHE-P-1712
		0.42	N.S.	153		0.02	(N53)
		0.21	N.S.	133	40 cm height	0.07	
		0.42	N.S.	133		0.12	
UK 1984	SR-EE	0.21	N.S.	113		0.07	GHE-P-1712
		0.42	N.S.	113	50 cm height	0.11	(N53)
		0.21	N.S.	93		0.07	
		0.42	N.S.	93		0.11	
		0.21	N.S.	69		0.06	
		0.42	N.S.	69		0.08	
UK 1985	SR-EE	0.21	N.S.	115	30 cm height	0.1	GHE-P-1712
		0.42	N.S.	115		0.15	(N53)
UK 1985	SR-EE	0.1	N.S.	123		0.01	GHE-P-1712
		0.21	N.S.	123	20 cm height	0.03	(N53)
		0.42	N.S.	123		0.03	
UK 1985	SR-EE	0.1	N.S.	84	end of	<0.01	GHE-P-1712
		0.21	N.S.	84	flowering	0.01	(N53)
		0.42	N.S.	84		0.02	
		0.1	N.S.	56	senescing	0.06	
		0.21	N.S.	56		0.14	
		0.42	N.S.	56		0.16	
Germany 1988	R-Me	0.1	0.026	2	flowering complete	0.37	GHE-P-1977 (N50)
				42	mature	0.26	
Germany 1988	R-Me	0.1	0.026	13	bud formation beginning	0.33	GHE-P-1977 (N50)
				86	mature	0.1	

Germany 1988	R-Me	0.1	0.026	13	cover almost complete	0.36	GHE-P-1977 (N50)
				115	mature	0.06	
Germany 1988	R-Me	0.1	N.S.	6	first contact with adjacent plants	0.26	GHE-P-1977 (N50)
				42	mature	0.14	
Germany 1988	R-Me	0.1	N.S.	20	first contact with adjacent plants	0.2	GHE-P-1977 (N50)
				49	mature	0.1	
Germany 1988	R-Me	0.1	N.S.	20	first contact with adjacent plants	0.22	GHE-P-1977 (N50)
				90	mature	0.07	
Germany 1988	R-Me	0.1	N.S.	7	flowering complete	0.03	GHE-P-1977 (N50)
				42	mature	0.02	
Germany 1988	R-Me	0.1	N.S.	26	stem alongation	0.26	GHE-P-1977 (N50)
				102	mature	0.06	
Germany 1988	R-Me	0.1	N.S.	26	stem alongation	0.23	GHE-P-1977 (N50)
				118	mature	0.03	
Germany 1988	R-Me	0.1	N.S.	7	flowering complete	0.08	GHE-P-1977 (N50)
				42	mature	0.12	
Germany 1988	R-Me	0.1	N.S.	27	stem alongation	0.04	GHE-P-1977 (N50)
				114	mature	0.02	
Germany 1988	R-Me	0.1	N.S.	27	stem elongation	0.02	GHE-P-1977 (N50)
				123	mature	0.02	

[1] Not specified

Sugar beet. Forty two supervised trials in seven European countries were with racemic haloxyfop-etotyl at 0.1-0.83 kg ai/ha (mostly single treatments) with PHIs of 13-182 days. Eight supervised trials in France, Germany and Italy with haloxyfop-R-methyl were at 0.052-0.1 kg ai/ha with PHIs of 13-165 days. The residues of haloxyfop in the roots are shown in Table 27.

Table 27. Residues of haloxyfop in sugar beet (roots). All EC applications.

Country, year	Application				PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	No.	kg ai/ha	kg ai/hl				
Belgium 1983	SR-EE	1	0.1	0.021	135	4 leaves	0.01	GHE-P-1222 (N13)
Denmark 1983	SR-EE	1	0.21	N.S.[1]	134	6 leaves	0.01	GHE-P-1263
		2	0.1	N.S.	118	8-10 leaves	0.04	(N14)
France 1982	SR-EE	1	0.1	N.S.	141		<0.03	GHE-P-994
		1	0.21	N.S.	141	2 leaves	<0.03	(N5)
		1	0.42	N.S.	141		<0.03	
France 1982	SR-EE	1	0.21	N.S.	120	2 leaves	<0.03	GHE-P-994

Country, year	Application				PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	No.	kg ai/ha	kg ai/hl				
		1	0.42	N.S.	120		<0.03	(N5)
France 1982	SR-EE	1	0.21	N.S.	126	2 leaves	<0.03	GHE-P-994
		1	0.42	N.S.	126		<0.03	(N5)
France 1982	SR-EE	1	0.21	N.S.	128	2 leaves	0.05	GHE-P-994
		1	0.42	N.S.	128		0.08	(N5)
France 1982	SR-EE	1	0.1	N.S.	128		0.03	GHE-P-1049
		1	0.21	N.S.	128	2 leaves	0.1	(N9)
		1	0.42	N.S.	128		0.13	
France 1982	SR-EE	1	0.1	N.S.	120	2 leaves	0.01	GHE-P-1049 (N9)
France 1982	SR-EE	1	0.1	N.S.	126	2 leaves	0.01	GHE-P-1049 (N9)
France 1983	SR-EE	1	0.1	0.021	147		<0.01	GHE-P-1259
		1	0.21	0.042	147	7-8 leaves	<0.01	(N10)
		1	0.42	0.084	147		0.01	
		1	0.63	0.13	147		0.01	
France 1983	SR-EE	1	0.1	0.032	107		0.01	GHE-P-1259
		1	0.21	0.064	107	6-8 leaves	0.03	(N10)
		1	0.42	0.13	107		0.04	
France 1983	SR-EE	1	0.1	0.032	119		0.01	GHE-P-1259
		1	0.21	0.064	119	6-8 leaves	0.03	(N10)
		1	0.42	0.13	119		0.05	
France 1983	SR-EE	1	0.1	0.027	141		<0.01	GHE-P-1259
		1	0.21	0.053	141	8 leaves	0.02	(N10)
		1	0.42	0.11	141		0.05	
France 1988	SR-EE	1	0.1	0.042	131	2-3 leaves	<0.02	GHE-P-1972
		1	0.21	0.084	131		<0.02	(N10)
France 1988	SR-EE	1	0.1	N.S.	165	2 leaves	<0.02	GHE-P-1972
		1	0.21	N.S.	165		<0.02	(N10)
France 1988	SR-EE	1	0.1	N.S.	134	2 leaves	<0.02	GHE-P-1972
		1	0.21	N.S.	134		<0.02	(N10)
Germany 1982	SR-EE	1	0.21	0.052	21		0.15	GHE-P-1198
					87	N.S.	0.04	(N11)
					117		0.03	
					130	normal crop	0.01	
Germany 1982	SR-EE	1	0.21	0.042	82		0.02	GHE-P-1198
					118	N.S.	0.02	(N11)
					126	normal crop	0.02	

Country, year	Application				PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	No.	kg ai/ha	kg ai/hl				
Germany 1983	SR-EE	1	0.21	0.052	89		<0.005	GHE-P-1198
					119	4-5 leaves	<0.005	(N11)
					150	normal crop	<0.005	
Germany 1983	SR-EE	1	0.1	0.021	37		0.04	GHE-P-1198
					71	N.S.	0.01	(N11)
					106		0.01	
					115	normal crop	0.02	
		1	0.21	0.042	37		0.06	
					71		0.04	
					106		0.01	
					115	normal crop	0.03	
Germany 1983	SR-EE	1	0.1	0.021	36		0.02	GHE-P-1198
					70	N.S.	0.01	(N11)
					101		0.01	
					114	normal crop	<0.01	
		1	0.21	0.042	36		0.03	
					70		0.02	
					101		0.01	
					114	normal crop	<0.01	
Germany 1988	SR-EE	1	0.21	0.052	13		0.38	GHE-P-2036
					76	6-8 leaves	0.16	(N11)
					104		0.06	
					118	normal crop	0.06	
Germany 1988	SR-EE	1	0.21	0.052	24		0.08	GHE-P-2036
					76	crop cover	0.14	(N11)
					108	complete	0.08	
					128	normal crop	0.05	
Germany 1988	SR-EE	1	0.21	0.052	15		0.25	GHE-P-2036
					98	6 leaves	0.01	(N11)
					125	normal crop	<0.01	
The Netherlands 1982	SR-EE	1	0.21	N.S.	137	8-10 leaves	0.04	GHE-P-1223 (N12)
Sweden 1982	SR-EE	1	0.21	0.1	119	6-8 leaves	0.01	GHE-P-1265
		1	0.21	0.1	126	6-10 leaves	0.02	(N15)
Sweden 1982	SR-EE	2	0.1	0.052	104	8-10 leaves	0.02	GHE-P-1265
					112		0.04	(N15)

Country, year	Application				PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	No.	kg ai/ha	kg ai/hl				
Sweden 1982	SR-EE	2	0.21	0.1	133	6-10 leaves	0.04	GHE-P-1265
								(N15)
UK 1982	SR-EE	1	0.1	0.052	160	2-8 leaves	<0.03	GHE-P-993
		1	0.21	0.1	160		0.03	(N1)
UK 1982	SR-EE	1	0.21	0.1	168	2-8 leaves	<0.03	GHE-P-993
		1	0.42	0.21	168		<0.03	(N1)
UK 1982	SR-EE	1	0.21	0.1	181	2-8 leaves	0.03	GHE-P-993
		1	0.42	0.21	181		<0.03	(N1)
UK 1982	SR-EE	1	0.21	0.1	143		0.23	GHE-P-993
		1	0.21	0.1	181	2-8 leaves	0.06	(N1)
		1	0.42	0.21	143		0.15	
		1	0.42	0.21	181		<0.03	
UK 1982	SR-EE	1	0.21	N.S.	153	8 leaves	<0.01	GHE-P-1195
		1	0.42	N.S.	153		0.01	(N2)
UK 1982	SR-EE	1	0.21	0.1	180		0.01	GHE-P-1230
		1	0.42	0.21	180	6-8 leaves	0.01	(N3)
		1	0.83	0.42	180		0.02	
		1	0.21	0.1	143		0.06	
		1	0.42	0.21	143	10-12 leaves	0.09	
		1	0.83	0.42	143		0.25	
UK 1982	SR-EE	1	0.21	0.1	168		0.01	GHE-P-1230
		1	0.42	0.21	168	4-6 leaves	0.02	(N3)
		1	0.83	0.42	168		0.01	
		1	0.21	0.1	153		0.04	
		1	0.42	0.21	153	11 leaves	0.04	
		1	0.83	0.42	153		0.06	
UK 1982	SR-EE	1	0.21	0.1	181		<0.01	GHE-P-1230
		1	0.42	0.21	181	4-6 leaves	<0.01	(N3)
		1	0.83	0.42	181		0.02	
		1	0.21	0.1	166		0.02	
		1	0.42	0.21	166	12 leaves	0.05	
		1	0.83	0.42	166		0.13	
UK 1983	SR-EE	1	0.21	0.1	135		0.04	GHE-P-1262
		1	0.42	0.21	135	6-8 leaves	0.08	(N4)
		1	0.21	0.1	135		0.05	
		1	0.42	0.21	135		0.07	

Country, year	Application				PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	No.	kg ai/ha	kg ai/hl				
UK 1983	SR-EE	1	0.21	0.1	117	10-12 leaves	0.04	GHE-P-1262
		1	0.42	0.21	117		0.05	(N4)
UK 1984	SR-EE	1	0.21	0.1	38	mature	0.1	GHE-P-1310
					68	rows meeting	0.16	(N6)
					94	30 cm height	0.05	
					124	8-10 leaves	0.02	
					147	4 leaves	<0.01	
					174	cotyledon	<0.01	
		1	0.42	0.21	38		0.16	
					68		0.3	
					94		0.1	
					124		0.03	
					147		<0.01	
					174		<0.01	
		1	0.63	0.31	38		0.25	
					68		0.45	
					94		0.14	
					124		0.04	
					147		<0.01	
					174		<0.01	
UK 1984	SR-EE	1	0.21	0.1	28	mature	0.08	GHE-P-1314
					60	mature	0.09	(N7)
					97	40-50 cm height	0.1	
					126	10-12 cm height	0.05	
					153	4-6 leaves	0.05	
		1	0.42	0.21	28		0.15	
					60		0.16	
					97		0.16	
					126		0.1	
					153		0.08	
		1	0.63	0.31	28		0.21	
					60		0.23	
					97		0.26	
					126		0.2	
					153		0.02	

Country, year	Application				PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	No.	kg ai/ha	kg ai/hl				
UK 1984	SR-EE	1	0.21	0.1	43	mature	0.12	GHE-P-1314
					78	18-26 leaves	0.13	(N7)
					106	11 leaves	0.07	
					146	11 leaves	0.03	
					163	6 leaves	<0.01	
		1	0.42	0.21	43		0.15	
					78		0.23	
					106		0.12	
					146		0.04	
					163		0.02	
		1	0.62	0.31	43		0.22	
					78		0.33	
					106		0.17	
					146		0.06	
					163		0.02	
UK 1984	SR-EE	1	0.21	0.1	63	mature	0.07	GHE-P-1314
					98	28-30 leaves	0.15	(N7)
					125	25-30 leaves	0.13	
					166	9 leaves	0.02	
					182	4 leaves	<0.01	
		1	0.42	0.21	63		0.14	
					98		0.14	
					125		0.22	
					166		0.04	
					182		<0.01	
		1	0.62	0.31	63		0.15	
					98		0.12	
					125		0.23	
					166		0.05	
					182		<0.01	
France 1988	R-Me	1	0.052	0.021	131	2-3 leaves	<0.02	GHE-P-1972
		1	0.1	0.042	131		<0.02	(N10)
France 1988	R-Me	1	0.052	N.S.	165	2 leaves	<0.02	GHE-P-1972
		1	0.1	N.S.	165		<0.02	(N10)
France 1988	R-Me	1	0.052	N.S.	134	2 leaves	<0.02	GHE-P-1972
		1	0.1	N.S.	134		<0.02	(N10)
Germany 1988	R-Me	1	0.1	0.026	13		0.3	GHE-P-2036

Country, year	Application				PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	No.	kg ai/ha	kg ai/hl				
					76	6-8 leaves	0.06	(N11)
					104		0.05	
					118	normal crop	0.04	
Germany 1988	R-Me	1	0.1	0.026	24	crop cover	0.22	GHE-P-2036
					76	complete	0.03	(N11)
					108		0.04	
					128	normal crop	0.03	
Germany 1988	R-Me	1	0.1	0.026	15	6 leaves	0.11	GHE-P-2036
					98		0.01	(N11)
					125	normal crop	<0.01	
Italy 1992	R-Me	1	0.1	0.026	67	8-9 leaves	0.03	GHE-P-3078 (N13)
Italy 1992	R-Me	1	0.1	0.026	65	8-9 leaves	0.02	GHE-P-3078 (N13)

[1] Not specified

Cereals

Rice. Nine supervised trials in Brazil, Colombia, Costa Rica and Mexico with racemic haloxyfop-methyl at 0.03-10.24 kg ai/ha. Residues in husked rice, polished rice and rice bran were below the LOD (<0.01 or <0.02 mg/kg) at PHIs of 89-140 days (Tables 28 and 29).

Table 28. Residues of haloxyfop in husked rice. All single EC applications of racemic haloxyfop-methyl.

Country, year	Application		PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	kg ai/ha	kg ai/hl				
Brazil 1986	0.06	0.02	131	22 days	<0.01	GHB-P050
	0.09	0.03	131	after	<0.01	(N128)
	0.12	0.04	131	planting	<0.01	
	0.15	0.05	131	2-5 tillers	<0.01	
	0.18	0.06	131		<0.01	
	0.24	0.08	131		<0.01	
Brazil 1987	0.03	0.01	98	25 days after planting	<0.01	GHB-P050
	0.06	0.02	98	1-2 tillers	<0.01	(N128)
	0.12	0.04	98		<0.01	
Colombia 1985	0.06	0.038	118	26 days	<0.01	GHB-P025
	0.09	0.057	118	after	<0.01	(N130B)
	0.12	0.076	118	planting	<0.01	
	0.15	0.095	118		<0.01	
Mexico 1986	0.075	N.S.[1]	123	24 days	<0.01	GHB-P048
	0.09	N.S.	123	after	<0.01	(N127)
	0.12	N.S.	123	planting	<0.01	
Mexico 1985	0.04	N.S.	118	22 days	<0.01	GHB-P033
	0.08	N.S.	118	after	<0.01	(N130A)
	0.12	N.S.	118	planting	<0.01	
Mexico 1985	0.04	N.S.	122	12 days	<0.01	GHB-P033
	0.08	N.S.	122	after	<0.01	(N130A)
	0.12	N.S.	122	planting	<0.01	
Mexico 1985	0.08	N.S.	124	25 days	<0.01	GHB-P033
	0.12	N.S.	124	after planting	<0.01	(N130A)

[1] Not specified

Table 29. Residues of haloxyfop in polished rice and rice bran from single EC applications of racemic haloxyfop-methyl in Coasta Rica, 1985.

Application		PHI, days	Growth stage at last treatment	Residues, mg/kg		Reference
kg ai/ha	kg ai/hl			Polished rice	Bran	
0.06	0.03	118	22 days	<0.01	<0.02	GHB-P029
0.09	0.045	118	after planting	<0.01	<0.02	(N130D)
0.06	0.03	131	19 days	<0.01	<0.02	GHB-P030
0.06	0.03	140	after planting	<0.01	<0.02	(N130C)

Oil seeds

Cotton seed. Four supervised trials were carried out in Australia with racemic haloxyfop-etotyl at 0.16-0.37 kg ai/ha, and four in Brazil with racemic haloxyfop-methyl at 0.12-0.48 kg ai/ha. PHIs were 93-162 days. A single trial in Spain with haloxyfop-R-methyl at 0.16 kg ai/ha gave residues of <0.02 mg/kg at a PHI of 123 days (Table 30).

Table 30. Residues of haloxyfop in cotton seed. All single EC applications.

Country, year	Application			PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	kg ai/ha	kg ai/hl				
Australia 1986	SR-EE	0.16	N.S.[1]	123	flowering	0.06	
		0.31	N.S.	123		0.08	(N111)
	SR-EE	0.16	N.S.	97	flower + squares	<0.05	(N111)
Australia		0.2	N.S.	162	1 leaf	<0.05	
1986		0.31	N.S.	97		<0.05	
		0.37	N.S.	162		<0.05	
	SR-EE	0.16	N.S.	94	flowering	<0.05	(N111)
Australia				135	6-7 leaves	<0.05	
1986				157	2-6 leaves	<0.05	
		0.31	N.S.	94		<0.05	
				135		<0.05	
				157		<0.05	
	SR-EE	0.16	N.S.	113	flower + squares	0.08	(N111)
Australia				142	6-8 leaves	<0.05	
1986				157	2-6 leaves	<0.05	
		0.31	N.S.	113		0.1	
				142		<0.05	
				157		<0.05	
	SR-Me	0.12	0.032	112	40 days after	<0.1	GHB-P034
Brazil		0.24	0.065	112	planting	<0.1	(N113)
1984		0.36	0.097	112		<0.1	
	SR-Me	0.12	0.033	111	40 days after	<0.1	GHB-P034

Country, year	Application			PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	kg ai/ha	kg ai/hl				
Brazil		0.24	0.066	111	planting	<0.1	(N113)
1983		0.36	0.1	111		<0.1	
	SR-Me	0.12	0.04	101	23 days after	<0.1	GHB-P034
Brazil		0.24	0.08	101	planting	0.1	(N113)
1985		0.36	0.12	101		0.1	
		0.48	0.16	101		0.1	
	SR-Me	0.12	0.04	93	22 days after	0.1	GHB-P034
Brazil		0.24	0.08	93	planting	0.2	(N113)
1985		0.36	0.12	93		0.2	
		0.48	0.16	93		0.3	
Spain 1991	R-Me	0.16	0.052	123	8 leaves	<0.02	GHE-P-2802 (N150)

[1] Not specified

Peanuts. Six supervised trials in Argentina and Australia with 0.05-0.48 kg ai/ha of racemic haloxyfop esters with PHIs of 76-141 days (Table 31).

Table 31. Residues of haloxyfop in peanuts. All single EC applications.

Country, year	Application			PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	kg ai/ha	kg ai/hl				
Argentina 1990	SR-Me	0.12	0.06	141	28 days after	<0.05	GHB-P110R
		0.24	0.12	141	planting	<0.05	(N125A)
		0.48	0.24	141		<0.05	
Argentina 1983	SR-EE	0.05	0.075	114	N.S.[1]	<0.01	PAU-3312-186
		0.1	0.15	114		0.03	(N121)
		0.4	0.6	114		0.03	
Australia 1983	SR-EE	0.05	0.075	115	N.S.	<0.01	PAU-3312-189
		0.1	0.15	115		0.01	(N122)
		0.4	0.6	76		0.22	
Australia 1985	SR-Me	0.058	0.029	98	N.S.	0.02	PAU-3313-197
		0.12	0.058	98		0.03	(N123)
		0.23	0.12	98		0.03	
Australia 1986	SR-EE	0.16	0.14	82	first peanuts present	0.05	PAU-3313-252
				103	15-18 cm height, flowers present	0.03	(N124)
				117	8-9th trifoliate	0.03	

Country, year	Application			PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	kg ai/ha	kg ai/hl				
		0.31	0.29	82		0.08	
				103		0.07	
				117		0.06	
Australia 1986	SR-EE	0.16	0.14	84	first peanuts present	<0.03	PAU-3313-252
				97	30 cm height, flowering	<0.03	(N124)
				113	7th trifoliate	<0.03	
		0.31	0.29	84		<0.03	
				97		<0.03	
				113		<0.03	

[1] Not specified

Rape seed. Many supervised trials in Australia, France, Germany, Norway, Sweden and the UK with 0.078-0.63 kg ai/ha of racemic haloxyfop-etotyl with PHIs of 69-328 days. Five trials in France and Germany were with haloxyfop-R-methyl at 0.052-0.1 kg ai/ha with PHIs of 248-272 days (Table 32).

Table 32. residues of haloxyfop in rape seed. All single applications of EC formulation.

Country, year	Application			PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	kg ai/ha	kg ai/hl				
Australia 1986	SR-EE	0.078	0.078	119	6 leaves	0.04	PAU-3313-263
				134	5 leaves	<0.03	(N36)
				160	2 leaves	<0.03	
		0.16	0.16	119		0.07	
				134		<0.03	
				160		<0.03	
Australia 1986	SR-EE	0.078	0.078	69	30 cm height	0.54	PAU-3313-263
				110	2 leaves	<0.03	(N36)
		0.16	0.16	69		1.42	
				110		<0.03	
France 1989	SR-EE	0.1	0.042	268	8 leaves	<0.05	GHE-P-1973
		0.21	0.084	268	(Autumn)	<0.05	(N1)
France 1989	SR-EE	0.1	N.S.[1]	248	4-5 leaves	<0.05	GHE-P-1973
		0.21	N.S.	248	(Autumn)	<0.05	(N1)
France 1989	SR-EE	0.1	N.S.	261	4-5 leaves	<0.05	GHE-P-1973
		0.21	N.S.	261	(Autumn)	<0.05	(N1)
France 1982	SR-EE	0.16	0.031	201	60 days after	0.05	GHE-P-996 (N26)
		0.21	0.042	201	planting	0.05	
		0.26	0.052	201	(Autumn)	0.04	GHE-P-1047 (N27)

Country, year	Application			PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	kg ai/ha	kg ai/hl				
France 1982	SR-EE	0.16	0.052	164	4 months	0.125	GHE-P-996
		0.21	0.07	164	after	0.145	(N26)
		0.42	0.14	164	planting	0.315	GHE-P-1047
					(February)		(N27)
France 1983	SR-EE	0.1	0.026	122	5 months	0.28	GHE-P-1048
		0.21	0.052	122	after	0.37	(N28)
		0.42	0.1	122	planting	0.83	
		0.1	0.021	119		0.4	
		0.21	0.042	119	(March)	0.66	
		0.42	0.083	119		1.68	
France 1983	SR-EE	0.1	0.021	221	75 days after	0.06	GHE-P-1048
		0.21	0.042	221	planting	0.09	(N28)
		0.42	0.083	221	(Autumn)	0.17	
France 1983	SR-EE	0.1	0.026	227	55 days after	<0.05	GHE-P-1048
		0.21	0.052	227	planting	<0.05	(N28)
		0.42	0.1	227	(Autumn)	0.05	
France 1983	SR-EE	0.1	0.039	234	50 days after	<0.05	GHE-P-1048
		0.21	0.077	234	planting	<0.05	(N28)
		0.42	0.15	234	(Autumn)	0.05	
France 1983	SR-EE	0.1	0.021	150	5 months after planting (February)	<0.05	GHE-P-1196
		0.21	0.042	150		<0.05	(N29)
		0.42	0.084	150		<0.05	
France 1982	SR-EE	0.21	0.069	164	4-5 leaves	0.14	GHE-P-1050R (N30)
		0.42	0.14	164	(February)	0.32	
France 1983	SR-EE	0.1	0.026	227	5-6 leaves	<0.05	GHE-P-1313R (N31)
		0.21	0.052	227	(Autumn)	<0.05	
France 1983	SR-EE	0.1	0.026	122	beginning of spring growth (March)	0.28	GHE-P-1313R (N31)
		0.21	0.052	122		0.37	
Germany 1989	SR-EE	0.21	0.052	272	6 leaves (Autumn)	0.13	GHE-P-2144 (N2)
Germany 1989	SR-EE	0.21	0.052	259	6 leaves (Autumn)	<0.05	GHE-P-2144 (N2)
Germany 1982	SR-EE	0.16	0.04	95	7 mo after planting (April)	0.29	GHE-P-1194R (N32)
Germany 1982	SR-EE	0.16	N.S.	106	7 mo after planting (April)	0.14	GHE-P-1194R
		0.21	N.S.	106		0.1	(N32)
Germany 1983	SR-EE	0.16	N.S.	259	57 days after planting	<0.05	GHE-P-1194R (N32)

Country, year	Application			PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	kg ai/ha	kg ai/hl				
					(Autumn)		
		0.21	N.S.	99	7 mo after planting (April)	0.77	
Germany 1982	SR-EE	0.16	0.031	303	46 days after planting (Autumn)	<0.05	GHE-P-1194R (N32)
Germany 1983	SR-EE	0.1	0.021	107	8 mo after planting (April)	0.11	GHE-P-1194R
		0.21	0.042	107		0.13	(N32)
Germany 1982	SR-EE	0.1	0.021	116	7 mo after planting (March)	0.05	GHE-P-1194R
		0.21	0.042	116		0.15	(N32)
Germany 1983	SR-EE	0.16	0.031	301	36 days after planting (Autumn)	<0.05	GHE-P-1194R (N32)
Germany 1983	SR-EE	0.16	N.S.	289	33 days after	<0.05	GHE-P-1311
					planting		(N33)
					(Autumn)		
Germany 1983	SR-EE	0.16	N.S.	313	4 leaves (Autumn)	0.06	GHE-P-1311 (N33)
Norway 1983	SR-EE	0.21	N.S.	70	4-5 leaves (June)	1.49	GHE-P-1219 (N35)
Norway 1983	SR-EE	0.21	N.S.	79	4-5 leaves (June)	0.91	GHE-P-1219 (N35)
Norway 1983	SR-EE	0.21	N.S.	80	15-20 cm height (July)	2.13	GHE-P-1219 (N35)
Norway 1983	SR-EE	0.21	N.S.	85	5-10 cm height (June)	<0.05	GHE-P-1219 (N35)
Sweden 1982	SR-EE	0.1	0.026	85	18-20 cm	0.58	GHE-P-1220
		0.21	0.052	85	height	1.2	(N34)
		0.42	0.1	85	(June)	2.64	
UK 1982	SR-EE	0.12	0.06	237	64 days after planting (Autumn)	<0.05	GHE-P-995 (N21)
UK 1982	SR-EE	0.12	0.06	244	3 mo after planting (Autumn)	<0.05	GHE-P-995 (N21)
UK 1982	SR-EE	0.12	0.06	264	1 mo after planting (Autumn)	<0.05	GHE-P-995 (N21)

Country, year	Application			PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	kg ai/ha	kg ai/hl				
UK 1982	SR-EE	0.12	0.03	270	2 mo after planting (Autumn)	<0.05	GHE-P-995 (N21)
UK 1982	SR-EE	0.3	0.15	229	2 mo after planting (Autumn)	0.05	GHE-P-995 (N21)
UK 1982	SR-EE	0.3	0.15	235	3 mo after planting (Autumn)	<0.05	GHE-P-995 (N21)
UK 1982	SR-EE	0.3	0.15	270	39 days after planting (Autumn)	<0.05	GHE-P-995 (N21)
UK 1983	SR-EE	0.21	0.1	292	4-6 leaves	<0.05	GHE-P-1221
		0.42	0.21	292	(Autumn)	<0.05	(N22)
UK 1983	SR-EE	0.21	0.1	292	4-6 leaves	<0.05	GHE-P-1221
		0.42	0.21	292	(Autumn)	<0.05	(N22)
UK 1983	SR-EE	0.21	0.1	292	4-6 leaves	<0.05	GHE-P-1221
		0.42	0.21	292	(Autumn)	<0.05	(N22)
UK 1983	SR-EE	0.21	0.1	279	4-6 leaves	<0.05	GHE-P-1221
		0.42	0.21	279	(Autumn)	<0.05	(N22)
UK 1983	SR-EE	0.21	0.1	279	4-6 leaves	<0.05	GHE-P-1221
		0.42	0.21	279	(Autumn)	<0.05	(N22)
UK 1983	SR-EE	0.21	0.1	279	4-6 leaves	<0.05	GHE-P-1221
		0.42	0.21	279	(Autumn)	<0.05	(N22)
UK 1983	SR-EE	0.21	0.1	269	4-5 leaves	<0.05	GHE-P-1267
		0.42	0.21	269	(Autumn)	<0.05	(N23)
UK 1983	SR-EE	0.21	0.1	292	5 leaves	<0.05	GHE-P-1267
		0.42	0.21	292	(Autumn)	<0.05	(N23)
UK 1983	SR-EE	0.21	0.1	265	3-4 leaves	<0.05	GHE-P-1264
		0.42	0.21	265	(Autumn)	<0.05	(N24)
		0.21	0.1	158	7 leaves	0.05	
		0.42	0.21	158	(March)	0.06	
UK 1983	SR-EE	0.21	0.1	265	3-4 leaves	<0.05	GHE-P-1264
		0.42	0.21	265	(Autumn)	<0.05	(N24)
		0.21	0.1	158	7 leaves	0.06	
		0.42	0.21	158	(March)	0.08	
UK 1984	SR-EE	0.21	0.1	85	early flowering (May)	3.32	GHE-P-1312
				113	buds appearing (April)	1.62	(N25)
				142	spring growth (March)	0.42	
				167	spring growth (Feb.)	0.44	
				199	8 leaves (Jan.)	0.13	
				248	6 leaves (Autumn)	0.09	

Country, year	Application			PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	kg ai/ha	kg ai/hl				
				272	4-5 leaves (Autumn)	0.08	
		0.42	0.21	85		3.94	
				113		3.05	
				142		1.05	
				167		0.6	
				199		0.26	
				248		0.09	
				272		0.09	
		0.63	0.31	85		5.64	
				113		2.69	
				142		1.04	
				167		0.64	
				199		0.36	
				248		0.13	
				272		0.1	
UK 1984	SR-EE	0.21	0.1	83	full flower (May)	2.68	GHE-P-1312
				111	35-40 cm height (April)	1.98	(N25)
				140	9 leaves (March)	0.64	
				171	6 leaves (Feb)	0.17	
				234	6 leaves (Autumn)	0.08	
				259	6 leaves (Autumn)	0.11	
				287	5 leaves (Autumn)	0.11	
		0.42	0.21	83		5.31	
				111		2.78	
				140		0.87	
				171		0.11	
				234		0.12	
				259		0.24	
				287		0.22	
		0.63	0.31	83		7.57	
				111		4.37	
				140		1.06	
				171		0.33	
				234		0.17	
				259		0.26	
				287		0.21	
UK 1984	SR-EE	0.21	0.1	131	flowering (May)	2.49	GHE-P-1312
				153	11 leaves (April)	0.42	(N25)
				177	7 leaves (March)	0.1	
				208	7 leaves (Feb)	<0.05	
				280	7 leaves (Autumn)	<0.05	
				302	7 leaves (Autumn)	<0.05	
				328	5 leaves (Autumn)	<0.05	
		0.42	0.21	131		2.63	GHE-P-1312

Country, year	Application			PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	kg ai/ha	kg ai/hl				
				153		0.78	(N25)
				177		0.26	
				208		0.07	
				280		<0.05	
				302		<0.05	
				328		<0.05	
		0.63	0.31	131		5.35	GHE-P-1312
				153		1.29	(N25)
				177		0.28	
				208		0.09	
				280		<0.05	
				302		<0.05	
				328		<0.05	
France 1989	R-Me	0.052	0.021	268	8 leaves	<0.05	GHE-P-1973
		0.1	0.042	268	(Autumn)	<0.05	(N1)
France 1989	R-Me	0.052	N.S.	248	4-5 leaves	<0.05	GHE-P-1973
		0.1	N.S.	248	(Autumn)	<0.05	(N1)
France 1989	R-Me	0.052	N.S.	261	4-5 leaves	<0.05	GHE-P-1973
		0.1	N.S.	261	(Autumn)	<0.05	(N1)
Germany 1989	R-Me	0.1	0.026	272	6 leaves (Autumn)	0.07	GHE-P-2144 (N2)
Germany 1989	R-Me	0.1	0.026	259	6 leaves (Autumn)	<0.05	GHE-P-2144 (N2)

[1] Not specified

Sunflower seed. Eight supervised trials in Argentina, Australia and France at 0.078-0.78 kg ai/ha of racemic haloxyfop with PHI of 60-155 days. One supervised trial was carried out in France at 0.052-0.1 kg ai/ha of haloxyfop-R-methyl with PHI of 89-118 days (Table 33).

Table 33. Residues of haloxyfop in sunflower seed. All single EC applications.

Country Year	Application			PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	kg ai/ha	kg ai/hl				
Argentina 1982	SR-Me	0.36	0.18	67	50-70 cm	0.14	GHB-P017
		0.78	0.25	60	height	0.25	(N44)
Australia 1985	SR-EE	0.078	0.072	94	seedling	<0.01	PAU-3313-196
		0.1	0.095	94		<0.01	(N45)
		0.16	0.14	94		0.03	
		0.31	0.29	94		0.04	
Australia 1986	SR-EE	0.16	0.21	122	2 leaves	<0.03	PAU-3313-238
		0.31	0.42	122		<0.03	(N49)
		0.16	0.062	111	6 leaves	<0.03	
		0.31	0.125	111		0.04	
Australia 1986	SR-EE	0.16	0.16	84	15 leaves	0.04	PAU-3313-146
		0.31	0.32	84		0.06	(N50)
France 1982	SR-EE	0.1	0.026	155	40 days after	<0.05	GHE-P-997
		0.21	0.052	155	planting	<0.05	(N41)
		0.42	0.1	155		<0.05	
France 1982	SR-EE	0.1	0.026	155	40 days after	<0.05	GHE-P-1046
		0.21	0.052	155	planting	<0.05	(N42)
		0.42	0.1	155		<0.05	
France 1989	SR-EE	0.1	0.031	89	8 pairs of leaves	0.05	GHE-P-2059
				105	6 pairs of leaves	<0.05	(N20)
				118	3 pairs of leaves	<0.05	
		0.21	0.062	89		0.16	
				105		0.07	
				118		0.09	
France 1989	R-Me	0.052	0.016	89	8 pairs of leaves	<0.05	GHE-P-2059
				105	6 pairs of leaves	<0.05	(N20)
				118	3 pairs of leaves	<0.05	
		0.1	0.031	89		0.07	
				105		<0.05	

Country Year	Application			PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	kg ai/ha	kg ai/hl				
				118		<0.05	

Animal feeds

Alfalfa. Five supervised trials in Australia with 0.1-0.31 kg ai/ha of racemic haloxyfop-etotyl (PHIs 4-42 days) and two with 0.052-0.1 kg ai/ha of haloxyfop-R-methyl with PHIs of 8-32 days (Table 34).

Table 34. Residues of haloxyfop in alfalfa in Australia. All single EC applications.

Year	Application			PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	kg ai/ha	kg ai/hl				
1984	SR-EE	0.2	0.2	42	N.S.	3.71	PAU-3312-191 (N126)
1989	SR-EE	0.1	0.11	8	N.S.	3.08	GHF-P925
				14		2.77	(N126A)
				22		1.49	
				32		1.13	
		0.21	0.21	8		8.41	
				14		6.45	
				22		2.45	
				32		1.34	
1989		0.1[1]	0.11	8		3.61	GHF-P925
				14		4.44	
				22		3.36	
				32		1.86	
1988	SR-EE	0.1	0.1	4	N.S.	4.56	GHF-P857
				7		4.68	(N126D)
				14		2.48	
				21		2.11	
		0.21	0.21	4		8.35	
				7		8.15	
				14		3.09	
				21		3.11	
		0.31	0.31	4		11.8	
				7		10.1	
				14		5.94	
				21		2.93	
1989	SR-EE	0.1[1]	0.11	8	N.S.	3.61	GHF-P-1355
				14		4.44	(N126C)
				22		3.36	
				32		1.86	
1989	R-Me	0.052	0.053	8	N.S.	1.3	GHF-P997

Year	Application			PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	kg ai/ha	kg ai/hl				
				14		1.3	(N126B)
				22		0.8	
				32		0.7	
		0.1	0.11	8		3.2	
				14		2.4	
				22		1.8	
				32		1.9	
1989	R-Me	0.052	0.053	8		1.58	GHF-P-1355
				14		1.93	(N126C)
				22		1.6	
				32		1.01	
		0.1	0.11	8		3.52	
				14		3.42	
				22		2.21	
				32		1.94	

[1] Spray solution containing oil

Bean fodder and foliage. The results of six supervised trials were submitted: five with haloxyfop-R-methyl and one with racemic haloxyfop-etotyl (Table 35).

Table 35. Residues of haloxyfop in field bean fodder and foliage. All single EC application.

Country	Application			PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	kg ai/ha	kg ai/hl				
UK 1991	SR-EE	0.21	N.S.[1]	104	end of	0.18	GHE-P-2654
		0.42	N.S.	104	flowering	0.34	(N65)
Germany 1989	R-Me	0.1	0.035	0	4 leaves	2.67[2]	GHE-P-2155
				35		0.03[2]	(N35)
				55		<0.02[2]	
				89		<0.05	
Germany 1989	R-Me	0.1	0.035	0	4 leaves	4.19[2]	GHE-P-2155
				30		0.05[2]	(N35)
				46		0.02[2]	
				91		<0.05	
Germany 1989	R-Me	0.1	0.026	1	6 leaves	4.65[2]	GHE-P-2155
				36		0.06[2]	(N35)
				71		0.02[2]	
				120		<0.05	
Germany 1989	R-Me	0.1	0.026	1	6 leaves	0.63[2]	GHE-P-2155

				17		0.13[2]	(N35)
				42		0.02[2]	
				105		<0.05	
UK 1991	R-Me	0.1	N.S.	104	end of flowering	0.12	GHE-P-2654 (N38)
		0.21	N.S.	104		0.16	

[1] Not specified
[2] Whole plant

Pea fodder and foliage. The results of six supervised trials were submitted, five with haloxyfop-R-methyl and one with the racemic ethoxyethyl ester (Table 36).

Table 36. Residues of haloxyfop in pea hay or fodder. All single EC applications.

Crop, Country, Year	Application			PHI, days	Growth stage at last treatment	Residues, mg/kg	Reference
	Compound	kg ai/ha	kg ai/hl				
Peas Germany 1989	R-Me	0.1	0.035	0	3 leaves	2.92[1]	GHE-P-2154 (N36)
				43		<0.02[1]	
				56		<0.02[2]	
				56		<0.02[3]	
				76		<0.02[3]	
Peas Germany 1989	R-Me	0.1	0.035	0	4 leaves	4.3[1]	GHE-P-2154 (N36)
				38		0.03[1]	
				53		<0.02[2]	
				53		<0.02[3]	
				77		0.05[3]	
Peas Germany 1989	R-Me	0.1	0.026	1	10 leaves	1.13[1]	GHE-P-2154 (N36)
				20		0.39[1]	
				42		0.12[3]	
				60		<0.05[3]	
Peas Germany 1989	R-Me	0.1	0.026	1	6-7 leaves	0.47[1]	GHE-P-2154 (N36)
				42		<0.02[1]	
				60		<0.02[3]	
				80		<0.05[3]	
Pigeon peas Australia 1989	SR-EE	0.16	0.14	14	43 days after planting	2.59[1]	GHF-P-941 (N70B)
				28		1.53[1]	
				56		0.48[1]	
		0.31	0.28	14		6.65[1]	
				28		3.14[1]	
				56		1.3[1]	
Pigeon peas Australia 1989	R-Me	0.038	0.035	14	43 days after planting	1.83[1]	GHF-P-941 (N70B)
				28		0.41[1]	
				56		0.13[1]	
		0.075	0.068	14		1.44[1]	
				28		1.00[1]	
				56		0.21[1]	

[1] Whole plant CLICK HERE to continue