CHLORMEQUAT (015)

EXPLANATION

Chlormequat, originally evaluated by the JMPR in 1970 and re-evaluated for residues in 1972, 1976 and 1985, is included in the CCPR periodic review programme (ALINORM 89/24A, para 299; Appendix V). The 1990 CCPR indicated that there appeared to be continued use, but there was no indication that residue data were available. It was proposed that the CXLs should be withdrawn if data were not going to be provided (ALINORM 91/24, para 358; Appendix VI). The 1991 CCPR scheduled a review for 1994 since at least some new data were promised (ALINORM 91/24A, Appendix VI). Information on current GAP and data on residues were requested by Circular Letters (CL 1989/22-PR and CL 1992/12-PR). At the 1993 CCPR Sweden, The Netherlands, Finland, France and Germany indicated that there were still uses on cereals.

The Meeting received information on GAP from Australia, Canada, Norway, Spain and Sweden, on GAP and residues in mushrooms from Germany and on GAP and residues in pears from The Netherlands. One manufacturer provided (1) recent information on GAP with relevant labels, (2) publications, mostly older, on plant metabolism, fate in soil, residue analysis, and animal metabolism and feeding studies, (3) residue data on pears, grapes, tomatoes, barley, maize, oats, rye, wheat, cotton and rape, and (4) a list of national maximum residue limits.

IDENTITY

Iso common name: chlormequat

Chemical name

IUPAC: 2-chloroethyltrimethylammonium

CA: 2-chloro-*N*,*N*,*N*-trimethylethanaminium

CAS No.: chlormequat 7003-89-6; chlormequat chloride 999-81-5

CIPAC No.: 143

Synonyms: CCC, chlorocholine chloride for chloremquat chloride. Trade marks are listed in Table 1.

Structural formula:

$$
\begin{array}{l}
\qquad\qquad\qquad\quad CH_3 \quad ^{+} \\
Cl\text{-}CH_2\text{-}CH_2\text{-}N\text{-}CH_3 \\
\qquad\qquad\qquad\quad CH_3
\end{array}
$$

Molecular formula: chlormequat $C_5H_{13}ClN$
chlormequat chloride $C_5H_{13}Cl_2N$

Molecular weight: chlormequat 122.6
chlormequat chloride 158.1

Physical and chemical properties

Pure active ingredient (chlormequat chloride)

Vapour pressure: <1 x 10^{-5} Pa at 20°C
Melting point: 245°C with decomposition
Octanol/water partition coefficient: log P_{ow} = -1.58 at pH 7 and 20°C
Solubility (g/100 g at 20°C):

water	>100
acetone	0.03
chloroform	0.03
ethanol	32

Specific gravity: not available
Hydrolysis: not stable towards alkalies. The solid is extremely hygroscopic. Aqueous solutions are stable but corrosive to unprotected metals.

Technical material (chlormequat chloride)

Purity: >96%
Melting range: 235°C
Stability: 2 years at 30, 40 and 50°C

Formulations

Table 1. Formulations of chlormequat, incomplete. All formulations are SL.

Name	Concentration of ai (g/l)	Remarks
AGRICHEM CCC 460	460	
AGRICHEM CCC 675	675	
bercema CCC	357	
CCC Feinchemie	357	
CCC SPROYTEMIDDEL	460	
CCC 750	750	
CCC 460	460	
CeCeCe	367	
Cycocel	460	used for reported trials
Cycocel 77A	77	
Cycocel 720	720	used for reported trials
Cycocel 750A	582	
New 5C Cycocel	645	used for reported trials
Stabilan	367	
STE 24371	558	
Terpal	236	+ Ethephon (155 g/l)
Terpal C	305	+ Ethephon (155 g/l)

Name	Concentration of ai (g/l)	Remarks
Ucesol 720	558	
Vivax	300	+ Ethephon (150 g/l)
Zeiticel	400	

METABOLISM AND ENVIRONMENTAL FATE

Animal metabolism

Rats. Older publications on the metabolism and biokinetics of [^{14}C]chlormequat in rats by Blinn (1967) and by Bier and Ackermann (1970) suggested that ingested chlormequat is principally eliminated unchanged in the urine.

In more recent studies Giese (1988, 1989) investigated the metabolic fate of [^{14}C]chlormequat in rats at three dose levels: 0.1 mg/kg bw by intravenous administration and 0.5 and 30 mg/kg bw by oral administration. The structural formula shows the position (*) of the ^{14}C labels.

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                   +
           CH3
Cl-CH2-CH2-N-CH3    Cl-
   *   *
           CH3
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In all cases more than 85% of the test substance was excreted unmetabolized in the urine, most of the radioactivity being excreted during the first 24 hours. Excretion in the faeces accounted for less than 6%, and elimination of volatile ^{14}C for less than 1%, of the administered radioactivity. About 50% of the radioactivity recovered in the faeces could be extracted with methanol. The extractable radioactivity accounted for more than 82% of the intact [^{14}C]chlormequat. About 70% of the radioactivity recovered in the faeces could be extracted after acidic hydrolysis. Thin-layer chromatography revealed, in addition to chlormequat, a very polar unidentified metabolite accounting for about 25% of the radioactivity applied to the TLC plate.

Radioactivity eliminated with the bile during 24 hours was in all cases below 1% of that administered, and contained more than 78% of unchanged [^{14}C]chlormequat. The maximum radioactivity appeared in all groups between two and five hours after oral administration of the test substance, so enterohepatic circulation is negligible.

The residues in organs and tissues 168 hours after administration of the test substance were all below 0.25 mg/kg (calculated as the parent compound) in all groups. The highest residues were found after high-dose peroral administration of 30 mg/kg bw in liver (males 0.16 mg/kg, females 0.23 mg/kg) and kidney (males 0.18 mg/kg, females 0.24 mg/kg). TLC of liver and kidney taken 1.5 hours after administration revealed more than 90% of unchanged [^{14}C]chlormequat.

The total recovery of radioactivity was between 82 and 104% in all groups.

Goats.The biochemical behaviour of [1,2-^{14}C]chlorocholine chloride in lactating goats was investigated by Blinn (1975). Three lactating goats were dosed orally for ten consecutive days with [^{14}C]chlormequat. The doses represented 0.8 and 8 ppm in the daily diet. Radioactivity was excreted rapidly. In the experiment at the 8 ppm level, about 84% of the total administered radioactivity was found in the urine, about 12% in the faeces and about 1% in the contents of the rumen and intestinal tract, giving a total recovery from the non-tissue compartments of about 97%. In the experiment at 0.8 ppm the corresponding values were 68% in the urine, 14% in the faeces and 2% in the rumen-intestinal tract contents, so the total non-tissue recovery was 84%. Within two days after the first dose, the levels of radioactivity in the milk from the goat treated at 8 ppm reached a plateau of 0.03 to 0.04 mg/kg, but detectable residues were not found in any of the milk samples from the goat treated at 0.8 ppm (limit of detection 0.016 mg/kg). The radioactivity 24 hours after dosing was below the limit of detection of 0.04 mg/kg in the brain, omental fat, muscle, heart and liver, 0.06 mg/kg in back fat and 0.14 mg/kg in kidney. At 8 ppm, levels of radioactivity were 0.08 mg/kg in brain, 0.09 mg/kg in omental fat, 0.1 mg/kg in leg muscle, 0.08 mg/kg in tenderloin muscle, 0.15 mg/kg in the liver and 0.23 mg/kg in the kidney. TLC showed that no radioactive compound was present in the goat urine except the unmetabolized parent compound.

Cow. A lactating cow was given one oral does of 1 g of ^{15}N-labelled chlormequat (Lampeter and Bier, 1970). The compound was excreted mainly in the urine. It was absorbed relatively quickly from the digestive tract and appeared in the urine and milk three hours after administration. Peak values for the levels in urine were obtained 15 and 39 hours after administration (49 mg/kg and 13 mg/kg, respectively); even on the 5th day 2 mg/kg of chlormequat could still be detected. The peak concentration of chlormequat in milk occurred between 12 and 60 hours after administration, but the levels were below 1 mg/kg. The fact that chlormequat was still being excreted six days after a single oral administration of 1 g indicates that it persists in the animal body. The distribution in organs and excretion in the faeces were not investigated.

Hens. Fifteen White Leghorn hens were dosed orally for ten days with 0.3 mg/bird/day of 2-chloro[1,2-^{14}C]ethyltrimethylammonium chloride, which corresponds to 3 ppm in the daily diet (Wilbur, 1975). This rate represents a level of 10 times that which would be present in a chicken ration containing estimated maximum levels of chlormequat residues in molasses (6 mg/kg) and of molasses in the feed (5%). Excreta, blood and eggs were collected daily. Hens were killed 24 hours after the last dose and samples of muscle, fat, liver, kidney, eggs in the oviduct, and gastro-intestinal contents were taken.

The recovery of radioactivity in the excreta was 97% for the total dose period. The remaining ^{14}C was rapidly and almost totally (97%) excreted within 24 hours of the last dose.

The highest concentration recorded in the blood was 0.01 mg/kg, expressed as chlormequat equivalents, observed in some hens after the seventh dose and continuing at this level until 24 hours after the last dose.

The maximum levels of radioactivity (chlormequat equivalents) in the eggs were <0.01 mg/kg in albumen, 0.08 mg/kg in yolk, and 0.03 mg/kg in whole egg. Only 0.3% of the total radioactivity was accounted for in the eggs.

Tissue residues expressed as chlormequat equivalents were very low. The residues 24 hours after the last dose in muscle and fat were below the limit of determination (<0.01 mg/kg). Levels of 0.02 mg/kg were determined in liver and kidney (Table 2).

Table 2. ^{14}C as chlormequat equivalents in six laying hens 24 hours after the end of a 10-day oral administration of 0.3 mg/hen/day (Wilbur, 1975).

Sample	Residue, mg/kg
Muscle	<0.01
Fat	<0.01
Liver	0.02
Kidney	0.02
Whole egg	0.03
Albumen	<0.01
Yolk	0.08
Excreta	97.2 %

Plant metabolism

In experiments on potted wheat and barley plants to study the uptake, decomposition and translocation of [^{14}C]methyl- or [^{14}C]ethyl-labelled chlormequat in wheat Schilling and Bergmann (1971) found that, within four weeks after leaf-application, only 10% of the chlormequat absorbed was metabolized. In the wheat plants acropetal transport of chlormequat was predominant, while in barley chlormequat was transported in a basipetal direction. The authors explained the difference in translocation behaviour as being because barley, unlike wheat, was tillered up to the stage of ear formation, and the shoots acte1 3 4ated particularly to the rapidly growing parts of plants.

Studies of the metabolism of chlormequat in higher plants have produced varying results. Bohring (1972), Blinn (1967), Faust and Bier (1967), Birecka (1967), Bier and Dedek (1970) and Bettner (1974) found negligible amounts of labelled metabolites in studies with ^{14}C- or ^{15}N-labelled chlormequat. The formation of choline in particular is ruled out by some of the above authors.

The capacity of vegetable plants to metabolize chlormequat was also found to be insignificant by Müller and Schuphan (1975), with the conversion rates being 1-6% in kohlrabi, 1-4% in cauliflower, and 1-2% in tomatoes.

The metabolism of [*methyl*-^{14}C]chlormequat during the reproductive stage was studied by Bohring (1982) in pot experiments with spring wheat. The persistence of ^{14}C-labelled chlormequat in wheat kernels was also examined during a period of one year. The following results were found after spray treatment at late growth stages (tillering, ear emergence).

The mobility of chlormequat in the plant was very low. Even when it was applied at the beginning of ear emergence, 98% of the applied ^{14}C remained in the shoots and only 1-2% was translocated towards the ears.

Chlormequat was very stable in the plants. By far the main proportion of the applied ^{14}C was recovered as chlormequat and only 2-5% was found in the choline fraction. The radioactivity in the other chemical fractions was extremely low or zero.

In the kernels the ^{14}C activity in the choline fraction amounted to 12% of the total ^{14}C and thus was twice as high as in the straw. This relatively high level of ^{14}C in the choline fraction may be related to metabolic processes typical of grain growth. It is also possible that choline synthesized in the leaves is more easily translocated than chlormequat towards the kernels.

Mature kernels stored at room temperature did not show any metabolism of chlormequat during a period of one year. Neither the total ^{14}C activity nor the content of chlormequat changed significantly during this time.

The only recent study using such methods as ion chromatography (IC), radio-HPLC and HPLC-MS as well as TLC was carried out by Keller (1990) to investigate the metabolism of chlormequat as 2-chloro[1,2-^{14}C]ethyltrimethylammonium chloride in spring wheat. In a pot experiment carried out in a phytotron with fluorescent lamps spring wheat was sprayed with 580 mg ai/trial (equivalent to 1.38 kg ai/ha) and harvested 118 days later in January 1988. The total radioactive residues in whole plants were 49 mg/kg at 0 days, 42 mg/kg at 28 days and 14 mg/kg at 84 days; they were 46 mg/kg in the straw and 1.3 mg/kg in the grain. The parent compound was found to be the only major component. Betaine could also be identified in grain but its concentration was <10% of the total ^{14}C residue.

Other authors showed that metabolism was extensive. Jung and El Fouly (1966, 1969) and El Fouly and Ismail (1969) showed that the active ingredient was quickly converted to choline in aqueous extracts of many plants. They supposed that this hydrolysis also occurred in whole plants.

Schneider (1967) applied methyl- and ethyl-^{14}C-labelled chlormequat to barley and chrysanthemum sprouts. After 24 hours incubation he found labelled choline in both plants.

Interieri and Ryugo (1974) treated almond seedlings with [^{14}C]chlormequat. They found that $^{14}CO_2$ was released and a number of radiolabelled metabolites, in particular choline, 2-chloroethylamine and 17 amino acids, were detectable in methanolic extracts of the leaves. The evolution of $^{14}CO_2$ was most rapid two hours after application, then gradually slowed until the fourth day and continued at about the same level until the tenth day.

Stephan and Schütte (1970) studied the metabolism of methyl-labelled chlormequat chloride in barley, wheat, tobacco and maize. Ten to 20% of the applied radioactivity was located in the choline fraction, and a small proportion was found in the betaine fraction. Degradation to $^{14}CO_2$ was observed to only a small extent.

Dekhuijzen and Vonk (1974) determined the distribution and degradation of chlormequat as 2-chloro[1,2-^{14}C]ethyltrimethylammonium chloride after uptake by the roots of summer wheat seedlings. The compound was completely translocated from the roots to the parts above and converted into choline. Choline was further metabolized to betaine which upon demethylation yielded finally glycine and serine. Both amino acids were incorporated into a protein fraction (see Figure 1). The occurrence of radio-labelled glycine and serine in the amino acid pool and the evolution of $^{14}CO_2$ from chlormequat-treated plants indicated that serine was formed from glycine with the release of $^{14}CO_2$ during photorespiration. One week after the uptake period 82% of the [^{14}C]chlormequat taken up by the roots was recovered as the parent compound or as breakdown products in the wheat plants, and a further 5% was released as $^{14}CO_2$ by the leaves. 50% of the chlormequat originally present in the wheat plant was metabolized after 7½ days.

Figure 1. Metabolic pathway of chlormequat in wheat plants proposed by Dekhuijzen and Vonk (1974).

2 $(CH_3)_3N^+CH_2CH_2Cl$ > 2 $(CH_3)_3N^+CH_2CH_2OH$
chlormequat choline

> 2 $(CH_3)_3N^+CH_2COOH$ > 2 $(CH_3)_2NCH_2COOH$
betaine dimethylglycine

> 2 CH_3NHCH_2COOH > 2 H_2NCH_2COOH
sarcosine glycine > incorporation into proteins

photo-
H_2N-CHCOOH + CO_2 <
respiration
CH_2OH
serine
> incorporation into proteins

CH_2OH-CO-COOH
hydroxypyruvic acid

Environmental fate in soil

The degradation of chlormequat in soil was investigated by Keller (1993) with [^{14}C]chlormequat (2-chloro[1,2-^{14}C]ethyltrimethylammonium chloride) in a field experiment with a sandy loam soil and in a greenhouse with a clay soil. The rates of treatment corresponded to 3.4 and 2.7 kg ai/ha respectively. Rapid microbiological degradation occurred in both cases. The applied radioactivity decreased to 88% of the original in loam and 33% in clay after three weeks and to 22% in loam and 33% in clay after six weeks. In both soils 70-98% of the activity was in the top 5 cm layer. Chlormequat was extensively mineralized and CO_2 was the ultimate product of degradation. Other degradation products could not be identified. The half-life depends on several factors including temperature, and is in the range of <1 to 28 days. DT 90 periods are less than 100 days.

Environmental fate in water/sediment systems

No data were received.

METHODS OF RESIDUE ANALYSIS

Analytical methods

The determination of chlormequat residues in plant material is difficult owing to the necessary separation of chlormequat from naturally occurring choline. If separation is not quantitative high blank values are found, which may lead to false positive results.

The extraction of chlormequat residues from plant material is carried out with methanol or ethanol. The active ingredient is isolated from native choline and other plant constituents by cation exchange or column chromatography on aluminium oxide and interfering substances are precipitated. Former publications described a thin-layer chromatographic determination with detection by Dragendorff's reagent (Jung and Henjes, 1964; Kretzschmann, 1972). The limit of determination of the semi-quantitative method was reported to be from 0.1 mg/kg in cereal grains and green plants to 0.3 mg/kg in cereal straws, with recoveries between 70 and 80%.

The main manufacturer also provided a photometric method by Jung (1968) and Jung and Henjes (1969). Chlormequat was determined as a dipicrylamine complex after the same extraction and clean-up procedure. An LOD of 0.1 mg/kg was reported for fruits, vegetables and cereals (grain, straw and green plant), but the validation was carried out with fortifications from 10 to 50 mg/kg.

Sachse (1977) used thin-layer chromatography for clean-up and the colour reaction with dipicrylamine for the determination. Recoveries were 98 ± 5% for wheat grain and straw and 80 ± 5% for oat grain. The detection limit was 0.1 mg/kg, but the lowest fortification was 20 µg with 100 g grain. A limit of determination was not reported.

After extraction and clean-up as above, residues were determined by GLC after conversion to *N,N*-dimethyl-2-(phenylthio)ethylamine with thiophenolate (Anon, 1979). A sulphur-specific flame-photometric detector was used. Recoveries were between 80 and 95% at 0.05-0.5 mg/kg for cereal grains, cereal plants and milk, and between 70 and 80% at 0.2-5 mg/kg for straw. The limit of determination was 0.05 mg/kg for cereal plants, grains and milk, and 0.2 mg/kg for straw.

In the method described by Schepers (1989) plant material is extracted with methanol. After a liquid-liquid partition (dichloromethane-water), the active ingredient is isolated by complexing it with dipicrylamine, re-extracted with HCl and then purified by column chromatography on aluminium oxide. The final determination is carried out by ion-pair chromatography using conductivity detection and a suppressor system. The limit of determination is 0.05 mg/kg for wheat green matter, grain and straw. The recoveries ranged from 79 to 84% (fortifications 0.05 to 5 mg/kg).

Stability of pesticide residues in stored analytical samples

Eight wheat grain samples with residues ranging from 0.05 to 0.4 mg/kg were analysed after 0, 16 and 32 weeks of storage at -18°C. The results (Table 3) show that chlormequat is stable in wheat (Elzner, 1980).

Table 3: Storage stability of chlormequat in wheat grain.

Time (weeks)	Chlormequat residues, mg/kg, in sample no.							
	5	6	7	8	9	10	11	12
0	0.06	0.07	0.13	<0.05	0.36	0.33	0.38	0.17
16	0.06	0.08	0.1	<0.05	0.41	0.27	0.3	0.11
32	0.08	0.1	0.15	<0.05	0.31	0.35	0.32	0.18

USE PATTERN

The Meeting received summaries of GAP from the main manufacturer and from the authorities of Australia, Canada, Germany and The Netherlands (Table 4).

Table 4. Registered uses of chlormequat.

Crop	Country	Application			PHI, days
		Rate per applicn., kg ai/ha	Spray conc., kg ai/hl	No.	
Almonds	Spain	0.92		1	28
		1.2			
Barley	Peru	1.4	0.23	1	100
	Poland	0.61			
	Spain	0.53-0.59	2-3		
Barley, Summer	Belgium	0.46	0.23	1	F
	Italy	0.76-1.8	1		
	Germany	0.47	0.12	1	42
	Netherlands	0.30-0.61	0.05-0.61	1	F
	UK	0.31-1.6		1	F
Barley, Winter	Belgium	0.69	0.35	1	F
	France	0.76		1	ES10
	Germany	0.59	0.15	1	42
	Netherlands	0.61-0.92	0.10-0.46	1	-
	UK	0.46-1.6		1-2	F
Cereals	Norway	0.46-1.2		1	F
	Saudi arabia	1.1		1	
Cotton	Argentina	0.065		1	
	Australia	0.019-0.038			70-100% cap fall
	India	0.075			
Currants	Australia	0.0077			
Egg plant	India	0.075			
Autumn planted cereals	Poland	0.76			
Flax, Common	Netherlands	1.4		1	F
	UK	1.6		1	F
Garlic	Argentina	0.5		1	
Grapes	Spain	0.84			
Linseed and fibrous flax	Netherlands	0.92-1.4		1	
Maize	Belgium	0.46	0.23	1	F
Oats	Belgium	1.4	0.72	1	F
	Germany	1.1	0.19-0.56	1	42
	Greece	1.8		1	ES 9
	Italy	1.8		1	
	Luxembourg	1.4	0.72	1	F

Crop	Country	Application			PHI, days
		Rate per applicn., kg ai/ha	Spray conc., kg ai/hl	No.	
	Netherlands	1.2-1.4	0.20-0.68	1	F
	New Zealand	1.0		1	
	Switzerland	1.8	0.613	2	ES 30
	UK	1.6-1.7		1	F
	Uruguay	1.4		1	ns
Oats, Winter	France	1.4		1-2	*
	Netherlands	1.2-1.4	0.20-0.68	1	
	UK	0.46-1.7		1	F
Onion	Peru	0.69	0.17	1	100
Pear	Belgium	1.4	0.23-0.24	4-5	F
	Netherlands	0.8-2.7	0.1-0.18	2	90
	Norway	0.92-1.8	0.005-0.18	1	
	Spain	0.14		1	28
		1.5			
Potato	Argentina	0.49-1.0		1	1
	India	0.075			
	Peru	0.92	0.15	1	100
	Uruguay	1.8		1	ns
Rape seed	Belgium	0.69	0.35	1	F
	UK	1.9		1	F
Rye	Belgium	0.81	0.4	1	F
	Greece	1.8		1	ES 9
	Italy	0.61-1.8		1	
	New Zealand	2.0			42
	Poland	0.61			
	Spain	0.53-0.59	2-3		
	Switzerland	1.2	0.38	2	ES 30
	UK	1.6-1.7		1	F
	Uruguay	1.4		1	ns
Rye, Winter	Canada	1.5	0.75		60
	France	1.2		1-2	*
	Germany	1.1 (ES 30-32)	0.19-0.56	1	63
		0.47 (ES 32-49)	0.12	1	42
	Netherlands	0.30-0.61	0.05-0.30	1	F
	Sweden	0.42		1	F
	UK	0.61		1	F
Spelt	Belgium	0.90-0.92	0.45	1	F
	Luxembourg	0.9	0.45	1	F

Crop	Country	Application			PHI, days
		Rate per applicn., kg ai/ha	Spray conc., kg ai/hl	No.	
Sugar cane	Uruguay	1.8		1	ns
Tomato	Argentina	0.075	0.075	1	
	Italy	1.6		1	
	Peru	0.92	0.23	1	100
Triticale	Belgium	0.69-0.92	0.35-0.45	1	F
	Germany	0.71	0.24-0.71	1	63
	Luxembourg	0.9	0.45	1	F
	Poland	0.61			
	Switzerland	1.2	0.383	2	ES 30
	UK	0.46-1.7		1-2	F
Vines	Australia	0.0023-0.031			1-2 weeks before flowering
	Italy	1.6		1	
	Peru	0.92	0.15	1	100
	Spain	0.18		1	28
Wheat	Spain	0.53		2-3	
		1.4			30
Wheat, Dry land	Australia	0.29	0.29-0.97		
Wheat, Irrigated	Australia	0.76			
Wheat, Hard	France	0.92-1.6		1-2	*
	Italy	1.8		1	
Wheat, Soft	Argentina	1.0-2.0		1	
	Greece	1.8		1	ES 9
	Ireland	1.9			
	Italy	0.76-1.8		1	
	Paraguay	1.4	3.4	1	
	Poland	0.61			
	Spain	0.59-1.8		1	28
	Uruguay	1.4		1	ns
	Zimbabwe	1.8			
Wheat, Summer	Belgium	0.69-0.74	0.35-0.36	1	F
	Canada	1.5	0.75		60
	Chile	0.92-1.2		1	
	France	0.90-0.92		1-2	*
	Germany	0.71-0.73 (ES 21-29)	0.12- 0.71	1	63
		0.47 (ES 32-49)	0.12	1	42
	Luxembourg	0.72	0.36	1	F
	Netherlands	0.4-0.46	0.066-0.23	1	F

Crop	Country	Application			PHI, days
		Rate per applicn., kg ai/ha	Spray conc., kg ai/hl	No.	
	New Zealand	1.0		1	
	Poland	0.92			
	Switzerland	1.2	0.38	2	ES 30
	UK	0.79-0.83		1	F
Wheat, Winter	Belgium	0.69-0.92	0.35-0.45	1	F
	Canada	a) 0.92-1.4		1	
		b) 0.92-1.2 + 0.23-0.35		2	
	Chile	0.92-1.2		1	
	France	0.76-0.92		1-2	*
	Germany	1.1-1.2 (ES 21-31)	0.18-1.1	1-2	63
		0.59 (ES 32-49)	0.15	1	42
	Luxembourg	0.9	0.45	1	F
	Netherlands	a) 0.40-0.92	0.066-0.46	1	F
		b) 0.61-0.63	0.11-0.31	1	F
	New Zealand	1.0		1	
	Poland	1.6			
	Romania	0.8			
	Switzerland	1.2	0.38	2	ES 30
	UK	0.46-1.7		1-2	F

* until stem elongation
+ no data available because product is not sold
ns not specified by authorities
F fixed by approved use, PHI is given by the time between treatment and harvest
ES stage of growth
Winter wheat, Canada a): single spring application at Feekes large scale growth stage 6 (Zadok stage 31)
Winter wheat, Canada b): split application at Feekes large-scale growth stages 4 and 6 (Zadok stages 23-29 and 31 respectively)
Winter wheat, Netherlands a): formulations 400 SL, 457 SL, 460 SL, 675 SL, 750 SL; 0.4-0.92 kg ai/ha (chlormequat)
Winter wheat, Netherlands b): formulations 360 g/l chlormequat and 180 g/l ethephon SL or 305 g/l chlormequat and 155 g/l ethephon SL; 0.63 kg ai/ha chlormequat and 0.31 kg ai/ha ethephon

RESIDUES RESULTING FROM SUPERVISED TRIALS

The Meeting reviewed supervised trials data on pears, grapes, tomatoes, mushrooms, cotton seed, rape seed and cereals. The residues were calculated as chlormequat chloride in most cases.

Underlined residues in Tables 5-17 are from treatments according to GAP.

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Pears. Chlormequat is used on pears for the inhibition of vegetative growth and promotion of flowering in the following season. Residues after spraying in trials in The Netherlands and Norway are shown in Table 5.

Table 5. Residues of chlormequat in pears. Dutch residues calculated as chlormequat cation, Norwegian residues calculated as chlormequat chloride.

Country, Year	Application				PHI, days	Residues, mg/kg	Ref. or BASF Reg. Doc. no.
	Form.	No.	kg ai/ha	kg ai/hl			
Netherlands, 1989	396 SL	1	1.5		91	1.5, 1.6, 1.9, 2	Wit, 1969
		1	1.5		116	0.3 (2), 0.4 (2)	
		1	1.2		142	<0.1 (3), 0.2	
		1	1.2		142	<0.1 (2), 0.3, 0.6	
		2	0.74		70	0.5, 0.9, 1.5, 2.8	
		2	0.74		91	0.3, 0.4, 0.6, 0.8	
1980	400 SL	4	1.6 + 3 x 1.2		90	0.94, 1.2, 1.5, 1.6	Greve and Hogen-doorn, 1983
	400 SL	2	1.6 + 1.2		101	4.2, 5.2, 7.4, 8.1	
1983	457 SL	2	1.8	0.4	124	2.4, 3.1, 3.5, 5.3	
	457 SL	2	1.8 + 1.1	0.4 + 0.25	113	5.4, 5.5, 6.5, 6.9	
Norway,	460 SL	1		0.5*	94	1.5	BASF
1973		1			94	2	74/10287
		1			103	1.2	BASF
1975	460 SL	1		0.44*	98	2.4	75/10193
		1			98	2.4	75/10194
		1			98	3	75/10195
		1			98	8.1	75/10196

* applied until run-off

Grapes. The use of chlormequat on grapes for bloom induction is registered in Spain (0.84 kg ai/ha) and its use on vines in Australia, Italy, Peru and Spain. Only two trials from Germany were available, which were not according to GAP. Single applications of 460 SL were made at 0.24 kg ai/ha. Residues after 128 days were 0.4 and 0.25 mg/kg (BASF Reg. Docs. 75/10191, 75/10192).

Tomatoes. Residue trials on tomatoes were conducted in the UK, but they could not be evaluated because there is no registered use in the UK and the trials were not according to the GAP of Argentina, Italy or Spain. The results are summarized in Table 6.

Table 6. Residues of chlormequat in tomato (under glass) in the UK, calculated as chlormequat chloride (BASF Reg. Doc. 84/1026).

	Application			PHI, days	Residues, mg/kg
Year	Form	No	kg ai/ha		

	Application			PHI, days	Residues, mg/kg
Year	Form	No	kg ai/ha		
1984	645 SL	1	0.25	87	0.37
1983		1	0.25	63	0.17
		1	0.25	42	0.98
1983	460 SL	2	0.25	51	0.32, 0.37
		2	0.25	57	0.33, 0.46
		2	0.50	57	0.51, 0.81

Mushrooms. It is common practice to cultivate some varieties of mushroom on cereal straw. In German trials oyster mushrooms were cultivated on wheat or barley straw which was grown in the season before and treated with chlormequat (Siebers *et al*., 1991; Lelley, 1992). In all cases the straw used was from commercial producers. The stem stabilizer was applied to cereal crops according to GAP taking into account the sensitivity of the varieties used to chlormequat (chlormequat is not registered for use on mushrooms). Table 7 shows the results.

Table 7. Residues of chlormequat in mushrooms grown on treated straw in Germany, calculated as chlormequat chloride.

Source of straw, Year	Application				PHI, days	Residues, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl			
Winter wheat	357 SL	1	1.4	0.36	76*	straw 5.3	Siebers *et al*., 1991
1991					119**	1.3	
					253***	0.16	
					30- 56^	mushrooms 4.9	
					56- 64^	5.5	
					94-101^	0.7	
					126^	1	
					160^	1.7	
Winter barley	357 SL	1	0.46		65*	straw 1.6	Lelley, 1992
1992					26^	mushrooms 2.1	
					57^	1.2	
Winter wheat	558	2	0.72+1.1		112*	straw 0.8	
	SL				26^	mushrooms 2.2	
					57^	1.4	

Source of straw, Year	Application				PHI, days	Residues, mg/kg	Ref.
	Form	No	kg ai/ha	kg ai/hl			
		2	0.86+0.22		116*	straw 1.7	
					26^	mushrooms <u>0.6</u>	
					57^	<u>1.8</u>	

* Harvest of straw
** Beginning of first mushroom sampling period
*** Last sampling of mushrooms
^ Days after inoculation of mushroom spores

<u>Barley</u>. Residue trials on summer barley were conducted in Canada, Denmark, Germany, Sweden and the UK, and on winter barley in Denmark, France, Germany, Sweden, Switzerland and the UK. The residues in green plants, grain and straw are shown in Tables 8 and 9.

Table 8. Residues of chlormequat in summer barley, calculated as chlormequat chloride. All single applications.

Country, Year	Application			PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form.	kg ai/ha	kg ai/hl			
Canada, 1987	305 SL	0.46	0.2	48	grain 1.3, 0.94, 1, 1.2	87/10381
		0.46	0.42	61	grain 0.39, 0.42, 0.51, 0.57	87/10382
		0.46	0.46	44	grain 1.2, 1.4, 1.7, 1.9	87/10383
		0.46	0.23	49	grain 1.4, 1.5 (2), 1.6	87/10384
		0.46	0.46	57	grain 0.17, 0.43, 0.58, 0.72	87/10385
		0.46	0.2	48	grain 1.2 (2), 1.4, 1.6	87/10386
Denmark	305 SL	0.46	0.11	30	green* 2.5	83/10206
1983				59	grain 0.05	
				59	straw 2.7	
		0.46	0.11	29	green 0.85	83/10207
				70	grain 0.3	
				70	straw 1.3	
1982	305 SL	0.61	0.15	61	grain <0.05	82/10190
				61	straw 4.3	
				77	grain <0.05	82/10191
				77	straw 4.4	
Germany,	305 SL	0.61	0.15	0	green 10	82/10207
1982				21	2.1	
				35	0.96	
				41	0.55	
				48	0.36	
				69	grain 0.17	
				69	straw 4	

Country, Year	Application			PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form.	kg ai/ha	kg ai/hl			
		0.61	0.15	0	green 7.6	82/10208
				20	1.5	
				34	grain 0.46	
				41	0.5	
				48	0.62	
				34	straw 4.4	
				41	3.9	
				48	4	
Sweden,	460 SL	0.23		82	grain 0.06	78/10210
1978		0.46		82	0.1	
		0.92		82	0.19	
		0.23		111	grain <0.05	78/10211
		0.46		111	<0.05	
		0.92		111	<0.05	
		0.23		107	grain <0.05	78/10212
		0.46		107	<0.05	
		0.92		107	<0.05	
		0.23		72	grain <0.05	78/10213
		0.46		72	0.1	
		0.92		72	0.1	
		0.23		86	grain <0.05	78/10214
		0.46		86	<0.05	
		0.92		86	<0.05	
		0.23		112	grain <0.05	78/10215
		0.46		112	<0.05	
		0.92		112	0.08	
		0.23		75	grain 0.23	78/10216
		0.46		75	0.5	
		0.92		75	0.73	
UK,	460 SL	1.6	0.64	97	grain 0.37	80/10237
1980				97	straw 4.9	
		1.6	0.64	104	straw 1.6	80/10238
1982	645 SL	0.81	0.37	135	grain 0.18	82/10186
		1.6	0.81	110	grain 0.24	82/10187
				110	straw 1.6	

* Green plant

Table 9. Residues of chlormequat in winter barley, calculated as chlormequat chloride.

Country, Year	Application				PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form.	No.	kg ai/ha	kg ai/hl			
Denmark, 1982	305 SL	1	0.76	0.19	61	stalk 0.1	82/10213
					61	ear 0.1	
					69	grain 0.05	
					69	straw 0.9	
France, 1982	305 SL	1	0.76	0.14	69	grain 0.18	82/10195
					69	straw 1.8	
		1	0.76	0.14	56	grain 0.16	
					56	straw 11	
		1	0.76	0.13	70	grain <0.05	82/10196
					70	straw 3.1	
		1	0.76	0.13	57	grain <0.05	
					57	straw 8.5	
		1	0.76	0.13	77	grain <0.05	82/10197
					77	straw 0.36	
		1	0.76	0.13	62	grain 0.21	
					62	straw 2.4	
		1	0.76	0.13	75	grain 0.24	82/10198
					75	straw 4.7	
		1	0.76	0.13	63	grain 0.35	
					63	straw 5.4	
1983		1	0.76	0.13	56	grain 0.3	83/10210
					56	straw 4.4	
		1	0.76	0.13	68	grain 0.29	83/10211
					68	straw 5.5	
		1	0.76	0.13	67	grain 0.3	83/10212
					67	straw 2.8	
Germany, 1982	305 SL	1	0.76	0.19	0	green* 8.3	82/10205
					21	4.3	
					35	grain 1.1	
					42	1.5	
					49	1.6	
					35	straw 7.8	
					42	6.4	
					49	5.8	
		1	0.76	0.19	0	green 9.9	82/10206
					21	3	

Country, Year	Application				PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form.	No.	kg ai/ha	kg ai/hl			
					35	grain 1.6	
					42	1.5	
					49	1.6	
					35	straw 4.1	
					42	3.5	
					49	5.8	
1983	305 SL	1	0.76	0.19	0	green 6.4	83/10200
					21	1.1	
					35	3.3	
					42	ear 0.96	
					49	5.9	
					42	stalk 4.4	
					49	2.4	
		1	0.76	0.19	0	green 9	83/10201
					21	ear 7.3	
					35	6.5	
					21	stalk 7.7	
					35	8.8	
					42	12	
					49	grain 2.3	
					49	straw 12	
		1	0.76	0.19	0	green 6.4	83/10202
					20	1.3	
					33	0.89	
					53	1.9	
					68	grain 0.18	
					76	0.2	
					68	straw 6.2	
					76	3	
		1	0.76	0.19	0	green 7.6	83/10203
					20	3.3	
					35	grain 1	
					43	1.3	
					35	straw 7.3	
					43	8.7	
		1	0.76	0.19	0	green 7.3	83/10204
					21	2	
					35	2.2	

Country, Year	Application				PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form.	No.	kg ai/ha	kg ai/hl			
					43	ear 0.54	
					49	0.78	
					43	stalk 2.9	
					49	2.6	
					76	grain 0.17	
					76	straw 5.8	
		1	0.76	0.19	0	green 10	83/10205
					21	ear 7.7	
					35	4.7	
					42	2.5	
					21	stalk 4.9	
					35	7.8	
					42	11	
					49	grain 2.1	
					49	straw 9	
Sweden, 1983	305 SL	1	0.61	0.23	68	grain 0.07, 0.13, 0.32, 0.42	83/10195
Switzerland 1984	305 SL	1	0.61	0.1	72	grain 0.23	84/10231
					72	straw 4.5	
		1	0.61	0.12	70	grain 0.29	84/10232
					70	straw 4.2	
UK, 1980	460 SL	1	1.6	0.64	80	grain <u>0.15</u>	80/10236
					80	straw <u>1</u>	
1982	645 SL	1	1.6	0.73	40	green 0.97	82/10188
					96	grain 0.07	
					96	straw 1.1	
		1	1.6	0.73	51	green 0.41	82/10189
					115	grain <u><0.05</u>	
					115	straw <u>2.2</u>	
1987	645 SL	1	1.9	0.88	0	green 17, 19, 24	87/10378
					128	grain 0.16, 0.15, 0.36	87/10379
					128	straw 1.7, 2.1, 2.4	87/10380
1983	645 SL	2	0.48+1.6		98	grain <u>0.05</u>	83/10185
					98	straw <u>8.9</u>	
		2	0.48+1.6		31	grain <u>0.24</u>	83/10186
					31	straw <u>0.98</u>	
1984	645 SL	2	0.48+1.6		113	grain <u><0.05</u>	84/10226
					113	straw <u>2.4</u>	

Country, Year	Application				PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form.	No.	kg ai/ha	kg ai/hl			
1985	305 SL	1	0.46	0.21	1	green 2.4, 2.6 (2)	87/10366
					83	ear 0.25, 0.3, 0.33, 0.34, 0.43, 0.47	
		1	0.46	0.23	5	green 2, 3.3, 4.8	87/10366
					82	grain <u>0.45</u>, <u>0.5</u> , <u>0.58</u>	
					82	straw <u>10</u>, <u>11</u>, <u>12</u>	
		1	0.46	0.21	0	green 9.2	87/10366
					75	grain <u>0.43</u>	
					75	straw <u>16</u>	
	2 x 645 SL	3	0.48+1.5+0.4		1	green 7, 7.4, 11	87/10366
	+1 x 305 SL				83	ear 0.48, 0.63, 0.67	
					83	straw 6.9, 17, 19	
		3	0.48+1.6+0.4		5	green 2, 5, 5.8	87/10366
					82	grain 0.71, 0.76, 0.93	
					82	straw 10, 12	
		3	0.48+1.6+0.4		1	green 20	87/10366
					75	grain 0.47	
					75	straw 21	

* green plant

<u>Maize</u>. Chlormequat is registered in Belgium, but residue data on maize (green plant, cob, plant remaining after harvest and grain) were available only from nine German trials. They are shown in Table 10.

Table 10. Residues of chlormequat in maize, calculated as chlormequat chloride, from trials in Germany.

Year	Application				PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form.	No.	kg ai/ha	kg ai/hl			
1984	305 SL	1	0.61	0.15	0	green* 4.4	84/10237
					26	2.7	
					34	4.8	
					98	cob 0.34	
					98	rem** 2.7	
					111	4.1	
					111	grain 0.14	
		1	0.61	0.15	0	green 22	84/10238
					17	6.2	
					35	cob 0.88	
					86	1.6	
					113	1.7	
					35	rem 8.3	
					86	6	
					113	4.3	
		1	0.61	0.15	0	green 9.1	84/10239
					21	2.4	
					32	1.6	
					68	cob 0.82	
					109	1.2	
					68	rem 1.2	
					109	2.5	
		1	0.61	0.15	0	green 26	84/10240
					22	1.6	
					34	0.69	
					83	cob <0.05	
					106	<0.05	
					83	rem 0.79	
					106	0.68	
		1	0.61	0.15	0	green 20	84/10241
					20	0.92	
					30	0.89	
					62	cob 0.34	
					62	rem < 0.5	
					92	0.8	

Year	Application				PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form.	No.	kg ai/ha	kg ai/hl			
					92	grain 0.5	
1985	305 SL	1	0.61	0.15	0	green 4.8	85/10309
					13	5.0	
					36	1.2	
					71	cob 1.2	
					71	rem 3.7	
					90	2.4	
					90	grain 0.68	
		1	0.61	0.15	0	green 6.3	85/10310
					20	0.32	
					33	0.39	
					71	cob 0.20	
					93	0.23	
					71	rem < 0.05	
					93	0.36	
		1	0.61	0.15	0	green 3.1	85/10311
					35	3.4	
					64	cob 0.4	
					77	0.35	
					107	0.44	
					64	rem 2.7	
					77	3.9	
					107	5.1	
		1	0.61	0.15	0	green 5.3	85/10312
					13	4.3	
					27	3.6	
					61	cob 2.9	
					61	rem 2.7	
					78	4.5	
					78	grain 2.4	

* green plant
** plant remaining after harvest

Oats. Residues of chlormequat were determined in oats treated once with 0.9 to 1.7 kg ai/ha at various sites in Germany and the UK (Table 11).

Table 11. Residues of chlormequat in oats, calculated as chlormequat chloride from trials in Germany.

Country, Year	Application				PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form.	No.	kg ai/ha	kg ai/hl			
Germany, 1974	460 SL	1	1.2	0.29	0	green* 116	74/10197
					21	15	
					43	9.2	
					63	4.8	
					81	grain 2.4	
					81	straw 8.2	
		1	1.2	0.38	0	green 100	74/10198
					21	17	
					49	1.8	
					74	grain 1.5	
					74	straw 4.0	
1973	460 SL	1	1.4	0.38	0	green 84	73/10129
					23	8.1	
					44	6.8	
					49	grain 3.7	
					49	straw 5.2	
		1	1.4	0.38	24	green 15	73/10130
					48	4.0	
					59	3.9	
					70	grain 3.3	
					70	straw 1.2	
1975	460 SL	1	1.2	0.23	0	green 17	75/10184
					21	3.7	
					42	2.5	
					63	grain 0.14	
					63	straw 0.9	
		1	1.4	0.23	0	green 17	75/10185
					21	7.6	
					32	3.3	
					51	grain 1.6	
					51	straw 2.2	
		1	1.4	0.23	0	green 17	75/10186
					21	6.4	
					42	5.1	
					55	grain 1.9	
					55	straw 1.9	
1976	460 SL	1	1.4	0.34	59	grain 1.8	76/10144
					59	straw 1.2	

Country, Year	Application				PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form.	No.	kg ai/ha	kg ai/hl			
		1	0.92	0.23	59	grain 1.2	76/10145
						straw 1.2	
1978	460 SL	1	1.4	0.23	0	green 9.9	78/10209
					21	3.5	
					42	2.3	
					54	3.2	
					75	grain 2.4	
					75	straw 1.9	
1976	340 SL	1	1.4	0.17	0	green 11	76/10155
					21	1.5	
					42	grain < 0.05	
					57	1.0	
					63	1.1	
					42	straw 1.6	
					57	1.6	
					63	1.6	
		1	1.4	0.17	0	green 20	76/10156
					21	1.8	
					42	0.36	
					73	grain 0.45	
					60	straw 1.3	
					73	0.78	
		1	1.4	0.17	0	green 14	76/10157
					22	6.9	
					42	grain 1.2	
					44	1.5	
					42	straw 12	
					44	9.6	
					62	5.3	
		1	1.4	0.17	0	green 19	76/10158
					19	4.3	
					82	grain 2.0	
					89	1.9	
					82	straw 4.8	
					89	< 0.1	
1977	370 SL	1	0.92	0.15	0	green 10	77/10253
					21	1.4	
					42	0.7	

Country, Year	Application				PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form.	No.	kg ai/ha	kg ai/hl			
					74	grain 1.8	
					63	straw 2.0	
					74	3.5	
		1	0.92	0.15	0	green 11	77/10256
					19	5.5	
					35	4.6	
					48	4.7	
					70	grain 1.6	
					70	straw 8.6	
1980	720 SL	1	1.4	0.24	0	green 12	80/10244
					32	2.5	
					82	grain 0.86	
					91	1.2	
					82	straw 9.9	
					91	3.0	
		1	1.4	0.24	0	green 6.3	80/10245
					21	0.69	
					30	1.1	
					91	grain 0.09	
					91	straw 0.79	
					91	3.0	
		1	1.4	0.24	0	green 3.8	80/10246
					21	2.9	
					50	2.0	
					57	grain 0.51	
					57	straw 9.9	
		1	1.4	0.24	0	green 6.7	80/10247
					20	3.1	
					42	2.1	
					62	grain 0.9	
					62	straw 6.3	
		1	1.4	0.36	0	green 3.8	80/10248
					21	1.3	
					70	grain 1.7	
					73	1.2	
					70	straw 9.9	
					73	8.1	
1982	305 SL	1	0.61	0.15	0	green 4.6	82/10209

Country, Year	Application				PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form.	No.	kg ai/ha	kg ai/hl			
					21	1.6	
					35	2.2	
					43	stalk 5.2	
					48	4.5	
					43	ear 0.45	
					48	0.31	
					64	grain 0.27	
					64	straw 4.5	
		1	0.61	0.15	0	green 7.4	82/10210
					22	stalk 8.9	
					37	12	
					22	ear 0.82	
					37	1.5	
					43	grain 1.0	
					43	straw 5.2	
UK,	460 SL	1	1.7	0.66	51	grain 9.2	74/10199
1974						straw 25	
1976		1	1.7	0.66	34	grain 0.63	76/10159
					34	straw 0.48	
1977		1	1.7	0.66	27	green 4.7	77/10248
					58	1.6	
					94	grain 0.1	
					94	straw 3.3	
1985	645 SL	2	1.3 + 0.6		1	green 17,18,	87/10366
						19	
	+				64	grain 4.2,	
	305 SL					4.4, 4.9	
					64	straw 36,	
						39, 40	
		2	1.3 + 0.5		1	green 24,25,	87/10366
						27	
					88	grain 3.1,	
						3.2, 3.7	
					88	straw 8.6,	
						9.2, 15	

* green plant

Rye. Chlormequat is used for stem consolidation in rye. Four trials on summer rye were carried out in Germany with 1.1 kg ai/ha (Table 12). The Meeting received details of 28 residue trials on winter rye from Denmark, Germany, Sweden and the UK at rates of 0.46 to 3.9 kg ai/ha. Generally the crops had one treatment in the spring, but in three trials in the UK plants were treated twice in spring at an interval of three to five weeks. The data are summarized in Table 13.

Table 12. Residues of chlormequat in summer rye (Germany, 1977), calculated as chlormequat chloride. All trials single applications of 370 SL at 1.1. kg ai/ha (0.18 kg ai/hl).

PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
0	green* 14	77/10249
19	12	
29	0.50	
48	0.10	
70	grain 0.06	
70	straw 0.30	
0	green 24	77/10250
17	13	
38	8.8	
69	grain 2.1	
46	straw 18	
59	<0.10	
69	0.20	
0	green 11	77/10251
21	12	
42	5.6	
63	grain 2.6	
63	straw 9	
0	green 13	77/10252
22	9.7	
43	11	
64	9.4	
92	grain 1.5	
85	straw 3.1	
92	4.7	

* green plant

Table 13. Residues of chlormequat in winter rye, calculated as chlormequat chloride.

Country, Year	Application				PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form., SL	No.	kg ai/ha	kg ai/hl			
Denmark,	305	1	0.46	0.11	32	green* 1.3	83/10208
1983					63	0.96	
					92 92	grain <0.05 straw 1.3	
		1	0.46	0.11	32	green 1.2	83/10209

Country, Year	Application				PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form., SL	No.	kg ai/ha	kg ai/hl			
					95	grain 0.06	
					95	straw 1.5	
Germany,	460	1	1.4	0.34	0	green 468	74/10195
1974					55	20	
					83	9.7	
					122	grain 0.24	
					122	straw 4.8	
		1	1.4	0.34	0	green 193	74/10194
					27	18	
					53	9	
					81	4.4	
					123	grain 0.22	
					123	straw 2.8	
		1	1.4	0.34	0	green 264	74/10196
					28	9.0	
					57	3.0	
					84	1.0	
					117	grain 0.3	
					117	straw 3.1	
1975	460	1	1.4	0.23	0	green 25	75/10188
					29	2.1	
					56	1.5	
					84	1.3	
					99	grain 0.3	
					99	straw 4.3	
		1	1.4	0.23	0	green 52	75/10187
					28	2.2	
					58	1.1	
					83	1.4	
					98	1.3	
					105	grain 0.34	
					105	straw 2.2	
		1	1.4	0.23	0	green 13	75/10189
					28	4.1	
					56	1.2	
					85 92	3.5 grain 0.33	
					92	straw 5.7	

Country, Year	Application				PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form., SL	No.	kg ai/ha	kg ai/hl			
		1	1.4	0.23	0	green 39	75/10190
					28	1.9	
					56	0.73	
					85	2.3	
					92	grain <0.05	
					92	straw 2.7	
	340	1	1.4	0.23	0	green 26	75/10197
					28	4.9	
					56	3.4	
					84	1.5	
					96	grain 0.62	
					93	straw 6.9	
					96	5.2	
		1	1.4	0.23	0	green 19	75/10198
					28	5.9	
					56	0.13	
					85	grain 1.23	
					84	straw 6.6	
					85	9.6	
1976	340	1	1.4	0.23	3	green 24	76/10152
					32	4.3	
					59	1.2	
					66	grain <u>0.26</u>	
					84	0.36	
					91	0.45	
					66	straw <u>2.9</u>	
					91	4.5	
		1	1.4	0.23	0	green 3.1	76/10153
					28	28	
					52	12	
					58	0.92	
					77	grain 1.9	
					77	straw 16	
					85	9.6	
		1	1.4	0.23	0	green 24	76/10154
					29	17	
					56	grain <u>2.0</u>	

Country, Year	Application				PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form., SL	No.	kg ai/ha	kg ai/hl			
					67	1.4	
					56	straw 18	
					67	12	
1982	305	1	0.61	0.15	0	green 7.3	82/10203
					21	3.6	
					35	2.9	
					42	2.8	
					49	1.8	
					75	grain 0.43	
					75	straw 5.5	
		1	0.61	0.15	0	green 8.4	82/10204
					20	4.2	
					34	grain 1.8	
					41	1.1	
					48	1.1	
					34	straw 7.5	
					41	4.5	
					48	2.8	
Sweden,	460	1	1.4	0.51	104	straw 7.2	81/10185
1981							
1982	305	1	0.46	0.17	77	grain 0.09	82/10193
		1	0.61	0.23	85	grain <0.05	82/10192
1983	305	1	0.61	0.31	80	grain 0.09	83/10191
		1	0.61	0.31	77	grain 0.07	83/10197
		1	0.61	0.23	86	grain 0.08	83/10193
		1	0.61	0.23	97	grain 0.05	83/10194
UK,	460	1	1.6	0.64	92	grain 0.88	76/10149
1976					92	straw 12	
		1	1.6	0.72	113	grain 0.45	76/10150
					113	straw 0.48	
		1	3.9	1.74	99	grain 0.23	76/10151
					99	straw 0.12	
		1	1.2	0.46	69	grain 1.2	76/10148
					69	straw 12	
1985	645 + 305	2	1.6+0.45		9	green 5.8	87/10366
					96	grain 2.2	
					96	straw <0.05	
	645 + 305	2	1.6+0.6		1	green 4.5	87/10366

Country, Year	Application				PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form., SL	No.	kg ai/ha	kg ai/hl			
					112	grain 0.52	
					112	straw 11	
1987	645 + 305	2	1.9+1.6		0	green 20	87/10377
					137	grain 0.18	
					137	straw 1.8	

* green: green plant

Wheat. The Meeting received data from 38 German trials on summer wheat. Only two of them were according to German GAP for summer wheat, but some of the others conformed to GAP for winter wheat and could be used for evaluation (Table 14). Most of the 17 residue trials from Germany on winter wheat were not according to GAP, because the PHI was longer than 63 days. Thirteen trials according to GAP were available from the UK. The trials in Denmark (3), France (3) and Sweden (4) could be evaluated on the basis of GAP in other European countries (Table 15).

Table 14. Residues of chlormequat in summer wheat in Germany, calculated as chlormequat chloride.

Year	Application				PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form., SL	No.	kg ai/ha	kg ai/hl			
1979	460	2	1.2+0.46		0	green* 6.4	79/10193
					20	3.6	
					36	4.5	
					55	4.3	
					86	grain 0.28	
					86	straw 12	
		2	1.2+0.46		0	green 9.1	79/10199
					21	4.1	
					42	2.2	
					63	3.9	
					71	grain 1.0	
					71	straw 9.6	
		2	1.2+0.46		0	green 14	79/10191
					21	11	
					35	6.1	
					48	6.4	
					62	grain 1.2	
					70	1.3	
					62	straw 0.3	
					70	16	
		2	1.2+0.46		0	green 9.6	79/10195
					21	1.1	

Year	Application				PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form., SL	No.	kg ai/ha	kg ai/hl			
					42	1.4	
					63	0.32	
					70	grain 0.42	
					77	0.34	
					70	straw 3.1	
					77	4.1	
		2	1.2+0.46		0	green 16	79/10197
					20	8.3	
					41	4.7	
					61	6.6	
					70	grain 1.9	
					70	straw 13	
		1	1.4	0.23	0	green 15	79/10190
					21	10	
					35	8.9	
					48	5.0	
					62	grain <u>1.3</u>	
					70	1.3	
					62	straw <u>29</u>	
					70	9.4	
		1	1.4	0.23	0	green 6.1	79/10192
					20	3.9	
					36	5.4	
					55	3.3	
					86	grain 0.32	
					86	straw 13	
		1	1.4	0.23	0	green 16	79/10194
					21	0.18	
					42	1.6	
					63	1.2	
					70	grain 0.34	
					77	0.59	
					70	straw 10	
					77	4.4	
		1	1.4	0.34	0	green 7.5	79/10198
					21 42	7.3 5.3	
					63	6.7	
					71	grain 1.2	
					71	straw 17	
		2	1.4	0.34	0	green 23	79/10196

Year	Application				PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form., SL	No.	kg ai/ha	kg ai/hl			
					20	10	
					41	8.2	
					61	7.7	
					77	grain 2.5	
					77	straw 23	
	720	1	1.4	0.24	0	green 11	79/10200
					21	6.7	
					35	4.0	
					48	8.2	
					62	grain <u>1.1</u>	
					70	1.5	
					62	straw <u>21</u>	
					70	13	
		1	1.4	0.24	0	green 11	79/10202
					20	5.5	
					36	3.2	
					55	5.3	
					86	grain 0.09	
					86	straw 17	
		1	1.4	0.24	0	green 9.7	79/10204
					21	1.3	
					42	1.7	
					63	1.1	
					70	grain 0.62	
					77	0.68	
					70	straw 13	
					77	1.6	
		1	1.4	0.36	0	green 8.9	79/10208
					21	9.8	
					42	5.1	
					63	6.5	
					71 71	grain 1.3 straw 18	
		2	1.4	0.36	0	green 28	79/10206
					20	8.8	
					41	8.0	
					61	8.5	
					77	grain 2.3	
					77	straw 21	
		2	1.2+0.43		0	green 6.7	79/10201
					21	7.5	

Year	Application				PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form., SL	No.	kg ai/ha	kg ai/hl			
					35	5.0	
					48	7.0	
					62	grain 1.2	
					70	1.2	
					62	straw 22	
					70	6.8	
		2	1.2+0.43		0	green 9.6	79/10203
					20	4.4	
					36	4.0	
					55	2.8	
					86	grain 0.37	
					86	straw 14	
		2	1.2+0.43		0	green 2.6	79/10205
					21	1.7	
					42	0.98	
					63	0.98	
					70	grain 0.36	
					77	0.26	
					70	straw 4.0	
					77	2.1	
		2	1.2+0.43		0	green 26	79/10207
					20	4.2	
					41	4.0	
					61	4.8	
					77	grain 1.3	
					77	straw 8.6	
		2	1.2+0.43		0	green 7.2	79/10209
					21	3.5	
					42	1.7	
					63	2.9	
					71 71	grain 0.89 straw 8.8	
1980	460	1	1.6	0.27	0	green 1.2	80/10220
					22	6.0	
					43	7.8	
					64	0.31	
					64	grain 0.31	
					71	0.31	
					85	0.31	
					64	straw 15	
					71	16	

Year	Application				PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form., SL	No.	kg ai/ha	kg ai/hl			
					85	18	
		1	1.6	0.27	0	green 1.4	80/10222
					21	0.95	
					57	0.54	
					71	grain 0.52	
					71	straw 14	
		1	1.6	0.27	0	green 9	80/10224
					20	1.6	
					42	0.85	
					74	grain 0.41	
					92	0.40	
					74	straw 5.2	
					92	7	
		1	1.6	0.40	0	green 10	80/10226
					21	2.9	
					83	grain 0.25	
					87	0.33	
					83	straw 7	
					87	4.6	
		1	1.6	0.40	0	green 8.2	80/10228
					21	4.2	
					83	grain 0.30	
					87	0.48	
					83	straw 15	
					87	13	
		2	1.2+0.46		0	green 7.6	80/10229
					21 83	1.7 grain 0.2	
					87	0.3	
					83	straw 3.9	
					87	3.5	
		2	1.2+0.46		0	green 5	80/10221
					22	0.34	
					43	0.23	
					64	grain 0.64	
					71	0.20	
					85	0.19	
					64	straw 1.5	
					71	1.5	
					85	9.6	
		2	1.2+0.46		0	green 0.66	80/10223

Year	Application				PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form., SL	No.	kg ai/ha	kg ai/hl			
					21	0.35	
					57	<0.10	
					71	grain 0.43	
					71	straw 4.5	
		2	1.2+0.46		0	green 9.2	80/10225
					20	1.7	
					42	0.75	
					74	grain 0.45	
					92	0.45	
					74	straw 3.0	
					92	3.6	
		2	1.2+0.46		0	green 9.9	80/10227
					21	0.82	
					83	grain 0.17	
					87	0.25	
					83	straw 2.4	
					87	2.2	
	720	1	1.7	0.29	0	green 7.3	80/10239
					22	8.5	
					43	6.3	
					64	grain <u>0.31</u>	
					71	0.33	
					85	0.39	
					64	straw <u>20</u>	
					71	13	
					85	18	
		1	1.7	0.29	0	green 9.7	80/10240
					20	3.6	
					42	1.1	
					74	grain 0.56	
					92	0.59	
					74	straw 11	
					92	7.3	
		1	1.7	0.43	0	green 12	80/10241
					21	3.6	
					83	grain 0.44	
					87	0.39	
					83	straw 5.8	
					87	4.5	
		1	1.7	0.43	0	green 7.5	80/10243
					21	6.6	

Year	Application				PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form., SL	No.	kg ai/ha	kg ai/hl			
					83	grain 0.42	
					87	0.44	
					83	straw 6.0	
					87	12	
		2	1.2+0.58		0	green 9.2	80/10242
					21	2.4	
					83	grain 0.21	
					87	0.2	
					83	straw 4.0	
					87	2.6	
		2	1.2+0.58		0	green 7.7	
					21	2.6	
					83	grain 0.4	
					87	0.42	
					83	straw 15	
					87	4.3	
1982	305	1	0.61	0.15	0	green 8.3	82/10201
					21	3.2	
					35	2.4	
					42	1.7	
					48	grain 0.81	
					69	0.77	
					48	straw 6.2	
					69	4.3	
		1	0.61	0.15	0	green 12	82/10202
					20	8.2	
					34	grain 1.5	
					42	1.4	
					34	straw 13	
					42	12	

* green plant

Table 15. Residues of chlormequat in winter wheat, calculated as chlormequat chloride.

Country, Year	Application				PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form., SL	No.	kg ai/ha	kg ai/hl			
Denmark,	305	1	0.46	0.12	61	grain 0.15	82/10211
1982					86	0.1	
					61	straw 4.9	
					86	4.8	

Country, Year	Application				PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form., SL	No.	kg ai/ha	kg ai/hl			
		1	0.46	0.12	62	grain 0.21	82/10212
					86	0.20	
					62	straw 4.8	
					86	7.9	
		1	0.61	0.15	47	ear <0.1	82/10214
					47	stalk 0.11	
					99	grain 0.15	
					99	straw 1.5	
France,	305	1	0.61	0.1	96	grain <0.05	83/10197
1983					96	straw 2.3	
		1	0.61	0.1	82	grain <0.05	83/10198
					82	straw 4.8	
		1	0.61	0.1	84	grain <0.05	83/10199
					84	2.6	
Germany	460	1	1.2		0	green* 423	73/10126
1973					28	3.7	
					56	1.6	
					84	0.73	
					106	grain 0.07	
					106	straw 0.29	
		1	1.2		0	green 503	73/10127
					29	40	
					56	2.2	
					84	0.8	
					119	grain 0.09	
					119	straw 1.6	
		1	1.2		0	green 304	73/10128
					58	1.6	
					84	0.6	
					99	grain 0.16	
					99	straw 0.68	
1980	460	1	1.6	0.4	94	grain 0.15	80/10230
					98	0.17	
					94	straw 6.1	
					96	6.0	
		1	1.6	0.4	94	grain 0.28	80/10232
					98	0.17	
					94	straw 3.8	
					96	5.1	
		1	1.6	0.4	94	grain 0.34	80/10234
					98	0.29	

Country, Year	Application				PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form., SL	No.	kg ai/ha	kg ai/hl			
					94	straw 2.8	
					98	3.9	
		2	0.92+0.46		94	grain 0.14	80/10231
					98	0.14	
					94	straw 3.1	
					98	4.1	
		2	0.92+0.46		94	grain 0.14	80/10233
					98	0.11	
					94	straw 3.6	
					98	3.6	
		2	0.92+0.46		94	grain 0.29	80/10235
					98	0.22	
					94	straw 2.5	
					98	3.2	
	720	1	1.7	0.43	94	grain 0.22	80/10249
					98	0.23	
					94	straw 7.4	
					98	8.0	
		1	1.7	0.43	94	grain 0.25	80/10251
					98	0.31	
					94	straw 5.7	
					98	6.6	
		1	1.7	0.43	94	grain 0.33	80/10253
					98	0.37	
					94	straw 4.4	
					98	4.8	
		2	1.2+0.58		94	grain 0.22	80/10250
					98	0.13	
					94	straw 2.6	
					98	4.2	
		2	1.2+0.58		94	grain 0.13	80/10252
					98	0.25	
					94	straw 4.2	
					98	4.3	
		2	1.2+0.58		94	grain 0.32	80/10254
					98	0.2	
					94	straw 2.7	
					98	4.2	
1982	305	1	0.76	0.19	0	green* 10	82/10199
					21	4.4	
					35	2.0	

Country, Year	Application				PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form., SL	No.	kg ai/ha	kg ai/hl			
					42	ear 0.29	
					49	0.84	
					42	stalk 2.9	
					49	4.0	
					56	grain 0.28	
					56	straw 7.2	
		1	0.76	0.19	0	green 8.8	82/10200
					21	3.3	
					35	ear 2.7	
					35	stalk 8.3	
					42	grain 0.62	
					49	0.53	
					42	straw 15	
					49	15	
Sweden, 1982	305	1	0.61	0.23	73	grain 0.26	82/10194
1984		1	0.3	0.11	86	grain 0.14	84/10234
		1	0.3	0.11	97	grain 0.19	84/10235
		1	0.3	0.11	109	grain 0.21	84/10233
UK, 1976	460	1	1.6	0.64	93	grain 0.05	76/10147
					93	straw 5.4	
1977		1	1.6	0.64	51	grain 1.4	77/10247
					131	0.3	
					131	straw 0.5	
1984	645	2	1.1+1.3		129 129	grain <0.05 straw 1.5	84/10229
		2	1.3+1.6		129	grain <0.05	84/10227
					129	straw 2.6	
		2	1.3+1.6		129	grain <0.05	84/10228
					129	straw 0.12	
		2	1.3+1.6		129	grain <0.05	84/10230
					129	straw 1.0	
1985	645	2	1.6+0.46		3	green 6.5	87/10366
	+ 305				86	grain 0.35	
					86	straw 17	
		2	1.6+0.46		4	green 3.0	87/10366
					83	grain 0.14	
					83	straw 12	
		2	1.6+0.46		1	green 9	87/10366
					72	grain 1.2	
					72	straw 20	
		2	1.6+0.6		1	green 12	87/10366

Country, Year	Application				PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form., SL	No.	kg ai/ha	kg ai/hl			
					101	grain 0.45	
					101	straw 16	
1987	645	2	1.9+1.3		0	green 11	87/10374
					134	grain 0.07	
					134	straw 2.9	
		2	1.9+1.3		0	green 11	87/10375
					134	grain 0.11	
					134	straw 3.3	
		2	1.9+1.3		0	green 14	87/10376
					134	grain 0.07	
					134	straw 3	

* green plant

Cotton seed. Chlormequat is registered as a growth regulator for cotton in Argentina, Australia and India, but residue data were available only from India (Table 16).

Table 16. Residues of chlormequat in cotton in India, calculated as chlormequat chloride. All single applications of 500 SL.

Year	Application		PHI, days	Residues, mg/kg	BASF Reg. Doc. No., BASF No.
	kg ai/ha	kg ai/hl			
1979	0.063	0.016	123	boll 1 (3)	79/10212
	0.063	0.016	154	boll <0.05, 0.08, 0.17	79/10212
	0.063 0.088	0.016 0.022	154 123	plant 0.09, 0.08 (2) boll 0.8, 0.93, 1.0	79/10213 79/10210
	0.088	0.022	154	boll 0.1 0.2, 0.3	79/10210
	0.088	0.022	154	plant 0.08, <0.05 (2)	79/10211
1980	0.063	0.016	68	seed 0.35, 0.41, 0.52	81/10186
	0.063	0.016	83	seed 0.33, 0.4, 0.44	81/10188
	0.063	0.016	83	plant 0.12, 0.63, 0.7	81/10190
	0.088	0.022	68	seed 0.35, 0.44 (2)	81/10187
	0.088	0.022	83	seed 0.34, 0.37, 0.42	81/10189
	0.088	0.022	83	plant 0.63, 0.77, 0.88	81/10191

Rape seed. The use of chlormequat on rape is registered in Belgium and the UK. The Meeting received residue data from Germany and the UK (Table 17).

Table 17. Residues of chlormequat in rape, calculated as chlormequat chloride. All single applications.

Country, Year	Application			PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form., SL	kg ai/ha	kg ai/hl			
Spring rape						
UK, 1983	645	3.9	1.9	79	seed 4.6	83/10188
				79	straw 6.6	
Winter rape						
Germany	305	0.92	0.23	0	green* 4.2	85/10313
1985				14	1.4	
				75	seed 2.3	
		0.92	0.23	0	green 2.1	85/10314
				14	6.1	
				70	seed 1.4	
				87	4.3	
		0.92	0.23	0	green 6.0	85/10315
				15	4.8	
				88	seed 2.2	
		0.92	0.23	0	green 4.1	85/10316
				14	1.8	
				77	seed 2.6	
		0.92	0.23	0	green 8.9	85/10317
				14	6.5	
				77	seed 5.8	
1986		0.92	0.23	0	green 8.3	86/10378
				14	1.7	
				80	seed 2.9	
		0.92	0.31	0 15	green 15 1.4	86/10379
				86	seed 2.1	
		0.92	0.46	0	green 2.7	86/10380
				14	0.96	
				90	seed 1.7	
		0.92	0.23	0	green 9.9	86/10381
				14	3.0	
				77	seed 2.7	
UK, 1983	645	1.9	0.48	93	seed 3.7	83/10190
		3.9	1.6	99	seed 3.1	83/10187
				99	straw 2.9	
		3.9	1.9	97	seed 3.6	83/10189
1984		3.9	1.5	116	seed 1.1	84/10221
		3.9	1.5	98	seed 1.2	84/10222
		3.9	1.5	114	seed 0.91	84/10223
		3.9	1.5	100	seed 1.4	84/10224

Country, Year	Application			PHI, days	Residues, mg/kg	BASF Reg. Doc. No.
	Form., SL	kg ai/ha	kg ai/hl			
		3.9	1.5	107	seed 1.8	84/10225
1985		1.9	0.97	143	seed 4.4	85/10306

* green plant

Animal transfer studies

Cows. Twelve lactating Friesian dairy cows were divided into three groups of four animals and dosed with 9, 30 or 50 mg ai/cow/day for 14 days. The two lower levels were equivalent to the amounts that would be ingested by a cow consuming daily 3 kg oats containing 3 mg/kg chlormequat chloride or 2 kg cereal straw containing 15 mg/kg chlormequat chloride, respectively. Sampling of milk, urine and faeces was continued for 14 days after the last dose. In milk the average residue calculated as chlormequat chloride in the high-dose group rose from 0.034 mg/kg on day 3 to maxima of 0.068 and 0.051 mg/kg on days 5 and 7 respectively and 0.03 mg/kg on days 9, 11 and 13. The residues on all other days were less than 0.03 mg/kg. Residues in urine (0.32 mg/kg) and faeces (0.42 mg/kg) were determined on day 10 after administration. The limit of detection was reported in the study (Burrows *et al*., 1972) as 0.03 mg/kg, but the validation of the residue analytical method (Burrows *et al.*, 1972; Sword *et al*., 1973) showed limits of detection of 0.1 mg/kg in milk, 1 mg/kg in faeces and 2 mg/kg in urine. It must be concluded that the sensitivity of the colorimetric analytical method used did not suffice to determine residues at this low level.

FATE OF RESIDUES IN STORAGE AND PROCESSING

In storage

No data were received.

In processing

Barley. A processing study was carried out on barley treated once with 0.61 kg ai/ha (305 SL) in Germany in 1984. Grain samples were taken 44 days after treatment. Figure 2 shows the processing steps and Table 18 the results.

Figure 2. Processing of barley.

grain

glume

malt

malt sprouts

beer

pearl

meal

Oats. Two processing studies carried out on oats were provided from Germany. Oats were treated with 1.4 kg ai/ha and harvested 40 days after application. Figure 3 shows the processing steps and Table 19 the residue data.

Figure 3. Processing of oats.

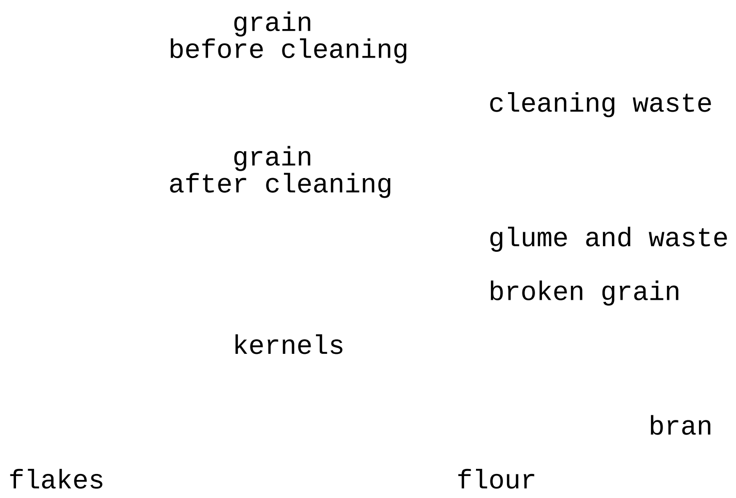

Table 18. Residues of chlormequat in processed products of barley, calculated as chlormequat chloride (BASF Reg. Doc. 84/10236).

Commodity	% of original wt. in fraction	Residue, mg/kg
grain	100	1.3
pearl	52	0.08
meal	17	1.5
glume	31	3.4
malt		0.9
malt sprouts		0.35
beer		0.02

Table 19. Residues of chlormequat in processed products of oats (Germany, 1984), calculated as chlormequat chloride.

Commodity	% of original[1,2]	Residues, mg/kg	BASF Reg. Doc. No.
Grain before cleaning		2.1	84/10218
Cleaning waste		5.2	
Grain after cleaning	100	2	
Glume and waste*	28.4[1]	0.69	
Kernels*	66.4[1]	0.24	
Broken grain*	5.2[1]	0.26	
Flakes**	66.4[1]	0.2	
Flour***	70.7[2]	<0.05	
Bran***	29.3[2]	0.27	
Grain before cleaning		1.6	84/10219
Cleaning waste		2.7	
Grain after cleaning	100	0.77	
Glume and waste*	29.4[1]	0.49	
Kernels*	60.9[1]	0.2	
Broken grain*	9.7[1]	0.14	
Flakes**	60.9[1]	0.19	
Flour***	76.3[2]	<0.05	

Commodity	% of original[1,2]	Residues, mg/kg	BASF Reg. Doc. No.
Bran***	23.7[2]	0.27	

[1] Wt. of fraction as % of wt. of cleaned grain * From cleaned raw oats
[2] Wt. of fraction as % of wt. of kernels ** After hydrothermal treatment of kernels
*** Produced from kernels of cleaned raw oats

Winter rye. A processing study was carried out on winter rye treated once with 1.4 kg ai/ha (305 SL) in Germany in 1984. Grain samples were taken 78 days after treatment (PHI for stalk and ear 69 days). Figure 4 shows the processing steps. The results are summarized in Table 20.

Figure 4. Processing of winter rye.

grain
before cleaning

cleaning waste

grain
after cleaning

bran

middlings

wholemeal

flour

wholemeal bread

bread

Table 20. Residues of chlormequat in processed products of winter rye, calculated as chlormequat chloride (BASF Reg. Doc. 84/10220).

Commodity	Wt. of fraction as % of wt. of cleaned grain	Residue, mg/kg
Stalk		12
Ear		2.5
Grain		0.73
Cleaning waste		1.2
Grain after cleaning	100	0.9
Bran	15.4	2.9
Middlings	4.6	2.6
Flour	80	0.89
Bread		0.13
Wholemeal	100	1.2
Wholemeal bread		0.86

Winter wheat. A processing study was carried out on winter wheat treated once with 1.5 kg ai/ha in Germany in 1984. Grain samples were taken 63 days after treatment. Figure 5 shows the processing steps. The results are summarized in Table 21.

Figure 5. Processing of winter wheat.

grain
before cleaning

cleaning waste

grain
after cleaning

bran, outside

bran, inside

wholemeal flour

wholemeal bread bread

Table 21. Residues of chlormequat in processed products of winter wheat, calculated as chlormequat chloride (BASF Reg. Doc. 06210W84/4E)

Commodity	Wt. of fraction as % of wt. of cleaned grain	Residue, mg/kg
Grain before cleaning		0.72
Cleaning waste		0.8
Grain after cleaning	100	0.39
Bran, outside	15.3	1.7
Bran, inside	5.3	1.9
Flour	72.7	0.16
Bread		0.07
Wholemeal	100	0.54
Wholemeal bread		0.31

Rape. Three processing studies on rape in 1985 were provided, one by Germany and two by the UK. Rape was treated with 0.92 kg ai/ha (305 SL) in the German trial and with 1.9 kg ai/ha (645 SL) in the British trials. The results are summarized in Table 22. The processing procedure was as follows.

The 0.5 kg sample of rape seed was ground in a Retsch mill with a 1 mm sieve, then heated for 15 min to 80°C, cooled to 60°C, mixed with 1 l of hot hexane (60°C) and stirred for 5 min. The mixture was filtered and the seed extracted twice more with 1 l hexane at 60°C and washed with 0.5 l of hexane.The combined hexane solutions were evaporated at 70°C and 50 mbar, and the extracted grain dried for 30 min at 8-10 mbar.

The dried grain was ground a second time in the same mill and the extraction repeated twice. All hexane fractions were combined. The extracted bruised grain was dried in the air to 0.03 to 0.05% moisture, the water content was determined and water added to 20% moisture. The moist grain was conditioned for 24 hours in a sealed container, with several agitations. If the material agglomerated it was passed through a 2 mm sieve.

To simulate the toasting during commercial practice the bruised grain was heated for 8 min at 112°C and 1.5 mbar in an autoclave, then dried for 12 h at 30°.

Table 22. Residues of chlormequat in processed products of rape, calculated as chlormequat chloride.

Country, year, commodity	PHI, days	Residue, mg/kg	BASF Reg. Doc.
Germany, 1985			85/10318
Green plant	0	1.3	
	14	1.1	
Seed	63	3.0	
Oil	63	<0.05	
Coarse meal	63	3.4	
UK, 1985			85/10307
Green plant	12	39	
Seed	117	4.7	
Oil	117	<0.1	
Coarse meal	117	7.3	
UK, 1985			85/10308

Country, year, commodity	PHI, days	Residue, mg/kg	BASF Reg. Doc.
Green plant	7	<0.5	
Seed	115	6.4	
Oil	115	<0. 1	
Coarse meal	115	5.6	

Residues in the edible portion of food commodities

Milling studies on wheat and rye showed the same residue level in unprocessed grain, wholemeal, and wholemeal bread, an accumulation in cereal brans (by factors of 2-4) and a reduction in wheat flour (by a factor of 0.2). Rye flour contained the same residue level as unprocessed rye grain (see Tables 20 and 21).

A processing (milling and brewing) study on barley showed a reduction of the residue in pearl (factor 0.06) and approximately the same level in the meal as in unprocessed grain. In brewing the residues in the beer were near the limit of determination (0.02 mg/kg, see Table 18).

Oats were processed to flakes, flour and bran (Table 19). The residue level in the flakes was 1/10 of that in the unprocessed grain. No residues were found in the flour. The residues in the bran were also smaller than in the unprocessed grain (factor 0.1-0.2).

Rape seed containing residues from 3 to 6.4 mg/kg was processed to crude oil. No residues were found in the oil (Table 22).

RESIDUES IN FOOD IN COMMERCE OR AT CONSUMPTION

No data were received.

NATIONAL MAXIMUM RESIDUE LIMITS

The following national MRLs were reported to the Meeting.

Country	Commodity	MRL, mg/kg
Australia	Grapes	0.75
	Raisins	0.75
	Wheat	5
Austria	Grapes	1
	Oats	5
	Rye	5
	Wheat	3
	Other food-/feedstuffs of plant origin	0.1
Belgium	Cereals	0.05
	Grapes	1
	Pear	3
	Other fruits	0.05
Brazil	Wheat	5
Canada	Wheat	1
Czechoslovakia	Rye	0.3
	Wheat	0.3
European Union	Grapes	1
	Pear	3
	Other food-/feedstuffs of plant origin	0.05
Finland	Cereals	5
	Grapes	1
	Pear	3
	Raisins	1
France	Cereals	2
	Grapes	1
	Pear	3
	Other fruits	0.05
Germany	Coffee (raw)	0.1
	Grapes	1
	Maize	5
	Pome fruits	3
	Oilseed (except rape)	0.1
	Rape seed	10
	Rape seed oil	0.5
	Rye bran	10
	Spices	0.1
	Tea and tea-like products	0.1

Country	Commodity	MRL, mg/kg
	Wheat bran	5
	Other cereals (grain except maize)	
	Other cereal products	3
	Other vegetable food	0.1
Hungary	Apricots, dried	1
	Banana, dried	1
	Coconut	1
	Figs, dried	1
	Grapes	1
	Oranges	1
	Pear	3
	Plums, dried	1
	Raisins	1
	Rye	5
Ireland	Grapes	1
	Pear	3
	Other food-/feedstuffs of plant origin	0.05
Israel	Barley Grapes	5 1
	Pear	3
	Oats	5
	Raisins	1
	Wheat	3
Italy	Cereals	1
	Grapes	1
	Pear	3
	Other food-/feedstuffs of plant origin	0.05
Luxembourg	Cereals	0.5
	Grapes	1
	Pear	3
	Vegetables	0.05
	Other fruits	0.05
The Netherlands	Fruits, dried	1
	Grapes	1
	Oats	10
	Pear	10
	Other cereals (except barley)	5
	Other food-/feedstuffs of plant origin	0.1
New Zealand	Oats	5
	Wheat	1
Spain	Almonds	0.05

Country	Commodity	MRL, mg/kg
	Apple	3
	Beets	0.05
	Citrus fruits	0.05
	Grapes	1
	Hops	0.05
	Legumes	0.05
	Olives	0.05
	Oats	3
	Pear	3
	Potato	0.05
	Quince	3
	Raisins	1
	Rye	3
	Sugar cane	0.05
	Spices	0.05
	Stone fruits	0.05
	Strawberry	0.05
	Tea and tea-like products	0.05
	Tobacco Wheat	0.05 1
	Other cereals (straw)	10
	Other food-/feedstuffs of plant origin	0.05
	Other fruits	0.05
	Other nuts	0.05
	Other vegetables	0.05
Sweden	Grapes	1
	Raisins	1
	Vegetables	3
	Other fruits	3
Switzerland	Oats	5
	Spelt	2
	Wheat	2

APPRAISAL

Chlormequat is a plant growth regulator used as a stalk stabilizer in cereals and for the inhibition of vegetative growth and promotion of flowering in fruits and vegetables. It was evaluated by the JMPR before 1976, re-evaluated for residues several times up to 1985 and proposed for re-evaluation under the periodic review programme at the 19th Session (1989) of the CCPR. The 1990 CCPR indicated that there appeared to be continued use, but there was no indication of the availability of data. Cancellation of the CXLs was proposed if no data were provided. The 1991 CCPR scheduled a review for the 1994 JMPR. The Meeting received data from information on GAP and data from supervised trials on pears, grapes, tomatoes, mushrooms, cereals, cotton and rape.

In metabolism studies on cows, goats and hens chlormequat was rapidly excreted unchanged, mainly in the urine (or excreta of the hens), and did not accumulate in milk, eggs or tissues.

The metabolism of chlormequat in barley and wheat differed according to the treatment (on roots or leaves) and the developmental stage of the plant. The literature reports that metabolic rates in cereals range from stable (only 2 to 10% metabolized) to 50% conversion into choline, betaine, glycine, serine and CO_2, and incorporation into proteins 7.5 days after application.

The degradation of chlormequat in soil by micro-organisms proceeds very rapidly: its half-life varies between <1 and 28 days. The compound is mineralised to CO_2; other degradation products could not be identified.

The analytical determination of chlormequat in plant material is difficult owing to the necessary separation of chlorocholine from native choline. If separation is not quantitative high blank values are found, which may lead to false positive results.

The extraction of chlormequat residues from plant or animal matrices is carried out with methanol or ethanol. The active ingredient is separated from native choline and other plant constituents by cation exchange or column chromatography on aluminium oxide and dichloromethane/water partition.

Former publications described photometric (dipicrylamine complex) or TLC (Dragendorff reagent) determination. The limit of determination for the semi-quantitative TLC method was reported to range from 0.1 mg/kg (cereal grain, green plants) to 0.3 mg/kg (cereal straw) with recoveries between 70 and 80%. In some cases these methods were not validated.

Gas-chromatographic determination is carried out after conversion to *N*,*N*-dimethyl-2-(phenylthio)ethylamine, with detection by a sulphur-specific flame-photometric detector. The limit of determination is 0.05 mg/kg for cereal green plants, grain and milk, and 0.2 mg/kg for straw.

HPLC determination has been carried out by ion-pair chromatography with conductivity detection. The limit of determination was 0.05 mg/kg for the green matter, grain and straw of wheat.

Chlormequat was stable in samples of wheat stored at -18°C for 32 weeks.

Processing studies on cereals and rape showed the same residue levels in unprocessed grain, wholemeal and wholemeal bread (winter rye, winter wheat), an accumulation in the cereal brans, and a reduction in winter wheat flour, oat flakes and rape seed oil.

Because the residues from supervised trials were calculated as chlormequat chloride in most cases the original values were expressed as chlormequat and evaluated as follows.

As the Meeting withdrew the ADI for chlormequat, all estimates of maximum residue levels are recorded as Guideline Levels, not recommended as MRLs.

Pears. Data from seven trials in Norway were made available to the Meeting, but the spray concentrations ranged from 0.44 to 0.5 kg ai/hl whereas GAP concentrations are 0.005-0.18 kg ai/hl. Of the ten Dutch supervised trials received, three trials (twelve values) were according to GAP (2 applications, 1.1-1.8 kg ai/ha) although the PHI, 101-124 days, was longer than the Dutch PHI of 90 days. The residues ranged from 3.5 to 8.1 mg/kg calculated as chlormequat cation. The Meeting estimated a maximum residue level of 10 mg/kg for pears to replace the previous estimate (3 mg/kg).

Grapes and dried grapes. The use of chlormequat on grapes and vines is registered in Australia, Italy, Peru and Spain. Only two German trials on grapes were available, and they were not according to GAP. The Meeting agreed to withdraw the previous estimates for grapes and dried grapes of 1 mg/kg.

Tomatoes. The use of chlormequat on tomatoes is registered in Argentina, Italy and Peru. The Meeting received data from data from six trials from the UK, but there is no GAP in the UK or a country with comparable conditions. A maximum residue level could not be estimated.

Mushrooms. Four supervised trials on oyster mushrooms cultivated on cereal straw were provided from Germany. In all cases the straw used came from commercial producers and contained residues from 0.8 to 5.3 mg/kg (calculated as chlormequat chloride). Eleven residue values in mushrooms determined 26-160 days after inoculation of mushroom spores ranged from 0.6 to 5.5 mg/kg, calculated as chlormequat chloride, or from 0.47 to 4.3 mg/kg if calculated as chlormequat cation. The data suggest that residues in straw and mushrooms are about the same. It was recognized that residues will occur in mushrooms grown on treated straw. In the absence of data on mushrooms grown on straw containing residues close to the highest level expected to occur in practice (20 mg/kg) the Meeting did not estimate a maximum residue level for mushrooms.

Barley. In most cases the PHI is the time between treatment and harvest; a PHI is specified only in Germany, where it is 42 days.

Three trials on summer barley from Denmark (1 treatment, 0.46-0.61 kg ai/ha), two from Germany (1 treatment, 0.61 kg ai/ha) and seven from Sweden (1 treatment, 0.46 kg ai/ha) approximated GAP in The Netherlands, Belgium and Germany. After PHIs of 34-111 days the residues (15 values) in grain ranged from <0.05 to 0.62 mg/kg chlormequat chloride, which corresponds to <0.05-0.48 mg/kg chlormequat cation. From the UK, three residue values from trials according to GAP ranged from 0.18 to 0.37 mg/kg as chlormequat chloride, or 0.14 to 0.29 mg/kg as chlormequat cation. Canada provided six summer barley trials with 24 residue values (0.3-1.5 mg/kg calculated as chlormequat cation), but Canada has no GAP for chlormequat.

The Meeting evaluated eleven supervised trials on winter barley from France and seven from the UK. The residues in grain ranged from <0.05 to 0.58 mg/kg as chlormequat chloride or from <0.05 to 0.45 mg/kg calculated as chlormequat cation. Four residue values from Sweden, three from Germany, two from Switzerland and one from Denmark, evaluated according to the GAP of Belgium, The Netherlands, the UK or France, showed similar residues of 0.05 to 0.42 mg/kg as the chloride, or <0.05 to 0.33 mg/kg as the cation.

The Meeting estimated a maximum residue level of 0.5 mg/kg for barley.

Maize. Chlormequat is authorized only in Belgium. There were nine supervised trials from Germany which did not correspond to Belgium GAP. A maximum residue level could not be estimated.

Oats. The use of chlormequat on oats is registered in many countries, with one to two treatments and application rates from 1 to 1.8 kg ai/ha. In most cases the PHI is determined by approved use as the time between treatment and harvest, but in Germany (only) the PHI is 42 days. The Meeting evaluated three values from trials according to GAP in the UK and 18 German trials with 24 residue values (1 treatment, 1.2-1.4 kg ai/ha, PHI 42-91 days) on the basis of the GAP of Belgium, The Netherlands and Luxembourg. The residues ranged from <0.05 to 9.2 mg/kg as chlormequat chloride, or from <0.05 to

7.1 mg/kg if calculated as chlormequat cation. The Meeting agreed to maintain the current estimate of 10 mg/kg as a GL for oats.

Rye. The Meeting received data from data on 30 trials on winter rye from Denmark, Germany, Sweden and the UK, but only two from Germany, one from Sweden and two from the UK reflected approximately the national GAP. Two values from Denmark could be evaluated on the basis of Swedish, and five from Sweden on the basis of British GAP. Three German trials on summer rye could also be used. The residues were <0.05 to 2.6 mg/kg as chlormequat chloride, or <0.05 to 2 mg/kg as chlormequat cation. The Meeting estimated a maximum residue level of 3 mg/kg for rye to replace the previous estimate (5 mg/kg).

Wheat. Numerous results were provided to the Meeting because the main use of chlormequat world-wide is for the stem stabilization of wheat. Of 38 German trials on summer wheat, two were in accordance with German GAP for summer wheat, but six reflected GAP for winter wheat and were evaluated. Although only two of the 17 residue trials from Germany on winter wheat were in accordance with German GAP, they could be evaluated on the basis of British GAP. Eleven residue values on winter wheat from trials according to GAP were available from the UK. The Meeting also evaluated three residue values from Denmark and three from France on the basis of Dutch GAP. The residues in grain ranged from <0.05 to 1.4 mg/kg calculated as chlormequat chloride, which corresponds to <0.05-1.1 mg/kg if calculated as chlormequat cation. The Meeting estimated a maximum residue level of 2 mg/kg for wheat to replace the previous estimate (5 mg/kg).

Cotton seed. Twelve residue values from four Indian trials were approximately in accordance with GAP (0.063-0.088 kg ai/ha) and ranged from 0.33 to 0.52 mg/kg as chlormequat chloride, or 0.26-0.4 mg/kg if calculated as chlormequat cation. The Meeting estimated a maximum residue level of 0.5 mg/kg for cotton seed.

Rape seed. The use of chlormequat on rape is registered in Belgium and the UK. The Meeting received data from residue data from Germany and the UK, but only two British trials reflected UK GAP. Nine German trials were approximately in line with Belgian GAP (0.69 kg ai/ha). In other German trials applications were 0.92 kg ai/ha, slightly higher than Belgium GAP but within the GAP of the UK (1.9 kg ai/ha). After evaluating the total of twelve values from 1.4 to 5.8 mg/kg as chlormequat chloride, or 1.1 to 4.5 mg/kg if calculated as chlormequat cation, the Meeting estimated a maximum residue level of 5 mg/kg for rape seed.

Rape seed oil, crude. Three processing studies carried out in Germany and the UK showed that, because chlormequat is ionic, the residues in the oil are below the limit of determination. The Meeting estimated a maximum residue level for rape seed oil, crude, of 0.1* mg/kg as being a practical limit of determination.

Food of animal origin

Milks and milk products. Twelve dairy cattle were divided into three groups and treated with 9, 30 or 50 mg ai/cow/day for 14 days (corresponding to 0.2 ppm, 0.6 ppm or 1 ppm in the daily feed that would be ingested by a cow consuming a total of 50 kg green feed per day). The maximum residue in the milk of the high-dose group was 0.068 mg/kg on day 3. As the residues in green feed may be much higher (the MRL recommended for rye forage and oat forage (green) is 20 mg/kg) and there were inconsistencies in the reported analytical method an MRL for milks could not be recommended. The Meeting agreed to withdraw the previous estimates of 0.1* mg/kg for the milk of cattle, goats and sheep, and for milk products.

Poultry. Although feeding studies on hens with radiolabelled active ingredient for ten days at 0.3 mg ai/bird/day (corresponding to 3 ppm in the daily feed) showed that the total ^{14}C residues observed in eggs, poultry meat and edible offal of poultry were <0.1 mg/kg, the Meeting did not recommend an MRL because a residue analytical method for unlabelled chlormequat in these commodities was not provided.

Animal feeds

The Meeting considered all available residue data for barley, oat, rye and wheat straw and fodder, and estimated individual maximum residue levels of 20 mg/kg to replace the previous estimates of 50 mg/kg.

Barley straw and fodder, dry. Residues in supervised trials in Europe in the straw of summer and winter barley ranged from 0.36 to 16 mg/kg as chlormequat chloride or 0.28 to 12 mg/kg as chlormequat cation.

Oat straw and fodder, dry. Thirty residue values on straw were received from Germany and the UK, which ranged from <0.1 to 25 mg/kg as chlormequat chloride or <0.1 to 19 mg/kg as chlormequat cation.

Rye straw and fodder, dry. The Meeting evaluated residue data on straw from Denmark (3 values), Germany (3 values for winter rye, 4 for summer rye), Sweden (1 value) and the UK (2 values) in the light of British, German and Swedish GAP. The residues ranged from <0.1 to 18 mg/kg as chlormequat chloride or from <0.1 to 14 mg/kg as chlormequat cation.

Wheat straw and fodder, dry. An evaluation of 55 values from Denmark, France, Germany and the UK showed that after 42-131 days the residues in straw ranged from 0.29 to 29 mg/kg as chlormequat chloride, which corresponds to 0.22 to 22 mg/kg (only one value >20 mg/kg) as chlormequat cation.

Oat and rye forage (green). Residue data (15 values) on whole green oat plants from German trials with PHIs of 19-23 days were 0.69-17 mg/kg as chlormequat chloride, or 0.53-13 mg/kg as chlormequat cation. Residues (15 values) in whole green rye plants from German trials with PHIs of 17-22 days (summer rye) and 27-32 days (winter rye) ranged from 1.9 to 28 mg/kg as chlormequat chloride, or from 1.5 to 22 mg/kg as chlormequat cation (only one value >20 mg/kg).

The Meeting considered all the available residue data and estimated individual maximum residue levels of 20 mg/kg for oat forage (green) and rye forage (green).

Processed foods and feeds of plant origin

Unprocessed rye and wheat bran. Processing studies on wheat and rye showed that the residues in brans are twice in wheat and four times in rye those in the raw grain. In view of the estimates for rye (3 mg/kg) and wheat (2 mg/kg), the Meeting estimated maximum residue levels of 10 mg/kg and 5 mg/kg for unprocessed rye and wheat bran respectively.

Rye flour and wholemeal. A processing study on winter rye showed the same residue level in grain, wholemeal and flour. In view of the maximum residue level estimated for rye (3 mg/kg), the Meeting estimated a maximum residue level of 3 mg/kg for rye wholemeal. Because the high residue level in rye flour could not be explained, the Meeting could not estimate a maximum residue level for rye flour.

Wheat flour. A processing study on winter wheat showed a 78% reduction of the residues from 0.72 mg/kg in grain to 0.16 mg/kg in flour. On the basis of the maximum residue level estimated for wheat (2 mg/kg), the Meeting estimated a maximum residue level of 0.5 mg/kg for wheat flour.

Wheat wholemeal. A processing study on winter wheat showed only a minor reduction of the residues from 0.72 mg/kg in grain to 0.54 mg/kg in wholemeal. The Meeting therefore estimated a maximum residue level of 2 mg/kg for wheat wholemeal, the same as that for wheat.

Wholemeal bread. Processing studies on winter wheat and rye showed a reduction of the residues from 0.72 mg/kg in wheat grain to 0.31 mg/kg in wholemeal bread, but no reduction in the case of rye (0.73 mg/kg in the grain, 0.86 mg/kg in wholemeal bread).

RECOMMENDATIONS

The Meeting estimated maximum residue levels for a number of commodities as shown below. As the Meeting withdrew the ADI for chlormequat these estimates are recorded as Guideline Levels only.

Definition of the residue: chlormequat cation

Commodity		Guideline Level, mg/kg	
CCN	Name	New GL	Previous MRL or GL
GC 0640	Barley	0.5	-
AS 0640	Barley straw and fodder, dry	20	50
SO 0691	Cotton seed	0.5	-
DF 0269	Dried grapes	W	1
FB 0269	Grapes	W	1
ML 0107	Milk of cattle, goats and sheep	W	0.1*
	Milk products	W	0.1*
GC 0647	Oats	10	10
AF 0647	Oat forage (green)	20	-
AS 0647	Oat straw and fodder, dry	20	50
FP 0230	Pear	10	3
SO 0495	Rape seed	5	-
OC 0495	Rape seed oil, crude	0.1*	-
GC 0650	Rye	3	5
CM 0650	Rye bran, unprocessed	10	-
AF 0650	Rye forage (green)	20	-
AS 0650	Rye straw and fodder, dry	20	50
CF 1251	Rye wholemeal	3	-
GC 0654	Wheat	2	5
CM 0654	Wheat bran, unprocessed	5	-
CF 1211	Wheat flour	0.5	-
AS 0654	Wheat straw and fodder, dry	20	50
CF 1212	Wheat wholemeal	2	-

FURTHER WORK OR INFORMATION

Desirable

1. New feeding studies on cows with determination of residues in milk, meat and edible offal of cattle.
2. New feeding studies on poultry with determination of residues in eggs, meat and edible offal of poultry.
3. Residue analytical method for meat, eggs and edible offal of poultry and cattle.
4. Processing studies on cotton seed for residue determination in cotton seed oil.
5. Investigations on mushrooms grown on straw with a residue level of 15 to 20 mg/kg.

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