MCPA (257)

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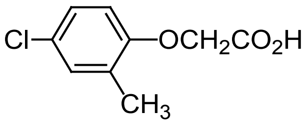
EXPLANATION

MCPA is an herbicide in the phenoxy or phenoxyacetic acid family that is used post-emergence for selective control of broadleaf weeds and works by concentrating in the actively growing regions of a plant (meristematic tissue) where it interferes with protein synthesis, cell division and the growth of the plant. MCPA is an acid, but it is usually formulated and applied as a salt, an amine salt or an ester. At the 43rd session of the CCPR (2011), it was scheduled for the evaluation as a new compound by 2012 JMPR. The Meeting received information on physical and chemical properties, metabolism, environmental fate, analytical methods and freezer storage stability, national registered use patterns, as well as supervised trials, processing studies and livestock feeding studies.

IDENTITY (Free acid)

ISO Common name	MCPA
Chemical name	
IUPAC name	4-chloro-o-tolyloxyaceic acid
CAS name	(4-chloro-2-methylphenoxy) acetic acid
CAS Registry Number	94-74-6
CIPAC Number	2
Synonyms and trade names	
Manufacturer's codes	
Structural formula	
Molecular formula	C9H9ClO3
Molecular weight	200.6 g/mol
Minimum content of ai	930 g/kg (FAO 1992)

PHYSICAL AND CHEMICAL PROPERTIES

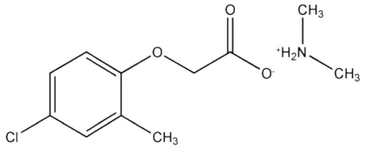
Pure active ingredient		*Ref*
Appearance (purity 99.9%)	Solid, white fine crystalline powder	Turk, 1994, MCPA-R002
Odour	weak intrinsic odour	
Vapour pressure (purity 99.4%):	4× 10^{-4}Pa at 32 ºC 4× 10^{-3}Pa at 45 ºC	Chakrabart,1985, MCPA-R009
Henry's law constant	5.5× 10^{-5}Pa.m^3/mol, calculated at 25 ºC	Downey, 1987, MCPA-R010
Boiling point (purity 99.9%)	Decomposition is observed at approximately 290 °C	Turk, 1994, MCPA-R002
Melting point (purity 99.9%)	120.0 to 120.8 ºC	Turk, 1994, MCPA-R002
Octanol-water partition coefficient at 25 ºC: (purity 99.4%)	log P_{ow} = 2.7–2.8 at pH 1 log P_{ow} = 0.28–0.59 at pH 5 log P_{ow} = -0.81–0.71 at pH 7 log P_{ow} = -1.07–0.88 at pH 9	Bailey and Hopkins, 1987, MCPA-R012
Solubility in water at 25 °C (purity 99.4%):	pH 1: 0.395 g/L unbuffered pH 5: 26.2 g/L buffered pH 7: 293 g/L buffered pH 9: 320 g/L buffered	Hopkins, 1987, MCPA-R011
Relative density (purity 99.9%)	1.41 g/cm³ at room temperature	Krohl, 1994, MCPA-R140
Dissociation constant in water (purity 99.8%)	pK_a = 3.73 at 20 ºC pK_a = 3.73 at 25 ºC	Redeker, 1988, MCPA-R013
Hydrolysis rate ^{14}C labelled MCPA, (radio-chemical purity 98.5%)	Radiolabelled MCPA acid does not degrade in aqueous solutions buffered at pH 5, 7 and 9.	Lai, 1993, MCPA-R031
Photochemical degradation ^{14}C labelled MCPA (radio-chemical purity 99.8%)	The half-life of radiolabelled MCPA acid was calculated to be 25.4 days in sterile buffer solution at pH 7 and 25 °C.	Concha, 1993, MCPA-R037
Surface tension, 20 ºC	61.7 mN/m (0.5% w/w in water) 61.4 mN/m (20% w/w in water)	Krohl, 1994, MCPA-R140

Pure active ingredient		*Ref*
Quantum yield efficiency (purity > 99.0%)	≤ 0.093	Klopffer, 1991, MCPA-R036

Technical material (purity 95.0%)

Melting point	115.4 to 116.8 ºC	Roberts, 1993, MCPA-R001
Solubility in organic solvents at 25 °C:	Acetone 487.8 g/L Dichloromethane 69.2 g/L Ethyl acetate 289.3 g/L n-Hexane 0.323 g/L Methanol 775.6 g/L n-Octanol 218.3 g/L Propanol 425.6 g/L Toluene 26.5 g/L	Roberts, 1993, MCPA-R001

IDENTITY (Dimethylamine salt)

ISO Common name	MCPA Dimethylamine salt (DMA salt)
Chemical name	
IUPAC name	–
CAS name	(4-chloro-2-methylphenoxyacetic acid) dimethylamine salt
CAS Registry Number	2039-46-5
CIPAC Number	2
Synonyms and trade names	
Manufacturer's codes	
Structural formula	
Molecular formula	$C_{11}H_{16}ClNO_3$
Molecular weight	245.7 g/mol
Minimum content of ai	920 g/kg (FAO 1992)

PHYSICAL AND CHEMICAL PROPERTIES

Preparation containing 504 g/L MCPA acid equivalent

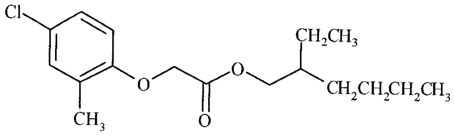
		Ref
Appearance	Yellow; Munsell colour description: Very pale brown 10YR 8/3	Bass, 2000, MCPA-R004
Colour		
Physical state	Liquid	
Odour	Amine-like odour	
pH undiluted material	9.2	
1% dilution	8.4	
Dilution stability at 20 ºC for 4 hr using CIPAC hard water D	Solution clear and free from precipitation	
5% dilution		
2% dilution		
0.5% dilution		
Relative density	1.128 g/cm³ at 20 ºC	
Water insolubles	No insoluble material	
Free phenol	1.2 g/L as 4-chloro-2-methyl phenol (PCOC)	
Viscosity	15.4 mPa	
Surface tension	0.0725 N/m	
Low temperature stability	No separated material after 48 hr at 0 ± 1 ºC or after reaching room temp.	
Persistent foaming	After 10 sec—no foam	
	After 15 min—no foam	

Preparation containing 746 g/L MCPA acid equivalent

		Ref
Appearance	Yellow; Munsell colour description: Very pale brown 10YR 8/2	Bass, 1999, MCPA-R005
Colour		
Physical state	Liquid	
Odour	Amine-like odour	

		Ref
pH undiluted material	9.5	
1% dilution	8.4	
Dilution stability at 20 ºC for 4 hr using CIPAC hard water D	Solution clear and free from precipitation	
5% dilution		
2% dilution		
0.5% dilution		
Dilution stability at 20 ºC for 4 hr using CIPAC hard water C 5% dilution	Solution clear and free from precipitate	
Relative density, 20 ºC	1.179	
Water insolubles	0 g/L	
Free phenol	4.2 g/L as 4-chloro-2-methyl phenol (PCOC)	Bass, 1999, MCPA-R005
Viscosity at 20 ºC	92.6 mPa	
Alkalinity	0.1% (as NaOH)	
Surface tension at 20 ºC	0.0712 N/m	
Low temperature stability	No separated material after 48 hr	
Persistent foaming at 20 ºC	4 mL after 10 sec 0 mL after 15 min	

IDENTITY (Ethylhexyl ester)

ISO Common name	MCPA 2-ethylhexyl ester (MCPA 2-EHE)
Chemical name	
IUPAC name	-
CAS name	2-ethylhexyl (4-chloro-2-methylphenoxy)acetate
CAS Registry Number	29450-45-1
CIPAC Number	2
Synonyms and trade names	
Manufacturer's codes	
Structural formula	
Molecular formula	$C_{17}H_{25}ClO_3$
Molecular weight	312.5 g/mol
Minimum content of ai	

PHYSICAL AND CHEMICAL PROPERTIES

Pure active ingredient (purity ≥ 99.1%)

		Ref
Appearance	Clear pale yellow; Munsell colour description: Very pale brown 10YR 8/2	Mahmood, 2004, MCPA-R003
Colour		
Physical state	Liquid	
Odour	Ester-like odour	
Relative density, 20 ± 1 ºC	1.074	
Partition coefficient	Log P_{ow} = 6.80	
Water solubility	pH 5= < 1.25×10^{-4} g/L pH 7= < 1.25×10^{-4} g/L pH 9= < 1.25×10^{-4} g/L	
Solubility in organic solvents at 25 °C:	Acetone > 1000 [a] g/L 1,2-Dichloroethane > 1000 g/L Ethyl acetate > 1000 g/L n-Heptane > 1000 g/L Methanol > 1000 g/L p-Xylene > 1000 g/L	
Flash point	138.0 ºC	
Viscosity at 20 ºC	30.8 mPa	
Surface tension at 20 ºC	0.0383 N/m	Mahmood, 2004, MCPA-R003
Rate constant, k, for the gas-phase reaction between MCPA 2-EHE and hydroxyl radicals	20.5053×10^{-12} cm^3/molecule/s	
Half-life for the degradation of MCPA 2-EHE by hydroxyl radicals in the troposphere	0.483 days (24-hour day)	

[a] indicates the compound is miscible with indicated solvent

FORMULATIONS

MCPA is available in the following formulations:

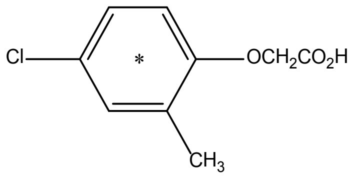
Formulation	MCPA acid equivalent
MCPA DMA salt	280 g ae/L SL, 300 g ae/L SL, 480 g ae/L SL, 500 g ae/L SL, 600 g ae/L SL, 750 g ae/L SL

Formulation	MCPA acid equivalent
MCPA 2-EHE	444 g ae/L EC, 480 g ae/L EC, 500 g ae/L EC, 600 g ae/L EC
MCPA sodium salt	300 g ae/L SL, 500 g ae/L SL, 600 g ae/L, 800 g ae/L SL
MCPA potassium salt	400 g ae/L SL

METABOLISM

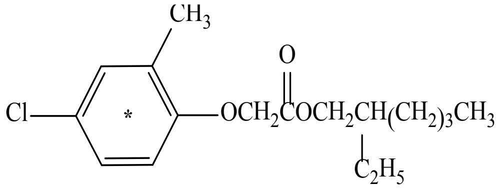
The Meeting received information on animal metabolism, plant metabolism and environmental fate studies using [^{14}C]-MCPA, [^{14}C]-MCPA 2-EHE, [^{14}C]-MCPA DMA, [^{14}C]-MCPB and [^{14}C]-CCPA radiolabelled in the ring.

[^{14}C]-MCPA:



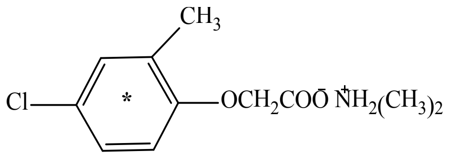
* = Position of ^{14}C-label

[^{14}C]-MCPA 2-EHE:



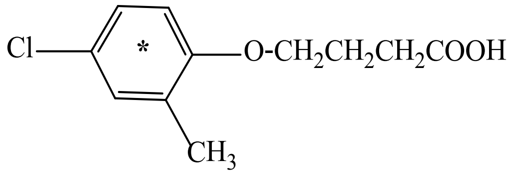
* = Position of ^{14}C-label

[^{14}C]-MCPA DMA:

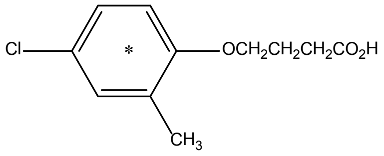


* = Position of ^{14}C-label

[^{14}C]-MCPB:

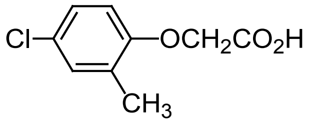


* = Position of ^{14}C-label

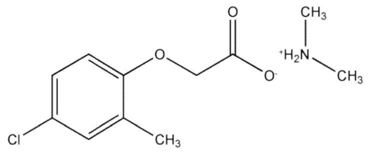


Structures, names and codes for MCPA and its metabolites in metabolism and environmental fate studies, and MCPB in a plant metabolism study are summarized below.

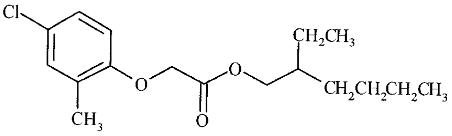
MCPA
(4-chloro-2-methylphenoxy) acetic acid



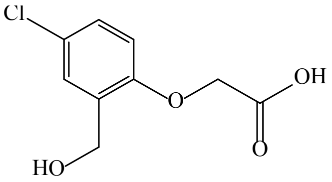
MCPA DMA
(4-chloro-2-methylphenoxyacetic acid) dimethylamine salt



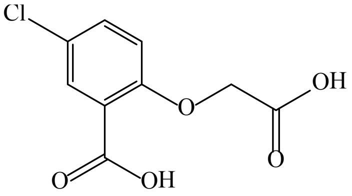
MCPA 2-EHE
2-ethylhexyl (4-chloro-2-methylphenoxy)acetate



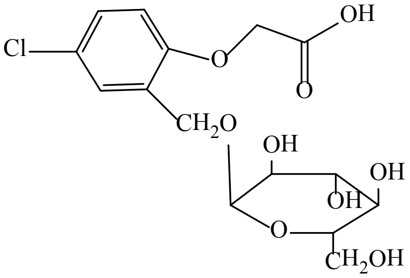
HMCPA or CHTA
2-hydroxy-4-chlorophenoxyacetic acid



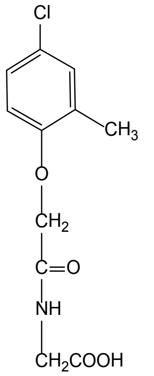
CCPA
2-carboxy-4-chlorophenoxyacetic acid



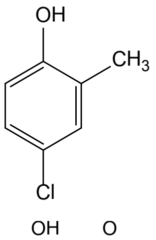
HMCPA Glucose conjugate
(4-chloro-2-methoxy-ß-glucopyranosido phenoxy) acetic acid



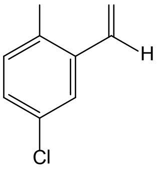
MCPA-glycine
4-chloro-2-methylphenoxyacetic acid, glycine conjugate



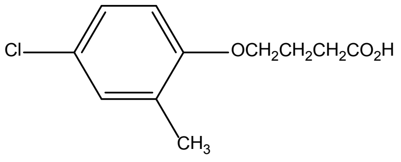
PCOC or 4-MCP
4-chloro-2-methyl phenol



5-CsAld
5-chlorosalicylaldehyde



MCPB
4-(4-chloro-2-methylphenoxy) butanoic acid



Animal metabolism

The Meeting received animal metabolism studies with MCPA in mice, rats, lactating goats and hens, and also received animal metabolism studies with CCPA in lactating goats. Laboratory animals' metabolism studies were evaluated by the WHO Core Assessment Group of the 2012 JMPR.

Rats

Following oral dose of uniformly ring-labelled [^{14}C]-MCPA, the rats predominantly excreted approximately 90% of the administered dose by urine, with low levels detected in faeces (approximately 5% of the administered dose). MCPA ion was the predominant compound detected in rat and dog excreta followed by HMCPA and glycine-conjugated MCPA. The proportions of MCPA and HMCPA in rat urine ranged from approximately 51–80% and 6–16% of the administered doses, respectively. In rat faeces, MCPA and HMCPA accounted for approximately 1–2% and 1–7% of the administered doses, respectively. Following oral dosing of rats, there was no evidence of accumulation of radioactivity in any tissues, with the concentration in the majority of tissues lower than in blood.

Lactating goats

Two lactating goats were dosed twice daily for 3 consecutive days with 967 mg of [^{14}C]-MCPA, which was uniformly labelled in the ring (specific activity, 8.56 µCi/mg; radiochemical purity, 98.5%) (Sabourin, PJ and Koebel, DD, 1995, MCPA-R016). At each dosing, the test substance was administered in two gelatine capsules (i.e., 483.5 mg/capsule). During the dosing phase, feed consumption was 2.21 kg/goat/day for goat 29 and 2.79 kg/goat/day for goat 53. Based on the actual administered doses and in-life feed consumption the actual mean daily doses were equivalent to 832 ppm in feed for goat 29 and 694 ppm in feed for goat 53. Goat 29 regurgitated a capsule on the last day of dosing. The capsule was recovered and the [^{14}C]-MCPA extracted and analysed by liquid scintillation counting. The recorded dose that the animal received from this capsule was the difference between 483.5 mg and the amount left in the regurgitated capsule (391 mg). The dose given goat 29 was still within 93% of the target dose (5411 mg over 3 days). Urine and faeces were collected daily and the cage was rinsed, collecting the rinsate. Milk was collected twice daily (in the morning and evening prior to dosing). Milk collected in the evening was stored at about 4 ºC overnight and pooled with the milk collected the following morning prior to the next dosing. The pooled milk samples were stored at ≤ -20 ºC.

The goats were sacrificed about 22.5 hours after the last dosing, and the following tissues were collected: liver, kidneys, muscle, fat, bile and gastrointestinal contents. These were collected and analysed along with the excreta and milk for total residues (TRR). Samples were stored at ≤ -20 ºC until analysis. Milk and tissue samples from Goat 53 were subjected to extraction and/or hydrolysis procedures for residue characterization and identification. During the extraction and fractionation procedures, aliquots of extracts, hydrolysates, and bond residues were analysed for radioactivity by LSC or combustion/LSC.

The post extraction solids of each tissue containing more than 10% of TRR (liver, kidney and muscle) was base hydrolysed in 3N NaOH:methanol (8:2, v:v) at 58 ºC overnight. The mixtures were acidified with HCl to pH 2 and filtered. Remaining bond residues were subjected to a second base hydrolysis over 2 nights at 70 ºC using 3N NaOH:methanol (1:1, v:v) and centrifuged. Remaining bond residues were rinsed with methanol:water (1:1, v:v) and centrifuged again. The resulting supernatants from these steps were combined, adjusted to pH 2 and diluted with water. The precipitate which formed was removed by filtration and redissolved in methanol. The acidified hydrolysates were cleaned up on a C-18 SPE column eluted with methanol. The methanol eluates were collected, concentrated and set aside for HPLC analysis. For fat, the post-extraction solids (PES) was not hydrolysed but was extracted with hexane. The hexane extract from fat and the remaining pellet contained less than 0.01 mg eq/kg determined by LSC and were not further analysed.

Following oral administration of [^{14}C]-MCPA for 3 consecutive days at 694 and 832 ppm, the goats excreted most of the dose (91% for Goat 29 and 108% for Goat 53) within 24 hours of dosing, primarily in the urine as un-metabolized MCPA. The primary [^{14}C] component excreted in faeces was also MCPA. The total per cent of the dose excreted in each animal was similar. Despite the slightly different dose to goat 29, residue levels in tissues of both treated goats were similar. Residue levels in tissues and milk of the two goats were similar and < 0.1% of the total radioactive residues. The results are summarized in Table 1.

Table 1 Total radioactive residues in milk and tissues from lactating goats following administration of [^{14}C]-MCPA for 3 consecutive days (Sabourin, PJ, Koebel, DD, 1995, MCPA-R016)

Matrix	Goat 53 (694 mg/kg)		Goat 29 (832 mg/kg)	
	mg eq/kg	% Dose	mg eq/kg	% Dose
Edible tissues and milk				
Milk (48–72 hr collection)[a]	0.160	< 0.1[b]	0.172	< 0.1
Fat	0.140	< 0.1	0.159	< 0.1
Muscle	0.099	< 0.1	0.070	< 0.1
Kidney	0.886	< 0.1	0.899	< 0.1
Liver	0.480	< 0.1	0.455	< 0.1
Non-edible tissues/samples				
Faeces	79.2[a]	10.5[c]	22.2[a]	2.4[c]
Urine	757[a]	93.4[c]	309[a]	85.7[c]
Cage rinse	48.1[a]	4.4[c]	13.7[a]	2.5[c]
Bile	1.19	< 0.1	0.816	< 0.1
Gastro-intestinal contents	0.558	0.1	0.698	0.1
Total		108.4		90.7

[a] 48–72 hr collection (highest individual value)

[b] Values of < 0.1 were considered equal to zero for determining total recovery

[c] Includes samples collected throughout the dosing period

The small amount of MCPA that is not excreted is metabolized to the glycine conjugate of MCPA in milk and to an unknown metabolite predominantly in liver, kidney, and bile, later identified as composed of three compounds of similar polarity, characterized as triglyceride-like compounds with a dechlorinated MCPA-like structure incorporated by ester or ether linkage (Lawrence, LJ, 1996, MCPA-R017). The release of MCPA and the triglyceride-like structures from bond residues by base hydrolysis indicates that MCPA and metabolites also bind to cell constituents.

Table 2 Characterization and identification of radioactive residues in milk and tissues from a lactating goat dosed with [^{14}C]-MCPA (Sabourin, PJ, Koebel, DD, 1995, MCPA-R016)

Fraction	Milk		Fat		Muscle		Kidney		Liver	
	%TRR	mg eq/kg	%TRR	mg eq/kg	%TRR	mg eq/kg	%TRR	mg eq/kg	%TRR	mg eq/kg
Identified (ID)										
MCPA (MCPA in PES)	28.5 –	0.046 –	30.2 –	0.042 –	22.3 2.9	0.022 0.0023	6.7 3.2	0.060 0.0069	4.9 –	0.024 –
MCPA-glycine	53.9	0.086	–		–	–	–	–	–	–
Total ID	82.4	0.132	30.2	0.042	22.3	0.022	6.7	0.060	4.9	0.024
Characterized (C)										

Fraction	Milk		Fat		Muscle		Kidney		Liver	
	%TRR	mg eq/kg	%TRR	mg eq/kg	%TRR	mg eq/kg	%TRR	mg eq/kg	%TRR	mg eq/kg
Identified (ID)										
Triglycerides	–	–	30.3	0.042	0.2	< 0.001	57.4	0.509	50.5	0.242
Unknown (R_1)	–	–	0.8	0.001	–	–	–	–	0.3	0.001
Unknown (R_2)	–	–	–	–	48.4	0.048	–	–	–	–
Unknowns (distinct peaks)	5.7	0.009	1.6	0.002	1.6	0.002	4.5	0.040	3.3	0.015
Total ID + C	88.1	0.141	62.9	0.087	72.5	< 0.073	68.6	0.609	59.0	0.283
Remaining	5.6	0.009	4.8	0.007	N/R	N/R	N/R	N/R	N/R	N/R

R_1 = 3–4.5 min.

R_2 = 27 min.

N/R = not reported

– = not analysed by HPLC

Distribution of metabolite CCPA in lactating goat

A lactating goat received a daily oral administration of [^{14}C]-CCPA, a plant metabolite of MCPA, in gelatine capsules over a period of 3 consecutive days (McLean, CL, 2004, MCPA-R018). The dose was nominally equivalent to dietary levels of 10 ppm. Urine and faeces were collected prior to the first dose and at 24-hour intervals thereafter, until 72 hours after the first dose. Milk was collected pre-dosing and twice daily, with the morning milk collected immediately prior to each dosing. The goat was sacrificed 24 hours after administration of the final dose, and liver, kidney, fat, muscle and blood were collected. Total radioactive residues were measured in all samples of excreta, cage wash, milk, plasma, cell fraction and edible tissues. The overall recovery of the total administered radioactivity was 98.06% (Table 3).

Table 3 Recovery of total radioactivity (McLean, CL, 2004, MCPA-R018)

Matrix	% Recovery
Urine	66.56
Faeces	26.28
Cage wash	5.16
Milk	0.02
Fat	0.00
Kidneys	0.02
Liver	0.01
Muscle	0.00
Blood cell fraction	0.00
Plasma	0.00
Total	98.06

Urinary excretion was the major route of elimination and accounted for 66.6% of the administered doses by the end of the study period. Excretion in faeces accounted for 26.3% of the administered doses. Concentrations of total radioactivity in milk were low, with a maximum of 0.002 mg eq/kg with the exception of a sample collected at 72 hours after the first dose, which was 0.006 mg eq/kg. This was assumed to be contaminated with faeces and urine. The total radioactivity in milk accounted for 0.02% of the administered doses. The highest concentration of total radioactivity in tissues was observed in kidney (0.072 mg eq/kg). Concentrations of total radioactivity in the liver were 0.006 mg eq/kg. Low concentrations were observed in muscle and fat (0.001 mg eq/kg each). Concentrations of total radioactivity in the plasma and blood cell fraction were 0.027 mg eq/kg and 0.009 mg eq/kg, respectively. The combined recovery of total radioactivity in liver and kidney was 0.03%. The results of radioactivity concentration are summarized in Table 4.

Table 4 Concentration of total radioactivity in tissues from lactating goat dosed with [^{14}C]-CCPA for 3 days at 10 ppm in diet (McLean, CL, 2004, MCPA-R018)

Matrix	Concentration (mg eq/kg)
Fat	0.001
Kidneys	0.072
Liver	0.006
Muscle	0.001
Blood cell fraction	0.009
Plasma	0.027

In kidney and liver, the amount of [^{14}C]-CCPA was determined to be 0.02% and 0.01% of administered doses. HPLC analysis of the 0–72 h urine and faeces composite samples showed the presence of one major component, co-chromatographed with CCPA. This peak accounted for 64.34% TAR and 22.65% TAR in urine and faeces, respectively. Following oral administration of [^{14}C]-CCPA to the lactating goat, the compound was found to be well absorbed and rapidly excreted predominantly in the urine. There was no evidence for accumulation of radioactivity in milk or edible tissues.

Laying hens

Fifteen laying hens were dosed orally by gelatine capsule with [^{14}C]-MCPA once daily for 7 consecutive days at the nominal equivalent of 100 ppm in the diet (Sabourin, PJ *et al.*, 1995, MCPA-R019). The test substance was uniformly labelled in the ring (specific activity, 12.8 µCi/mg; radiochemical purity, 98.5%). The treatment hens were separated into three cages of five hens each. Five hens were used as a control group.

During the testing period, the hens were allowed water and a commercial feed mixture ad libitum. Eggs were collected once daily, and were pooled by cage and by day. Hens were sacrificed 22 hours after the last dose, and the following samples were collected: breast muscle, thigh muscle, liver, fat, kidneys, skin with adhering fat, gastrointestinal tract and contents, and partially formed eggs. Samples were stored at -20 ºC until analysis.

Tissues were homogenized prior to TRR analysis. Eggs were separated into whites and yolks, and sub-samples from each cage were pooled and homogenized. Egg and tissue samples were analysed by LSC following solubilisation (eggs, liver and muscle) or combustion (fat). Table 5 summarizes the TRR found in eggs and tissues of test hens.

Eggs and tissue samples were subjected to extraction and/or hydrolysis procedures for residue characterization and identification. During the extraction and fractionation procedures, aliquots of extracts, hydrolysates, and bound residues were analysed for radioactivity by LSC or combustion/LSC. Samples of kidney, egg yolks and liver were extracted three times with acetonitrile:water (9:1, v:v) and centrifuged. The resulting supernatants for each matrix were pooled. A portion of the extract was purified, followed by concentration and partitioning three times with five volumes of hexane. The hexane fraction following partitioning was evaporated under nitrogen to near dryness and set aside. The acetonitrile:water fraction was concentrated, acidified and applied to a C-18 SPE column; residues were eluted from the column with 1N HC1, 25%, 50% and 75% acetonitrile in 1N HC1, acetonitrile and THF (tetrahudrofuran). The 50% acetonitrile eluate was then concentrated under nitrogen, and further purified on a C-18 SPE column eluted with 1N HC1, acetonitrile, and THF. The 100% acetonitrile eluate was analysed with HPLC.

Bound residues of kidney, egg yolk and liver were extracted with hexane at 50 ºC, centrifuged, and the hexane extracts evaporated under nitrogen. The hexane fractions from the acetonitrile:water partitioning and from extraction of the unextracted residues were suspended in THF, combined, evaporated under nitrogen and incubated with methanol:6N NaOH (10:1, v:v) at 80 ºC for 15 hours. After additional 6N NaOH was added to adjust the pH to 13, the fractions were incubated for an additional 21 hours. The methanol was removed under nitrogen, and hexane was added to dissolve any residual solids. The mixture was neutralized with 6N HC1, and partitioned with acetonitrile. Following phase separation, the acetonitrile fraction was extracted twice more with hexane. The hexane layers were combined, concentrated under nitrogen and extracted three times with acetonitrile. The acetonitrile:aqueous fractions were combined, concentrated under nitrogen and set aside for HPLC analysis.

The remaining bound residues following hexane extraction were incubated at 50 ºC for 6 days with methanol:aqueous 6N NaOH (1:1, v:v). The mixtures were centrifuged, and the supernatants were concentrated to remove methanol and adjusted to pH 5 with the addition of HC1. The salt which formed was assayed for TRR. The acidified hydrolysates were applied to a C-18 SPE column eluted with three volumes each of acetonitrile and THF. The eluates were combined, concentrated and resuspended in acetonitrile for HPLC analysis.

Table 5 Total radioactive residues in tissues and excreta from laying hens following administration of [^{14}C]-MCPA for 7 consecutive days at 100 ppm of diet consumed (expressed in MCPA-equivalents) (Sabourin, PJ *et al.*, 1995, MCPA-R019)

Matrix	mg eq/kg	% of Dose
Edible tissues and eggs		
Fat	0.033	0.00
Breast muscle	0.006	0.00
Thigh muscle	0.017	0.00
Liver	0.085	0.00
Egg yolk	0.220	0.02
Egg white	0.032	0.01
Skin	0.087	0.00
Non-edible samples		
Kidney	0.869	0.01
Gastro-intestinal contents	0.349	0.02
Excreta	83.1	99.3
Cage rinse	N/A	0.10
Total		99.5

The majority (approximately 99.3%) of the administered radioactivity was eliminated in the excreta after 7 days. The amount of total administered dose excreted each day ranged from 13% to 15%. This indicated that almost all of the MCPA is excreted within 24 hours following each dose. Only up to 0.1% of the administered dose remained in the tissues and eggs, with eggs (at 0.03% administered dose, 0.252 mg eq/kg) the largest single component. Highest residue concentrations were found in the kidney (0.869 mg eq/kg, 0.001% TAR) and the gastrointestinal contents (0.349 mg eq/kg, 0.002% TAR).

Table 6 Characterization and identification of radioactive residues in eggs and tissues from hens orally dosed with [^{14}C]-MCPA at 100 ppm for 7 days (Sabourin, PJ *et al.*, 1995, MCPA-R019)

Fraction	Egg white		Egg yolk		Fat		Thigh muscle		Breast muscle		Liver	
	% TRR	mg eq /kg	% TRR	mg eq /kg	% TRR	mg eq/kg	% TRR	mg eq/kg	% TRR	mg eq/kg	% TRR	mg eq/kg
Identified (ID)												
MCPA	90.3	0.029	57.4	0.127	12	0.004	35.5	0.006	–	–	78.2	0.0663
hydrolysed combined hexane	–	–	14.7	0.032	–	–	–	–	–	–	2.2	0.0019
hydrolysed PES	–	–	4.5	0.010	–	–	–	–	–	–	40.0	0.034
Characterized (C)												
Unknown (R_1= 69–72 min)	–	–	2.4	0.0053	–	–	–	–	5.1	0.0003	1.6	0.0014
Unknown (R_2 = 73–74 min) [a]	–	–	10.5	0.023	1.3	0.0005	–	–	16.7	0.001	1.4	0.0012
Unknown (distinct peaks) [b]	–	–	5.4	0.0122	2.8	0.001	–	–	8.3	0.0005	2.5	0.0021
Total ID + C	90.3	0.029	75.7	0.0168	16.1	0.006	35.5	0.006	30.0	0.0018	83.7	0.071
Non-extracted	3.1	0.001	0.9	0.002	2.8	0.001	23.5	0.004	50.0	0.003	5.9	0.005

[a] Found to consist of 3 components, one of which was identified as MCPA ornithine conjugate.

[b] Comprised of 1–13 distinct unknowns, each < 0.003 mg eq/kg.

–: not analysed by HPLC.

Following oral administration of uniformly ring-labelled [14C]-MCPA to 15 egg-laying hens at 100 ppm in the diet for 7 consecutive days, 99.5% of the radioactivity was recovered, primarily as MCPA and acid labile MCPA conjugates in the excreta. The daily recovery of the radioactivity indicated that each daily dose is almost completely eliminated within 24 hours in excreta. The combined in tissues and eggs accounted for only 0.04% of the dose administered over 7 days. MCPA was the major component identified in egg white (90.3% TRR, 0.029 mg/kg), egg yolk (57.4% TRR, 0.127 mg/kg), fat (12.0% TRR, 0.004 mg/kg), thigh muscle (35.5% TRR, 0.006 mg/kg) and liver (78.2% TRR, 0.0663 mg/kg). An unknown detected in egg yolk (10.5% TRR, 0.023 mg/kg), fat (1.3% TRR, 0.0005 mg/kg), breast muscle (16.7% TRR, 0.001 mg/kg) and liver (1.4% TRR, 0.0012 mg/kg) was found to consist of at least three components, one of which was tentatively identified as the di--MCPA ornithine conjugate. This identification fits the known role of ornithine as a known acceptor molecule for xenobiotics in birds. Remaining unknowns, which accounted for 1.6% to 8.2% TRR in eggs and tissues, were characterized as acid-labile conjugates. Other than MCPA and MCPA conjugates there was no radioactive residue in edible tissues or eggs at concentrations exceeding 0.01 mg eq/kg.

Plant metabolism

The Meeting received plant metabolism studies with MCPA on wheat and peas.

Wheat

The metabolism of [^{14}C]-MCPA was investigated in spring wheat using two different test substances, [^{14}C]-MCPA 2-EHE (specific activity, 18.1 µCi/mg MCPA acid eq; radiochemical purity > 98.0%, chemical purity 97.1%) and [^{14}C]-MCPA DMA (specific activity, 24.5 µCi/mg MCPA acid eq; radiochemical purity > 98.0%, chemical purity 99.1%) (Sabourin, PJ, 1995, MCPA-R014).

Wheat (variety: *Triticum aestivum*) was grown under greenhouse conditions and treated with one foliar application of either [^{14}C]-MCPA 2-EHE or [^{14}C]-MCPA DMA salt at the stage when the flag leaf was extended but before the wheat head emerged (stage 45 to 47 on Zadoks scale). The target application rate was 1.7 kg of MCPA acid equivalent per hectare. The actual applications were within 3% of these targets. Wheat forage samples were harvested 7 days after treatment and grain and straw samples from mature wheat plants were collected 67 days after treatment. Plants were harvested by cutting at the soil surface. Forage samples were chopped into 1inch segments and transported in dry ice to the laboratory for analysis. Grain heads were removed from mature wheat plants by hand and were stored at room temperature overnight before threshing. Straw samples were chopped into 1inch segments and combined with chaff for analysis. Straw and grain samples were transported on dry ice to the laboratory on the day of threshing. Samples were stored in the laboratory at -20 ºC until analysis. In order to determine residues remaining on the surface of plants, whole plant forage samples and straw samples, after removal of grain heads, were rinsed on the day of harvest with acetonitrile. The surface rinse was stored at -20 ºC until analysis.

Samples of forage, straw and grain were homogenized in liquid nitrogen, combusted and radio-assayed by liquid scintillation counting (LSC). The LOQ was 0.01 mg/kg. The TRR in samples are summarized in Table 7. For either test substance, the majority of the residues were found in the forage and straw. Less than or equal to 9.1% and 1.5% TRR were recovered in surface rinses with acetonitrile for the forage and straw, respectively, for either treatment group, indicating translocation of the majority of the residues into the plant.

Table 7 Total radioactive residues in wheat following a single application at 1.7 kg ai/ha of [^{14}C]-MCPA 2-EHE or [^{14}C]-MCPA DMA salt (Sabourin, PJ, 1995, MCPA-R014)

Matrix	TRR, mg/kg [^{14}C]-MCPA-equivalents	
	[^{14}C]-MCPA 2-EHE	[^{14}C]-MCPA DMA salt
Forage	33.2	52.0
Straw	82.2	135
Grain	0.406	0.549
Surface rinse (forage)	1.06	4.73
Surface rinse (straw)	0.37	2.08

Forage, straw and grain samples were extracted with methanol: water (9:1, v/v) and centrifuged. The resulting supernatants for each matrix were combined and concentrated. The precipitate formed on concentration was separated and re-suspended in methanol (forage and straw) or tetrahydrofuran (grain). The methanol: water, methanol, and tetrahydrofuran fractions were concentrated and prepared for HPLC analysis. The precipitate from the MCPA 2-EHE treatment was additionally extracted with chloroform.

A portion of the PES from forage and straw samples from either treatment was subjected to alkaline hydrolysis by incubation at 60 ºC with 3N sodium hydroxide:methanol (8:2, v/v) solution. The mixtures were then adjusted to pH2 with phosphoric acid and centrifuged. The supernatants were cleaned up on a C-18 solid-phase extraction column (SPE) eluted by phosphoric acid followed by methanol. The eluates were collected, concentrated and analysed by HPLC.

A portion of the PES from straw samples treated with MCPA 2-EHE was subjected to acid hydrolysis by overnight incubation in 1N HCl at 40 ºC. The samples were then neutralized with NaOH and filtered. The supernatant was concentrated and analysed with HPLC. Any remaining solid in the filter paper was re-hydrolysed with HCl, incubated at 1-hour periods at 60 ºC and 100 ºC, neutralized with NaOH and filtered. The remaining PES was extracted with dioxane:2N HCl (9:1, v/v), incubated at 70 ºC, filtered, and the filtrate was analysed by LSC.

Portions of the PES from grain samples from each treatment were hydrolysed with 6N HCl, refluxed under nitrogen for 4 hours and centrifuged, decanting the supernatants. The pH was adjusted to 1.5 to 2 with NaOH and the samples concentrated to half the volume. After eluting with acetonitrile and tetrahydrofuran, the resulting eluates were collected by solvent type and analysed by LSC.

Due to low recoveries of ^{14}C from the C-18 columns, the extracts were subsequently rinsed with hexane, acetonitrile, HCl and methanol. Eluates were again collected by solvent type and analysed by LSC. The deionized water, acetonitrile and HC1 eluates were pooled and adjusted to pH 7 with 1N NaOH, then concentrated by rotary evaporation and purified on Dowex-1 OH- columns. The Dowex eluates were combined with glacial acetic acid and concentrated to dryness. The salts which precipitated during concentration were rinsed with methanol to extract radioactivity, and the methanol extracts were evaporated to dryness, re-suspended in water, and analysed by HPLC on an Aminex ion exclusion column.

PES from grain from the MCPA 2-EHE and DMA salt treatments were also subjected to enzyme hydrolysis by incubating overnight at 38 ºC to 45 ºC with cellulase in 50 mM sodium acetate buffer, pH 5; or amylase + amyloglucosidase in 67 mM potassium phosphate buffer, pH 6.8. The samples were centrifuged and analysed for TRR, and in some cases were incubated again with the alternate enzyme. The resulting supernatants were either subjected to further preparative procedures or analysed by HPLC or TLC.

Extracts were analysed by reversed-phase HPLC and TLC. Metabolites were identified by co-chromatography with known standards. Summaries of identified [^{14}C]-residues in wheat treated with [^{14}C]-MCPA 2-EHE and [^{14}C]-MCPA DMA salt are presented in Tables 8 and 9.

Table 8 Characterization/identification of [^{14}C]-residues in wheat treated with [^{14}C]-MCPA 2-EHE (Sabourin, PJ, 1995, MCPA-R014).

Component	Forage, %TRR(mg/kg)		Straw, %TRR (mg/kg)		Grain, %TRR (mg/kg)	
	Extract	Bound	Extract	Bound	Extract	Bound
Void Peak	1.7 (0.557)	ND	1.0 (0.806)	ND	2.2 (0.009)	59.4 (0.241)
CCPA	14.1 (4.68)	0.5 (0.169)	13.7 (11.2)	1.1 (0.92)	8.6 (0.035)	16.7 (0.068)
HMCPA-gluc	40.4 (13.4)	1.6 (0.525)	23.9 (19.7)	15.1 (12.5)	1.2 (0.005)	ND ()
HMCPA	2.6 (0.857)	ND	8.6 (7.08)	1.5 (1.27)	0.8 (0.003)	4.2 (0.017)
MCPA	8.4 (2.77)	1.6 (0.525)	5.6 (4.58)	8.1 (6.68)	0.4 (0.002)	ND
MCPA/HMCPA Conjugates	10.8 (3.58)	ND	7.3 (5.94)	ND	2.2 (0.009)	ND
MCPA 2-EHE	4.2 (1.39)	ND	0.5 (0.411)	ND	ND	ND
16 min Peak(s)	6.4 (2.14)	ND	3.9 (3.19)	ND	ND	ND
Unidentified Minor Distinct Peaks	1.1 (0.375)	0.1 (0.030)	0.8 (0.698)	ND	1.0 (0.0036)	1.2 (0.005)
Unidentified Minor Non-Distinct Peaks	2.0 (0.667)	ND	0.5 (0.452)	0.7 (0.572)	1.9 (0.007)	ND
Total	91.7 (30.4)	3.8 (1.25)	65.8 (54.1)	26.5 (21.9)	18.3 (0.074)	81.5 (0.331)
Total % TRR Identified/ Characterized	88.6 (29.4)	3.7 (1.22)	64.5 (53.0)	25.8 (21.3)	15.4 (0.063)	80.3 (0.326)
% of Fraction Identified/Characterized	96.6	97.4	98.0	97.4	84.2	98.5

ND = Not detected in extractable fractions released by hydrolysis of bound residues.

Table 9 Characterization/identification of [^{14}C]-residues in wheat treated with [^{14}C]-MCPA DMA salt (Sabourin, PJ, 1995, MCPA-R014)

Component	Forage, %TRR(mg/kg)		Straw, %TRR (mg/kg)		Grain, %TRR (mg/kg)	
	Extract	Bound	Extract	Bound	Extract	Bound
Void Peak	0.6 (0.291)	ND	0.8 (1.16)	ND	2.5 (0.014)	62.0 (0.34)
CCPA	6.2 (3.20)	0.6 (0.322)	9.9 (13.4)	ND	4.7 (0.026)	11.8 (0.065)
HMCPA-gluc	21.0 (10.8)	1.9	18.3 (24.7)	7.3 (9.78)	1.4 (0.007)	ND
HMCPA	2.9 (1.47)	ND	6.5 (8.76)	ND	0.6 (0.003)	4.8 (0.027)
MCPA	51.6 (26.8)	2.8 (1.48)	18.8 (25.4)	7.8 (10.5)	0.5 (0.003)	ND
MCPA/HMCPA Conjugates	6.4 (3.35)	ND	4.2 (5.68)	ND	1.6 (0.009)	ND
16 min Peak(s)	2.4 (1.25)	ND	2.7 (3.58)	ND	0.5 (0.002)	ND
Unidentified Minor Distinct Peaks	0.3 (0.161)	0.2	ND	ND	1.0 (0.006)	7.3 (0.040)
Unidentified Minor Non-Distinct Peaks	1.2 (0.161)	ND	0.5 (0.755)	ND	1.2 (0.0058)	ND
Total	92.6 (0.586)	5.5	61.7 (83.4)	15.1 (20.3)	14.0 (0.076)	85.9 (0.472)
Total % TRR Identified/ Characterized	91.1	5.3	61.2 (82.6)	15.1 (20.3)	11.8 (0.064)	78.6 (0.432)
% of Fraction Identified/ Characterized	98.4	96.4	99.2	100	84.3	91.5

ND = Not detected in extractable fractions released by hydrolysis of bound residues.

The residue in forage and straw of wheat treated with either form of MCPA was qualitatively similar except for a higher proportion of parent, MCPA, in the forage and straw of [^{14}C]-MCPA DMA salt treated wheat. The residue profiles in grain were similar for either form of MCPA. Analysis of sample extracts by HPLC and TLC confirmed the presence of MCPA, CCPA and HMCPA, a glucose conjugate of HMCPA, and MCPA/HMCPA conjugates in all samples. PES extracted forage and straw samples were subjected to chemical hydrolysis to free bound residues. Analysis of the hydrolysates of the bound residue in forage and straw demonstrated the presence of conjugated forms of MCPA, HMCPA and CCPA. Remaining residue in grain was subjected to chemical and enzymatic hydrolysis and found HMCPA and CCPA conjugates. A majority of the bound residue of grain was incorporated into cellular endogenous compounds, primarily glucose, which could be further incorporated into starch or cellulose.

The proposed metabolic pathway for MCPA in wheat is shown in Figure 1. MCPA 2-EHE is readily hydrolysed to MCPA as evidenced by similar metabolite profiles with either [^{14}C]-MCPA 2-EHE or [^{14}C]-MCPA DMA. MCPA is first oxidized to HMCPA. HMCPA can then either conjugate with glucose or be oxidized further to CCPA. MCPA and its metabolites, HMCPA and CCPA, can react with cellular constituents forming extractable and bound conjugates. Hydrolysis of grain showed that MCPA can be completely degraded and incorporated into natural products, such as glucose and possible macromolecules such as starch and cellulose.

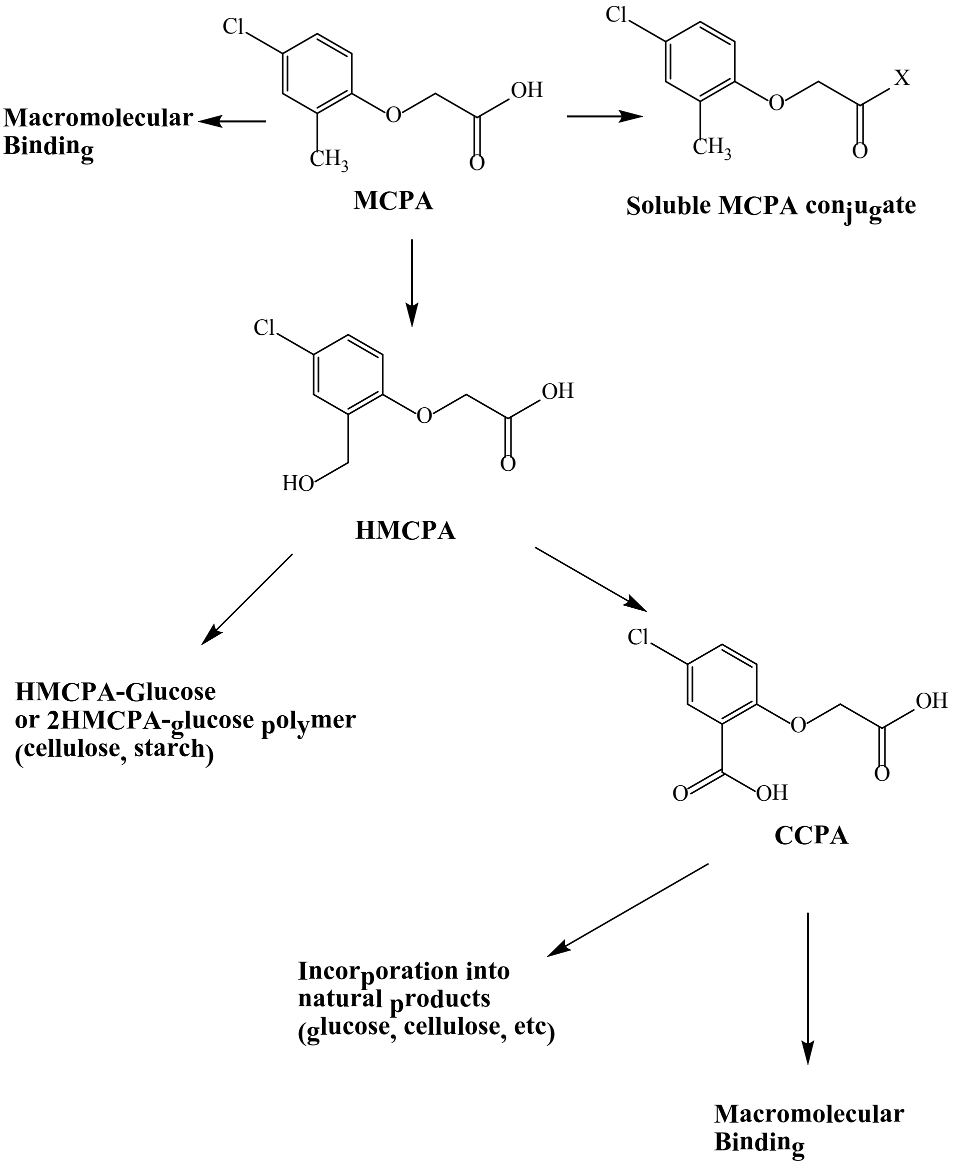


Figure 1 Proposed metabolic pathway of MCPA in wheat

Peas

The metabolism of MCPA and the related compound MCPB in peas was investigated using [^{14}C]-MCPB (4-(4-chloro-2-methylphenoxy) butanoic acid. Specific activity, 176 μCi/mg; radiochemical purity 99%, chemical purity 99.4%) uniformly labelled in the ring position (Goodyear, A, 1993, MCPA-R015). MCPB breaks down into MCPA by the process of β-oxidation. The MCPA is then further oxidized to HMCPA.

Pea seeds (variety: *Orb*) were planted in a mixture of 80% sandy soil and 20% perlite in 20 cm diameter plastic pots. Seven seeds were sown in each of the 40 pots, and the plantings were divided into four groups of 10 each. The plantings were maintained in a greenhouse throughout the study. Temperature and humidity were monitored, and water and fertilizer supplied as required. Three groups of plantings were treated with a foliar spray of [^{14}C]-MCPB at the rate equivalent to 2.26 kg ai/ha, at the 10× vegetative growth stage, 27 days after planting. The crop in each pot was thinned to four or five plants. Each pot was surrounded by a polyethylene spray chamber, and the test substance was sprayed onto each plant with an air brush. Ten plants and soil samples were immediately analysed to determine the rate of application. Ten immature plants were taken 38 and 42 days after treatment. Another 10 mature samples and 10 control samples were taken 56 and 62 days after treatment. Plants were separated into roots, vine, pods and seeds. Fresh weights were recorded for combined fractions. Roots were washed.

Immature plant parts (vine, roots and pods) and mature plant parts (roots, pods, vine and seeds) were each extracted sequentially with acetone and acetone/water and centrifuged. The combined acetone extract, the combined acetone/water extract of each part were analysed by LSC. The post-extraction solid (PES) of each part was combusted and analysed by LSC. The PES from mature seed was sequentially hydrolysed with 0.5 M methanolic sodium hydroxide (70 °C, 2 hours), 2 M methanolic sodium hydroxide (90 °C, 4 hours), and 2 M hydrochloric acid (90 °C, 5 hours). The hydrolysate at each step was partitioned against chloroform, and the aqueous and organic fractions were analysed by LSC. The final residual solid was combusted and analysed by LSC. All aqueous and organic hydrolysates were concentrated, combined and analysed by HPLC. The combined concentrate from hydrolyses of the seed PES and the immature vine acetone/water extract were each reacted with ß-glucosidase (37 °C, 24 hours). The product solutions were analysed by HPLC. An aliquot of the immature vine acetone/water concentrate was hydrolysed with 2M hydrochloric acid (80 °C, 5 hours). The product mixture was analysed by HPLC. GC/MS and LC/MS analyses were performed on selected extracts. The total radioactive residues found in the extracts and hydrolysates of various pea plant parts are summarized in Table 10.

Table 10 Total radioactive residues (mg/kg MCPB-equivalents) from a single application of [^{14}C]-MCPB at 2.26 kg ai/ha (Goodyear, A, 1993, MCPA-R015)

Matrix	Acetone extract		Acetone/water extract		PES		Total residue
	mg eq/kg	%TRR	mg eq/kg	%TRR	mg eq/kg	%TRR	mg eq/kg
Immature vine	2.63	79	0.49	15	0.23	7	3.35
Immature root	0.072	51	0.038	27	0.03	21	0.14
Immature pod	0.011	69	0.0024	15	0.0025	16	0.016
Mature vine	3.88	78	0.69	14	0.40	8	4.97
Mature root	0.11	55	0.035	18	0.054	27	0.20
Mature pod	0.019	76	0.0026	10	0.0033	13	0.025
Mature seed [a]	0.0063	26	0.0029	12	0.0037	15	0.024

[a] The 0.05M NaOH hydrolysis released 0.0018 ppm (8%); 2M NaOH hydrolysis released 0.0056 ppm (23%); and 2M HCl hydrolysis released 0.0021 ppm (9%)

Components of the plant matrices were characterized or identified by HPLC, including co-injection with reference standards. Several compounds were isolated from immature plant vines and were identified by GC/MS or LC/MS. The results are summarized in Table 11 and Table 12.

Table 11 Characterization and identification of MCPB in peas treated with [^{14}C]-MCPB (Goodyear, A, 1993, MCPA-R015)

Component	Matrix	Amount		Method used
		mg eq/kg	% TRR	
MCPB	Immature vine	2.20	66	HPLC; GC/MS
	Mature vine	3.59	72	HPLC; GC/MS
	Mature root	0.0021	1	HPLC
	Mature pod	0.01	40	HPLC
	Mature seed	0.0003	1.2	HPLC
MCPB conjugated [a]	Immature vine	0.064	1.9	HPLC; GC/MS

Component	Matrix	Amount		Method used
		mg eq/kg	% TRR	
	Mature seed	ND	–	HPLC
MCPB methyl ester (Unknown 2)	Immature vine	0.039	1.2	HPLC; LC/MS
	Mature seed	ND	–	HPLC
Polar unknowns	Immature vine	0.48	14	HPLC
	Mature vine	0.63	13	HPLC
	Mature root	0.13	65	HPLC
	Mature pod	0.012	48	HPLC
	Mature seed	0.0065	27	HPLC

ND = not detected

[a] Released by acid hydrolysis of acetone/water extract of vine or by acid hydrolysis of the seed PES

Table 12 Characterization and identification of MCPA and its metabolites in peas treated with [^{14}C]-MCPB (Goodyear, A, 1993, MCPA-R015)

Component	Matrix	Amount		Method used
		mg eq/kg	% TRR	
MCPA	Immature vine	0.20	6.0	HPLC; GC/MS
	Mature vine	0.29	5.8	HPLC; GC/MS
	Mature root	0.0015	0.8	HPLC
	Mature pod	0.0002	0.8	HPLC
	Mature seed	0.001	4.2	HPLC
MCPA conjugated [a]	Immature vine	ND	–	HPLC
	Mature seed	ND	–	HPLC
HMCPA (Unknown 5)	Immature vine	0.005	0.15	HPLC; LC/MS
	Mature seed	ND	–	HPLC
HMCPA Conjugated [a]	Immature vine	0.044	1.3	HPLC; LC/MS
	Mature seed	ND	–	HPLC
MCPA methyl ester (Unknown 3)	Immature vine	0.093	2.8	HPLC; LC/MS
	Mature seed	0.0017	7.1	HPLC
Glucose conjugate of HMCPA	Immature vine	0.064	1.9	HPLC; LC/MS
	Mature seed	0.003	12.5	HPLC

ND = not detected

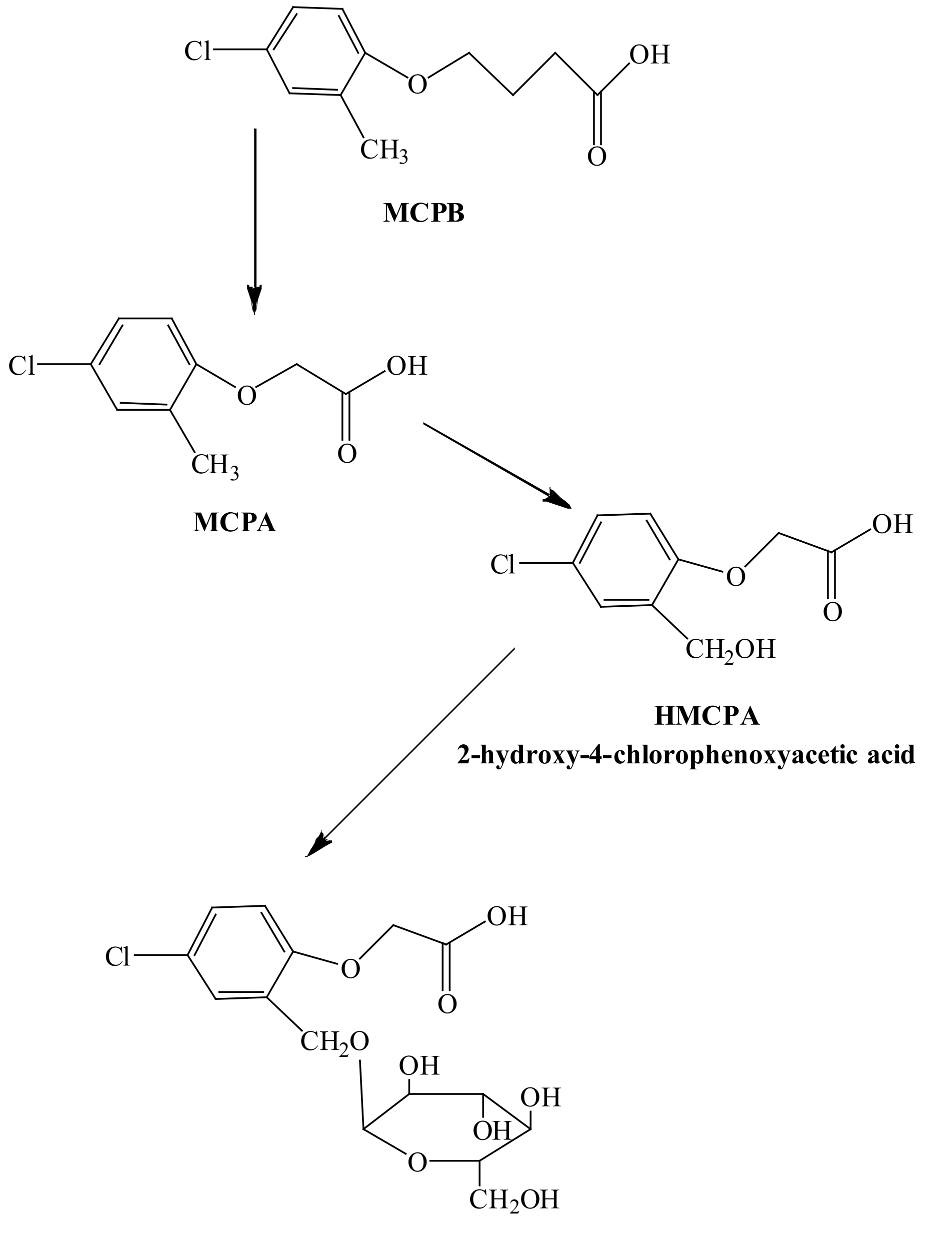
[a] Released by acid hydrolysis of acetone/water extract of vine or by acid hydrolysis of the seed PES.

[b] After acid and base hydrolysis of the PES.

Although the majority of the residues were found in the mature and immature vine, adequate radioactivity was found on mature pods (0.025 mg/kg), seeds (0.024 mg/kg) and foliage (4.97 mg/kg) to permit extraction and identification of major metabolites. A combination of acetone and acetone/water extracted the majority of the radiolabelled residue from mature foliage (92% TRR) and pod (86% TRR). Solvents extracted only 38% TRR from mature seed. Another 40% TRR was recovered by sequential base and acid hydrolysis. Some of the radiolabelled residue was identified in mature forage, pod and seed. Mature vine contained mainly the parent, 72% MCPB, 5.8% MCPA, and

13% polar unknowns. Mature pod contained 40% MCPB, 0.8% MCPA and 48% polar unknowns. Mature seed contained 1.2% MCPB, 11% MCPA/MCPA ester, 12.5% glucose conjugate of HMCPA and about 27% polar unknowns. The seed polar unknowns are distributed 28% in the solvent extract and 18% in the combined hydrolysates. About 29% TRR was unaccounted, including 15% TRR in the residual solid. Based on the study, MCPA and MCPB are the major residues in mature pea vines, pods and seeds after treatment of with [^{14}C]-MCPB.

Based on radiolabelled compounds identified in the various matrices, a metabolism pathway that involves conversion of MCPB to MCPA, hydroxylation of MCPA, and conjugation of the resulting HMCPA can be proposed. Ring hydroxylation was not reported, but such compounds may have been among the polar unknowns. The pathway is similar to the metabolism pathway in wheat. MCPA undergoes oxidation of the phenyl methyl, and the resulting hydroxymethyl compound forms conjugates, including a glucose conjugate. Figure 2 shows the proposed metabolic pathway in peas.



HMCPA GLUCOSE CONJUGATE

(4-chloro-2-methoxy-ß-glucopyranosido phenoxy) acetic acid

Figure 2 Proposed Metabolic Pathways in Peas

Environmental fate in soil

The Meeting received information on the environmental fate of MCPA in soil, including studies on soil metabolism, and crop rotational studies.

Soil metabolism (aerobic degradation)

The hydrolytic degradation of [^{14}C]-MCPA 2-EHE was determined in soil/water systems (Fernando, TR, 1993, MCPA-R033). Ring-labelled [14C]-MCPA 2-EHE was applied to both a sandy loam (pH 6.9, 1.5%oc) and a silt loam (pH 5.8, 2.1%oc) soil/water system at a nominal concentration of 3 mg/kg. Systems consisted of 7 g soil and 35 mL CaCl2 solution. The systems were tumbled for 12 hours at 25 °C and duplicate samples were removed at 2, 4, 8 and 12 hours for both soils and at 24 hours for the sandy loam soil. Mass balances were 81.9% to 94.3% of applied radioactivity. MCPA 2-EHE was rapidly hydrolysed to MCPA in both systems with 47% hydrolysed in the silt loam system after 2 hours and 84% after 12 hours. In the sandy loam system hydrolysis was slower with 31%, 72% and 88% hydrolysis to MCPA after 2, 12 and 24 hours respectively. Only MCPA was detected in the aqueous phase indicating adsorption of MCPA 2-EHE. Results are presented in Tables 13 and 14.

Table 13 Extraction and recovery of radioactivity from soil/water systems following application of [^{14}C]-MCPA 2-EHE (% applied radioactivity) (Fernando, TR, 1993, MCPA-R033)

Sample time (hours)	Supernatant	Acetonitrile extract	Unextracted	Tube rinse	Total
Silt loam					
2	47.1	N/A	34.7	0.1	81.9
4	62.3	N/A	24.6	0.1	87.0
8	66.0	N/A	18.9	0.1	85.0
12	71.7	16.7	12.0	< 0.1	100.4
Sandy loam					
2	31.3	N/A	58.6	0.3	90.2
4	47.5	N/A	46.7	0.1	94.3
8	63.6	N/A	30.4	0.1	94.1
12	67.0	18.9	9.5	0.1	95.5
24	81.5	9.6	10.3	0.1	101.5

Table 14 Detections of MCPA 2-EHE and MCPA at 12 and 24 hours incubation (% applied radioactivity) (Fernando, TR, 1993, MCPA-R033)

Sample time (hours)	MCPA in supernatant	MCPA adsorbed	Total MCPA	MCPA 2-EHE adsorbed
Silt loam				
12	71.7	12.2	83.9	4.5
Sandy loam				
12	67.0	4.5	71.5	14.4
24	81.5	6.2	*87.7*	3.4

In a further study (Lewis, CJ, 2006, MCPA-R142), the primary hydrolysis rate of [^{14}C]-MCPA 2-Ethylhexyl ester (MCPA 2-EHE) was studied in two US soils; a sandy loam (pH 6.3, OC 1.4%) and a clay loam (pH 6.3, OC 2.3%); and at two moisture contents (50 and 70% of maximum water-holding capacity). Initial concentration of the ester in the soil was 5 mg/kg. Samples of sieved soil (50 g dry weight) were dispensed into individual glass vessels into which moistened air was drawn. The units were maintained in the dark at 25 ± 1 °C for two days to equilibrate. Effluent air was passed through a polyurethane foam bung in the outlet of the incubation vessel followed by a safety trap and two 2M sodium hydroxide solution traps to collect devolved radiolabelled material. Dosing was carried out by drop-wise application of the radiolabelled test substance in acetonitrile to the soil samples. The soil was mixed thoroughly before further incubation in the dark. Duplicate soil samples from each incubation group were taken for analysis of MCPA 2-EHE and radiolabelled metabolites at 0 time and 3, 6, 12, 24 and 48 hours after application. Recovery of applied radioactivity from all samples exceeded 90%. During the 48 hours incubation, levels of MCPA 2-EHE decreased to between 5% and 16% of applied radioactivity (AR), and MCPA increased concomitantly to between 70% and 82%. There were no other significant metabolites present at this time. Specifically, no volatiles were collected in the polyurethane foam. MCPA 2-EHE hydrolysed quickly to MCPA in both soils. Half-life values ranged between 4.5 and 16.6 hours, dependent on the soil type and the moisture content. The most rapid hydrolysis occurred in the sandy loam soil at the lower of the two moisture contents (50%). Following an initial phase during which the majority of the ester was hydrolysed, degradation rates slowed at a greater rate than would be predicted from first order (single phase) kinetics. Computed half-live values using a two-phase model gave a better fit with the data points and were shorter than those calculated by single-phase first order kinetics. The results are presented in Tables 15 and 16.

Table 15 Degradation rates calculated assuming first order kinetics (Lewis, CJ, 2006, MCPA-R142)

Soil Name	Moisture (% WHC)	Cmax Computed (% of applied radioactivity)	Half-life (hours)	R^2
Sandy loam	50	95.3	4.5	0.967
Sandy loam	70	93.4	7.5	0.961
Clay loam	50	91.3	10.4	0.978
Clay loam	70	91.9	16.6	0.978

Table 16 Degradation rates calculated from a two-phase model (Lewis, CJ, 2006, MCPA-R142)

Soil Name	Moisture (% WHC)	Cmax Computed (% of applied radioactivity)	DT_{50} (hours)	DT_{90} (hours)	R^2
Sandy loam	50	98.7	3.6	28.3	0.998
Sandy loam	70	98.7	5.8	43.7	0.998
Clay loam	50	97.1	8.2	49.2	0.999
Clay loam	70	97.5	14.1	67.9	0.991

The principal metabolite MCPA was positively identified by HPLC and by LC-MS. The aerobic metabolism and degradation of [^{14}C]-MCPA was studied in a sandy loam soil (1.65% organic matter, pH 8.03) for 209 days (Matt, FJ, 1990, MCPA-R020). [^{14}C]-MCPA was applied to the soil at a nominal rate of 9.9 mg/kg, equivalent to an application rate of 7425 g ai/ha. The incubation conditions were aerobic, dark, 75% field moisture capacity, a temperature of 23 °C to 26 °C, traps to collect organic volatiles (ethylene glycol) and $^{14}CO_2$ (2-ethoxyethanol:ethanolamine). Soil samples were taken at 0, 1, 3, 6, 12, 19, 28, 61, 91, 154 and 209 days after treatment. Mean recoveries were 89.2% to 104% of applied radioactivity. The results are summarized in Tables 17 and 18. The lower material balance from day 28 onwards was due to a disconnected vacuum hose and subsequent loss of CO_2.

Table 17 Recovery of radioactivity in soil after application of [^{14}C]-MCPA (expressed as % applied radioactivity) (Matt, FJ, 1990, MCPA-R020)

Time	[^{14}C]-MCPA			
(days)	Extracts	Cumulative volatiles	Unextracted	Total
0	98.5	N/A	5.5	104.0
1	92.3	< 0.1	8.7	101.0
3	86.7	0.1	14.2	100.9
6	82.8	1.1	15.4	99.3
12	72.2	5.5	21.4	99.0
19	63.2	10.5	28.1	101.8
28	51.2	10.5	27.5	89.2
61	17.3	54.9	31.8	91.6
91	4.1	61.4	34.4	93.3
154	1.5	64.3	28.3	91.2
209	1.3	65.6	30.7	96.3

N/A = Not applicable

Table 18 Decline of [^{14}C]-MCPA in aerobic sandy loam soil at 23 °C to 26 °C (expressed as % applied radioactivity) (Matt, FJ, 1990, MCPA-R020)

Time	Radioactive component	
(days)	MCPA	Peak 1
0	93.0	ND
1	88.7	ND
3	83.1	ND
6	78.7	ND
12	66.2	ND
19	60.4	ND
28	47.2	ND
61	14.8	0.9
91	2.1	0.5
154	N/A	N/A
209	N/A	N/A

ND = Not detected

N/A = Not analysed

A total of 65.6% of applied radioactivity was evolved as volatile radioactivity over the 209-day incubation period. This volatile radioactivity was identified as $^{14}CO_2$. The sole major component was [^{14}C]-MCPA, which was totally mineralized within the time course of the study, with a minor unidentified peak of < 1% of applied radioactivity occurring on days 61 and 91. The calculated half-life was 24 days under aerobic conditions. Further information on degradation rate was provided in a literature review (Smith, AE, 1989, MCPA-R143). This author presented numerous data on degradation of MCPA in laboratory soils. The degradation rate was strongly influenced by microorganisms. After a lag phase, which can vary dependent on the characteristics of the soil (moisture, organic matter, pH, temperature) rapid breakdown of the active ingredient occurs. Subsequent investigations confirmed microbial degradation was the major mechanism, resulting in decomposition of MCPA in soils. Table 19 summarizes the degradation of MCPA.

Table 19 Breakdown of MCPA following single applications to laboratory soils (Smith, AE, 1989, MCPA-R143)

Soil type	pH	Org. matter	Moisture	Temperature	Concentr (mg/kg)	Half-life (days)
Sandy loam	7.0	2.0	12.7% FC	23	3.0	~ 8
Sandy loam	7.2	1.9	100% FC	26	2.5	32
Clay loam	7.8	1.8	100% FC	26	2.5	41
Clay loam	6.2	6.8	100% FC	26	2.5	15
Loam	7.6	2.4	100% FC	26	2.5	14
Loam	7.5	2.9	100% FC	26	2.5	22
	7.7	4.2	85% FC	20	2.0	< 7
Clay loam	6.0	11.7	85% FC	20	2.0	< 7
Sandy loam	7.6	4.0	85% FC	20	2.0	< 7
Clay	7.7	4.2	85% FC	20	2.0	13
Clay loam	6.0	11.7	85% FC	20	2.0	14
Sandy loam	7.6	4.0	85% FC	20	2.0	14
Sandy clay	5.2	6.3	100% FC	23	10.0	~ 28
Sandy clay	4.7	8.4	100% FC	25	10.0	~ 40

Soil photolysis

The photolytic degradation of [^{14}C]-MCPA was studied on a sandy clay loam soil (1.85%oc, pH 6.9) (Obrist, JJ, 1987, MCPA-R021). [^{14}C]-MCPA was applied separately to thin layers of soil in petri dishes at a concentration of 18 mg/kg (equivalent to an application rate of 137.6 g ai/ha, assuming application of 24.9 µg to a surface area of 18.1 cm^2). The incubation conditions were irradiation from a Chroma 50 lamp (with a spectral energy distribution and wavelength similar to natural sunlight, but a lower intensity [80 µW/cm^2 compared to 1200 µW/cm^2) or natural sunlight and a temperature of 25 °C (dark and artificial sunlight samples). Duplicate soil samples were taken at 0, 168, 336, 528 and 768 hours after treatment (dark controls and artificial sunlight) and at 0, 24, 48, 104 and 200 hours after treatment (natural sunlight irradiated). Traps collected volatile organic degradation products and $^{14}CO_2$. Samples from the final sampling period or soils containing > 10% of applied radioactivity were subjected to organic matter fractionation.

Total recoveries of radioactivity for artificially irradiated soils were in the range 100.8% to 112.5% of applied radioactivity, for naturally irradiated soils 83% to 112.5% of applied radioactivity (volatiles not trapped) and for dark controls 99.3% to 112.5% of applied radioactivity. The extraction and recovery of radioactivity from the soil following application of [^{14}C]-MCPA is detailed in Table 20. The detections of [^{14}C]-MCPA in soil are given in Table 21.

Table 20 Extraction and recovery of radioactivity from soil following application of [14C]-MCPA (% applied radioactivity) (Obrist, JJ, 1987, MCPA-R021)

Sample time (hours)	Organosoluble extract	Unextracted	Volatiles	Total
Dark Controls				

Sample time (hours)	Organosoluble extract	Unextracted	Volatiles	Total
0	110.5	2.0	N/A	112.5
168	99.2	5.0	< 0.1	104.2
336	52.6	47.3	ND	99.9
528	55.0	44.3	ND	99.3
768	97.6	5.9	ND	103.5
Artificially irradiated				
0	110.5	2.0	N/A	112.5
168	91.4	9.5	< 0.1	100.9
336	51.9	51.2	ND	103.1
528	53.5	50.1	ND	103.6
768	88.4	12.4	ND	100.8
Naturally irradiated				
0	110.5	2.0	N/A	112.5
24	93.3	13.5	N/A	106.8
48	49.3	43.1	N/A	92.4
104	40.8	49.2	N/A	90.0
200	54.2	28.8	N/A	83.0

N/A = Not analysed

ND = Not detected

Table 21 Detections of MCPA in the irradiated soils and dark controls (% applied radioactivity) (Obrist, JJ, 1987, MCPA-R021)

Sample time (hours)	Dark Controls	Artificially irradiated	Naturally irradiated	
	%AR	%AR	Sample time (hours)	%AR
0	107.4	107.4	0	107.4
168	97.0	88.8	24	95.7
336	92.9	87.7	48	74.0
528	92.2	87.8	104	64.2
768	99.6	92.5	200	56.3

No volatiles were detected in the artificially irradiated and dark control soils. In the artificially irradiated and dark control soils extractable radioactivity declined to 53.5% to 55% of applied radioactivity after 528 hours with a concurrent increase in unextractable radioactivity to 44.3% to 50.1% of applied radioactivity. Extractable radioactivity then increased to 88.4% to 97.6% of applied radioactivity after 768 hours. The majority of unextractable radioactivity was associated with the fulvic acid fraction in all three incubations. Calculated first order half-lives were 4718 hours for artificially irradiated soil and 220 hours for naturally irradiated soil.

The photolytic degradation of [^{14}C]-MCPA was studied on a sandy loam soil (1.15% organic matter, pH 6.1) (Concha, M, and Shepler, K, 1994, MCPA-R022). [^{14}C]-MCPA was applied to 2 mm layers of soil at a concentration of 4.7 mg/kg (equivalent to an application rate of 3525 g ai/ha). The incubation conditions were 75% field moisture capacity and irradiation from natural sunlight at a temperature of 25 °C. Duplicate soil samples were taken at 0, 7, 15, 21 and 30 days after treatment.

Traps collected volatile organic degradation products and $^{14}CO_2$. Samples from the final sampling period were subjected to organic matter fractionation.

The mean recovery of radioactivity was 97.2% of applied radioactivity for the irradiated soils and 98.2% of applied radioactivity for the dark controls. The extraction and recovery of radioactivity from the soil following application of [^{14}C]-MCPA is detailed in Table 22. The detections of [^{14}C]-MCPA and its degradation products in soil are given in Table 23.

Table 22 Extraction and recovery of radioactivity in the irradiated soils and dark controls following application of [^{14}C]-MCPA (% applied radioactivity) (Concha, M, and Shepler, K, 1994, MCPA-R022)

Sample time (days)	Organosoluble extract	Unextracted	Volatiles	Total
Dark Controls				
0	95.1	3.7	N/A	98.8
3	93.1	6.8	0	99.9
7	83.6	13.3	0	96.9
15	84.8	12.6	0.3	97.6
21	82.8	14.3	0.4	97.5
30	82	15.9	0.5	98.4
Irradiated				
0	95.1	3.7	N/A	98.8
3	92.4	6.9	0.1	99.3
7	84.1	9.6	0.4	94.1
15	81.3	14.7	0.9	96.9
21	77.8	17.9	1.4	97.1
30	75.9	19.7	2.7	98.2

N/A = Not analysed

Table 23 Detections of MCPA and its metabolites in the irradiated soils and dark controls (% applied radioactivity) (Concha, M, and Shepler, K, 1994, MCPA-R022)

Sample time (days)	MCPA	PCOC (4-MCP)	Others*
Dark Control			
0	94.7	0.0	0.4
3	92.6	0.0	0.5
7	89.2	0.0	0.6
15	84.0	0.0	0.8
21	81.0	0.7	1.1
30	80.6	0.3	1.1
Irradiated			
0	94.7	0.0	0.4
3	90.9	0.6	0.9
7	85.0	1.8	1.5
15	76.3	4.5	0.5

Sample time (days)	MCPA	PCOC (4-MCP)	Others*
21	70.2	5.1	2.5
30	70.6	3.9	1.5

*No individual component exceeded 1.2%

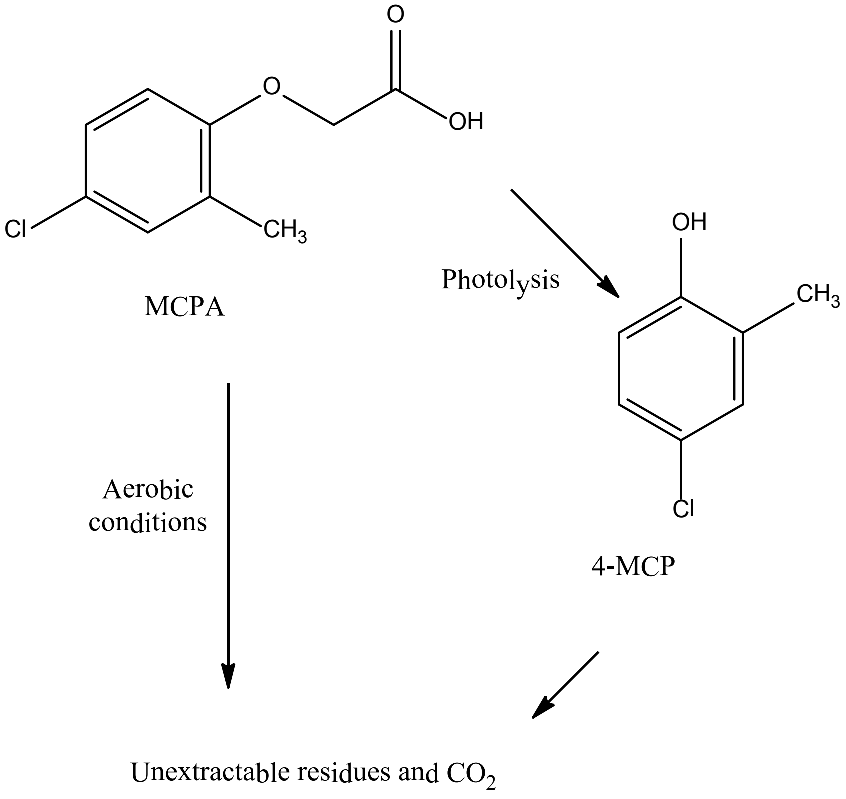


Figure 3 Proposed pathway for the degradation of MCPA in soil

Crop rotation studies

Information on the fate of MCPA in follow-on crop studies was made available to the Meeting.

In a confined rotational crop study an application of [^{14}C]-MCPA at the rate of 0.84 kg ai/ha (Ewing, DD, 1988, MCPA-R040) was made to bare ground. The plot was aged for 30 days, at which time 1/3 of the plot was planted with rotational crops (lettuce, turnips and barley). An additional third was cultivated and rotational crops were planted at 120 days after treatment. The last third was planted with rotational crops at 365 days after treatment. An untreated control plot was planted with rotational crops and harvested on the same schedule as the treated plots. Crops were harvested at maturity except for lettuce, which was harvested at intermediate intervals whenever sufficient leaf material could be obtained. The rotational crops sampled were lettuce leaves, turnip tops and roots, as well as barley grain, forage and straw. Soil samples were taken from each plot prior to treatment, immediately after the application, at each rotational crop planting and at the harvest date of each crop.

[^{14}C]-residues in the top 0–15 cm of soil were 0.276 mg/kg on the day of application and declined to 0.045 mg/kg by the final barley grain and straw harvest at 582 days after treatment. The decline in soil [^{14}C] residues was biphasic with a rapid initial phase (0 to120 days) having a half-life of 63 days, and a slow secondary phase (120 to 582 days) having a half-life of 511 days. Table 24 summarizes the soil residues after treatment.

Table 24 Total [^{14}C]-residue levels in soil treated with MCPA at the rate of 0.84 kg ai/ha (Ewing, DD, 1988, MCPA-R040)

Days post-treatment	Total ^{14}C-residue, mg/kg	Remarks
0 (1 hr)	0.276	Immediately after treatment
30	0.231	30 day plant-back
114	0.086	30-day lettuce, 1st harvest
120	0.075	120 day plant-back
140	0.102	30-day lettuce 2nd harvest
172	0.057	30-day turnips harvest
172	0.064	120-day lettuce, 1st harvest
185	0.095	30-day lettuce 3rd harvest
199	0.118	120-day lettuce 2nd harvest
199	0.091	30-day barley forage harvest
218	0.098	120-day lettuce 3rd harvest barley forage harvest
233	0.121	120-day turnips harvest
233	0.074	30-day barley grain and straw harvest
247	0.063	120-day lettuce 4th harvest
268	0.043	120-day barley and grain harvest
365	0.088	365-day plant-back
409	0.092	365-day lettuce 1st harvest
428	0.048	365-day lettuce 2nd harvest
455	0.056	365-lettuce 3rd harvest
582	0.045	365-day barley grain and straw harvest

After harvest, crop (lettuce, turnips and barley) samples were frozen at < -20 ºC at the field test site for 3 to 43 days prior to shipment on dry ice to the laboratory, where the samples were held at –20 ºC for 6 to 77 days prior to radioassay. Duplicate samples were ground with dry ice and assayed by liquid scintillation counting following combustion. The limit of quantification (LOQ) for the radioassays was 0.05 mg/kg, the limit of detection (LOD) was 0.013 mg/kg. The total radioactive residues in rotational crops are summarized below.

Table 25 Total radioactive residues found in lettuce, turnip, and barley grown in sandy loam soil treated with [^{14}C]-MCPA at 0.84 kg ai/ha, the maximum seasonal rate (Ewing, DD, 1988, MCPA-R040)

Commodity	Plant-back interval, days	Harvest period	Sampling interval		Total radioactive residue, mg/kg MCPA-equivalents*
			Days after treatment	Days after planting	
Lettuce	30	1st	114	84	0.023, 0.029
		2nd	140	110	0.013, 0.017
		3rd	185	155	< 0.013, < 0.013
Lettuce	120	1st	172	52	0.041, 0.044
		2nd	199	79	0.017, 0.013
		3rd	218	99	0.013, 0.018

Commodity	Plant-back interval, days	Harvest period	Sampling interval		Total radioactive residue, mg/kg MCPA-equivalents*
			Days after treatment	Days after planting	
		4th	247	127	0.014, < 0.013
Lettuce	365	1st	409	44	< 0.013, < 0.013
		2nd	428	63	< 0.013, < 0.013
		3rd	455	90	< 0.013, < 0.013
Turnip roots	30		172	142	< 0.013, < 0.013
	120		223	113	< 0.013, < 0.013
	365		455	90	< 0.013, < 0.013
Turnip tops	30		172	142	< 0.013, < 0.013
	120		223	113	< 0.013, < 0.013
	365		455	90	< 0.013, < 0.013
Barley forage	30		199	169	0.017
	120		218	98	< 0.013
	365		409	44	< 0.013, < 0.013
Barley straw	30		233	203	0.021, 0.013
	120		268	148	0.029, 0.021
	365		582	217	< 0.013
Barley grain	30		233	203	< 0.013, < 0.013
	120		268	148	< 0.013, < 0.013
	365		582	217	< 0.013

*All results were extrapolated from the LOD.

Following application of [^{14}C]-MCPA at 0.84 kg ai/ha, radioactive residues were generally highest in lettuce (0.044 mg eq/kg) at the first harvest from the 120-day plant back interval and lowest in barley grain, turnip roots and tops (< 0.013 mg eq/kg) at all plant back intervals. For lettuce at the 30-day and 120-day plant-back intervals, residues were greatest at initial sampling (0.029 or 0.044 mg eq/kg), declining to < 0.013 mg eq/kg except one sample with 0.014 mg eq/kg by the final harvest. For turnip tops and roots and barley grain, residues were non-detectable at all plant-back intervals. Residues in barley forage were detectable at the 30-day plant-back interval (0.017 mg eq/kg), while in barley straw, at the 30-day and 120-day plant-back intervals (0.021 and 0.029 mg eq/kg). Residues were all at non-detectable levels at the 365-day plant-back interval. Total MCPA-equivalent residues obtained from rotational crops were below the LOQ at all plant-back intervals. Due to the very low residue levels, metabolites identification was not done further.

RESIDUE ANALYSIS

Analytical methods

The Meeting received descriptions and validation data for analytical methods for residues of MCPA and HMCPA in animal matrices; MCPA, HMCPA and CCPA in plant matrices. MCPA residues can be measured in most matrices to an LOQ of 0.01 to 0.05 mg/kg. The methods effectively measure 'total' MCPA (and ‘total’ HMCPA in animal products and crops) present as acid, salts, esters and conjugates (esters with natural compounds).

Determination of 4-chloro-2-methylphenoxyacetic acid 2-ethylhexyl ester (MCPA 2-EHE) and 4-chloro-2-methylphenoxyacetic acid dimethylamine salt (MCPA DMAS) as their acid equivalent and 4-chloro-2-methylphenoxyacetic acid (MCPA) in pasture grass samples by gas chromatography with mass selective detection .(Stanley, DC, 1994, MCPA-R041)

Analyte:	MCPA, MCPA 2-EHE and MCPA DMA (as MCPA)	GC/MSD	Method QMAM94008
LOQ:	0.01 mg/kg		
Description	Pasture grass is hydrolysed in basic methanol, filtered and adjusted to a known volume. An aliquot of the extract is concentrated, acidified, and partitioned twice with diethylether. The ether extract is partitioned twice with $NaHCO_3$, evaporated to remove residual ether, acidified and passed through a pre-conditioned C-18 solid phase extraction (SPE) cartridge. The SPE cartridge is dried under vacuum and eluted with a hexane/acetone solution. The eluant is made basic, evaporated to dryness, reconstituted in acidic methanol solution and the MCPA derivatised to its methyl ester with BF_3/methanol. The reactants are quenched with water and partitioned with hexane. The hexane is passed through an acidic alumina column and the MCPA methyl ester is eluted with additional hexane. The eluant is concentrated for determination by GC/MSD.		

Internal Validation of a Method for Determining 4-Chloro-2-Methylphenoxyacetic Acid 2-Ethylhexyl Ester (MCPA 2-EHE) and 4-Chloro-2-Methylphenoxyacetic Acid Dimethylamine Salt (MCPA DMAS) as Their Acid Equivalent and 4-Chloro-2-Methylphenoxyacetic Acid (MCPA) in Pasture Grass Samples by Gas Chromatography with Mass Selective Detection. (Sorenson, BA, 1995, MCPA-R042)

Analyte:	MCPA, MCPA 2-EHE and MCPA DMA (as MCPA)	GC/MSD	Method QMAM94018
LOQ:	0.01 mg/kg.		
Description	Pasture grass is extracted at 70 °C in basic methanol, filtered and adjusted to a known volume. An aliquot of the extract is acidified, partitioned with diethylether and the aqueous layer discarded. The ether extract is back-partitioned with $NaHCO_3$, acidified and passed through a C-18 solid phase extraction (SPE) cartridge. The MCPA is eluted with an acetone/hexane solution, converted to an ammonium salt, evaporated to dryness and redissolved in acidic methanol. The MCPA is derivatised to MCPA methyl ester, quenched with water and the MCPA methyl ester partitioned into hexane. The hexane fraction is oxidized in the presence of potassium permanganate and reduced with sodium sulphite. The solution is cleaned-up on a micro alumina column. The MCPA methyl ester is eluted with ether/hexane, evaporated to a known volume and an aliquot taken for determination by GC/MSD.		

Determination of 4-chloro-2-methylphenoxyacetic acid 2-ethylhexyl ester (MCPA 2-EHE) and 4-chloro-2-methylphenoxyacetic acid dimethylamine salt (MCPA DMAS) as their 4-chloro-2-methylphenoxyacetic acid (MCPA) equivalent, MCPA, 4-chloro-2-hydroxymethylphenoxyacetic acid (HMCPA), 4-chloro-2-hydroxymethylphenoxyacetic acid glucose conjugate (HMCPA GLU) as its HMCPA equivalent, and 4-chloro-2-carboxyphenoxyacetic acid (CCPA) in wheat forage samples by gas chromatography with mass selective detection. (Hughes, 1997, MCPA-R043). *(Method updated in Apr 1998 and Nov 1998;* Eberhard, JS, *et al.*, 2001, MCPA-R058*), (ILV, Covance Laboratories* (Morissey, MA, *et al.*, 2000, MCPA-R044)

Analyte:	MCPA, MCPA 2-EHE and MCPA DMA (as MCPA) HMCPA, HMPCA glucose conjugate (HMCPA GLU) (as HMCPA) CCPA	GC/MSD	Method 6698-107
LOQ:	Forage: 0.25 mg/kg. Grain: 0.01 mg/kg.		
Description	Forage samples are extracted with 0.1N sodium hydroxide and hydrolysed overnight at room temperature. The extract is filtered and after adjusting the pH to 5, hydrolysed with -glucosidase for 2 hours at 37 °C. The resulting solution is brought to a known volume and an aliquot partitioned with diethyl ether. The diethyl ether is concentrated to dryness and derivatised with a sulphuric acid/methanol solution. The reactants are partitioned into hexane, and the hexane concentrated to a known volume for quantitation by GC/MSD. Grain samples are extracted with basic methanol. The extract is filtered and after adjusting the pH to 5, hydrolysed with -glucosidase for 2 hours at 37 °C. The resulting solution is partitioned with diethyl ether, cleaned-up using a silica column, and repartitioned into diethyl ether. The diethyl ether is concentrated to dryness and derivatised with a sulphuric acid/methanol solution. The reactants are partitioned into hexane, and the hexane concentrated to a known volume for quantitation by GC/MSD.		

Analytical method for determination of MCPA, HMCPA and MCPB in cereals and grass. (Cumberbatch, DJ, 2000, MCPA-R045)

Analyte:	MCPA, HMCPA, MCPB	GC/MSD	Method ATM 592
LOQ:	0.05 mg/kg.		
Description	Samples are extracted with alkaline methanol (0.1M KOH/methanol, 20:80 v/v). After filtration, the extract is cleaned-up by liquid/liquid partition with 0.1M KOH, saturated NaCl and dichloromethane. The lower organic layer is discarded, and the aqueous phase is adjusted to pH < 2 and partitioned three times against dichloromethane. The combined dichloromethane fraction is then partitioned three times against 0.1M KOH, and the combined aqueous fraction adjusted to pH < 2, diluted with water and applied to a C-18 solid phase extraction (SPE) column. The aqueous eluant is discarded, the column dried and then eluted with MTBE. The MTBE eluant is evaporated to dryness, methylated with methanol/sulphuric acid and the methylated sample extracted with hexane. The methylated solutions are analysed by GC/MSD.		

Validation of analysis for MCPA, MCPB and HMCPA residues in peas (Wasser, C, 2001, MCPA-R046)

Analyte: MCPA, HMCPA, MCPB GC/MSD Method ATM 592

LOQ: 0.05 mg/kg.

Description Samples are extracted with alkaline methanol (0.1M KOH/methanol, 20:80 v/v). After filtration, the extract is cleaned-up by liquid/liquid partition with 0.1M KOH, saturated NaCl and dichloromethane. The lower organic layer is discarded, and the aqueous phase is adjusted to pH < 1 and partitioned three times against dichloromethane. The combined dichloromethane fraction is then partitioned three times against 0.1M KOH, and the combined aqueous fraction adjusted to pH < 1, diluted with water and applied to a C-18 solid phase extraction (SPE) column. The aqueous eluant is discarded, the column dried and then eluted with MTBE. The MTBE eluant is evaporated to dryness, methylated with methanol/sulphuric acid and the methylated sample extracted with hexane. The methylated solutions are analysed by GC/MSD.

Validation of analysis for MCPA, MCPB and HMCPA residues in maize (Wasser, C, 2001, MCPA-R047)

Analyte: MCPA, HMCPA, MCPB GC/MSD Method ATM 592

LOQ: 0.05 mg/kg.

Description Samples are extracted with alkaline methanol (0.1M KOH/methanol, 20:80 v/v). After filtration, the extract is cleaned-up by liquid/liquid partition with 0.1M KOH, saturated NaCl and dichloromethane. The lower organic layer is discarded, and the aqueous phase is adjusted to pH 0.5 to 0.8 and partitioned three times against dichloromethane. The combined dichloromethane fraction is then partitioned three times against 0.1M KOH and the combined aqueous fraction adjusted to pH 0.5 to 0.8, diluted with water and applied to a C-18 solid phase extraction (SPE) column. The aqueous eluant is discarded, the column dried and then eluted with MTBE. The MTBE eluant is evaporated to dryness, methylated with methanol/sulphuric acid and the methylated sample extracted with hexane. The methylated solutions are analysed by GC/MSD.

Validation of analysis for MCPA, MCPB and HMCPA residues in cereals (green plant, grain, straw) (Wasser, C, 2000, MCPA-R048)

Analyte: MCPA, HMCPA, MCPB GC/MSD Method ATM 592

LOQ: 0.05 mg/kg.

Description Samples are extracted with alkaline methanol (0.1M KOH/methanol, 20:80 v/v). After filtration, the extract is cleaned-up by liquid/liquid partition with 0.1M KOH, saturated NaCl and dichloromethane. The lower organic layer is discarded, and the aqueous phase is adjusted to pH < 1 and partitioned three times against dichloromethane. The combined dichloromethane fraction is then partitioned three times against 0.1M KOH, and the combined aqueous fraction adjusted to pH < 1, diluted with water and applied to a C-18 solid phase extraction (SPE) column. The aqueous eluant is discarded, the column dried and then eluted with MTBE. The MTBE eluant is evaporated to dryness, methylated with methanol/sulphuric acid and the methylated sample extracted with hexane. The methylated solutions are analysed by GC/MSD.

Validation of analysis for MCPA, MCPB and HMCPA residues in grass (Wasser, C., 2001, MCPA-R049)

Analyte:	MCPA, HMCPA, MCPB	GC/MSD	Method ATM 592
LOQ:	0.05 mg/kg.		
Description	Samples are extracted with alkaline methanol (0.1M KOH/methanol, 20:80 v/v). After filtration, the extract is cleaned-up by liquid/liquid partition with 0.1M KOH, saturated NaCl and dichloromethane. The lower organic layer is discarded, and the aqueous phase is adjusted to pH < 1 and partitioned three times against dichloromethane. The combined dichloromethane fraction is then partitioned three times against 0.1M KOH, and the combined aqueous fraction adjusted to pH < 1, diluted with water and applied to a C-18 solid phase extraction (SPE) column. The aqueous eluant is discarded, the column dried and then eluted with MTBE. The MTBE eluant is evaporated to dryness, methylated with methanol/sulphuric acid and the methylated sample extracted with hexane. The methylated solutions are analysed by GC/MSD.		

Validation of a GC/MS Method of Analysis of 2,4-D, MCPA, and 2,4-D ethylhexyl ester in Cereal Grain and Straw. (Rawle, NW, 2001, MCPA-R050)

Analyte:	MCPA	GC/MSD	Method 1172
	2,4-D and 2,4-D 2-ethylhexyl ester (as 2,4-D)		
LOQ:	0.05 mg/kg.		
Description	Samples are extracted with aqueous methanol. After filtration, an aliquot of the extract is reacted with sulphuric acid and the methanol removed by rotary evaporation. Water is added to the extract and the residues extracted into cyclohexane/ethyl acetate (50:50 v/v) prior to clean-up by GPC. After GPC, the extract is evaporated to dryness and methylated with acidic methanol. Water is added and the residue extracted into isooctane. The isooctane extract is partitioned with saturated sodium sulphate and then shaken with saturated sodium chloride solution, prior to analysis by GC-MSD.		

Validation of an Analytical Method for Determination of Residues of MCPA in Cereals and Grass. (Pfarl, DIC, 1994, MCPA-R051)

Analyte:	MCPA	GC/MSD	Method 1172a
LOQ:	0.05 mg/kg.		
Description	Samples are extracted with methanol/water (80:20 v/v). After filtration, an aliquot of the extract is basified and rotary evaporated to dryness. The residue is redissolved in sulphuric acid and extracted into cyclohexane/ethyl acetate (1:1 v/v) prior to clean-up by GPC. After GPC, the extract is evaporated to dryness and methylated with acidic methanol. Water is added and the residue extracted into isooctane. The isooctane extract is partitioned with sodium hydrogen carbonate solution and then shaken with anhydrous sodium sulphate, prior to analysis by GC-MSD.		

MCPA—Validation of methodology for the determination of residues of MCPA in rape seed (Harper, H, 2005, MCPA-R052)

Analyte:	MCPA	GC/MSD	Method ATM 592
LOQ:	0.05 mg/kg.		
Description	Samples are extracted with alkaline methanol (0.1M KOH/methanol, 20:80 v/v). After filtration, the diluted extract is cleaned-up by liquid/liquid partition with 0.1M KOH, saturated sodium chloride and hexane. The upper hexane layer is discarded, and the partition with hexane repeated. The aqueous layer is then partitioned with dichloromethane, the lower organic layer is discarded, and the aqueous phase is adjusted to pH < 2 and partitioned three times against dichloromethane. The combined dichloromethane fraction is then partitioned three times against 0.1M KOH, and the combined aqueous fraction adjusted to pH < 2, diluted with water and applied to a C-18 solid phase extraction (SPE) column. The aqueous eluant is discarded, the column dried and then eluted with MTBE. The MTBE eluant is evaporated to dryness, methylated with methanol/sulphuric acid and the methylated sample extracted with hexane. The methylated solution is analysed for MCPA methyl ester by GC/MSD.		

MCPA—Independent Laboratory Validation of Methodology for the determination of MCPA in Grain and Straw and Validation of the Methodology for the Determination of MCPA in Apples. (Harper, H, 2005, MCPA-R053)

Analyte:	MCPA	GC/MSD	Method ATM 592
LOQ:	0.05 mg/kg.		
Description	Samples are extracted with alkaline methanol (0.1M KOH/methanol, 20:80 v/v). After filtration, the extract is cleaned-up by liquid/liquid partition with 0.1M KOH, saturated NaCl and dichloromethane. The lower organic layer is discarded, and the aqueous phase is adjusted to pH < 2 and partitioned three times against dichloromethane. The combined dichloromethane fraction is then partitioned three times against 0.1M KOH, and the combined aqueous fraction adjusted to pH < 2, diluted with water and applied to a C-18 solid phase extraction (SPE) column. The aqueous eluant is discarded, the column dried and then eluted with MTBE. The MTBE eluant is evaporated to dryness, methylated with methanol/sulphuric acid and the methylated sample extracted with hexane. The methylated solution is analysed for MCPA methyl ester by GC/MSD.		

Magnitude and Decline of MCPA and Metabolite Residues from Application of MCPA Dimethylamine Salt and MCPA 2-Ethylhexyl Ester to Flax in Canada. (Jones, GL, 2007, MCPA-R128;)

Analyte	MCPA	GC/MSD	Method 6698-107, modified
LOQ	0.01 mg/kg		

Description: The sample is extracted with basic methanol at room temperature. The extract is filtered, the methanol removed and after adjusting the pH to 5, hydrolysed with ß-glucosidase for 2 hours at 37 ºC. The resulting solution was acidified and partitioned with diethyl ether. The diethyl ether was concentrated to a low volume, dried, cleaned on a silica column, and repartitioned back into diethyl ether. The diethyl ether was concentrated to incipient dryness and derivatised with a sulphuric/methanol solution. Derivatives were partitioned into hexane, concentrated to a known volume and injected using gas chromatography with mass selective detection (GC/MSD) for quantitation.

Magnitude of Residues of MCPA in Dairy Cow Milk and Tissues. (Koch, DA, 2007, MCPA-R137)

Analyte: MCPA, HMCPA, CCPA GC/MSD Method PTRL 1905, modified

LOQ 0.05 mg/kg for tissues; 0.01 mg/kg for milk

Description Residues of MCPA are extracted from beef muscle tissue by blending with acidified acetonitrile. The centrifuged and filtered homogenate is then diluted with water and partitioned into diethyl ether then back-extracted into 0.1% NaOH solution. After removing the residual organic solvent in the basic extract, the extract is acidified and loaded onto C-8 and C-18 solid phase extraction (SPE) columns placed in series. Methyl-t-butyl ether (MTBE) is used to elute the columns. After concentration, MCPA is methylated using boron trifluoride in methanol (BFa/MeOH).

Beef fat tissue is extracted by blending in hexane and extracting the MCPA into 0.1% NaOH. After acidification, diethyl ether is used to partition the analyte from the aqueous phase. The diethyl ether is then back-extracted into 0.1% NaOH and then further processed as described above for the muscle method.

Milk is refluxed with concentrated HC1 for 1 hour. After cooling, the aqueous hydrolysate is diluted with acetonitrile and sodium chloride added to effect a phase separation. The acetonitrile layer is percolated through Florisil and further processed as described below for the beef kidney and liver. The derivatised extracts are analysed for MCPA by GC/MSD, comparing against external MCPA methyl ester standards prepared from the neat material.

Validated Analytical Method for the Determination of 4-Chloro-2-Methylphenoxy acetic Acid (MCPA), MCPA Glycine Conjugate, 4-Chloro-2-hydroxymethylphenoxy-acetic acid (HMCPA) and HMCPA glucose conjugate in Beef Tissues, Milk and Cream. (Johnson, T, and King, DL, 2001, MCPA-R054)

Analyte:	MCPA and MCPA glycine conjugate (as MCPA) HMCPA and HMCPA glucose conjugate (as HMCPA MME)	LC/MS	Method PTRL Report no. 2117
LOQ:	MCPA and conjugate: beef muscle, fat, liver, kidney, and cream 0.05 mg/kg; milk 0.01 mg/kg. HMCPA and conjugate: beef muscle, fat, liver, kidney, cream 0.05 mg/kg; milk 0.01 mg/kg		
Description	Beef muscle, liver and kidney or milk is hydrolysed with 2N HCl. Beef fat and cream are homogenized with hexane and partitioned with 1% NaOH, and the resulting aqueous phase is then hydrolysed with 2N HCl. The HCl hydrolysate is partitioned with acetonitrile. The organic phase is subjected to solid-phase extraction (SPE) on Florisil. The SPE eluant is concentrated by rotary evaporation and partitioned with ethyl acetate and cyclohexane. A portion of the aqueous phase is subjected to C-18 SPE clean-up. Following elution with tert-butyl methyl ether (MTBE), the sample is evaporated to dryness and methylated with 1:1 v/v H_2SO_4/methanol. The methyl ester and methyl ether derivatives are diluted in water and partitioned with hexane. The products in the hexane phase are then hydrolysed with 10% NaOH to produce the sodium salts of each compound. Following removal of hexane, the compounds are dissolved in saturated NaCl solution and HCl. The hydrolysed product, MCPA free acid and HMCPA monomethyl ether (HMCPA MME) are then partitioned into acetonitrile, concentrated and quantified by LC/MS in selected ion mode utilising internal standards of [^{13}C]-MCPA and [^{13}C]-HMCPA.		

MCPA—Independent Laboratory Validation of Methodology for the Determination of Residues of MCPA in Two Soil Types. (Harper, H, 2005, MCPA-R055)

Analyte:	MCPA	GC/MSD	BASF Method 173 and supplement 173/2

LOQ: 0.01 mg/kg.

Description Soil is extracted with methanol/water (80:20 v/v). After filtration, an aliquot of the extract is basified with 10M NaOH to convert the MCPA esters to the free acid, and then rotary evaporated. The residue is diluted with water, partitioned twice with dichloromethane and the dichloromethane layers discarded. The aqueous layer is acidified with 6N sulphuric acid and partitioned three times with dichloromethane. The combined dichloromethane extracts are filtered through sodium sulphate and rotary evaporated to dryness. The residue is mixed with acidic methanol to derivatise the MCPA to the methyl ester. The solution is partitioned with water and hexane. The hexane layer is washed with saturated sodium hydrogen carbonate, dried with sodium sulphate, evaporated to dryness and reconstituted in hexane/ethyl acetate (9:1 v/v). Further clean-up is by solid phase extraction (SPE) using Si cartridges; the eluate is evaporated to dryness and redissolved in hexane for quantitation by GC/MSD.

A summary of analytical method and procedural recoveries are presented in Table 26.

Table 26 Analytical recoveries for spiked MCPA, HMCPA and CCPA in various substrates

Commodity	Compound fortified	Fortification, mg/kg	n	Mean recov %	Range recov %	Method	Ref
Bovine muscle	MCPA	0.05–5.0	17	99%	81–118%	2117	MCPA-R054
Bovine muscle	HMCPA	0.05–5.0	17	106%	89–117%	2117	MCPA-R054
Bovine muscle	MCPA	0.05–0.5	9	104%	75–120%	PTRL 1905	MCPA-R137
Bovine liver	MCPA	0.05–0.5	10	106%	91–118%	PTRL 1905	MCPA-R137
Bovine liver	MCPA	0.05–75	17	97%	76–116%	2117	MCPA-R054
Bovine liver	HMCPA	0.05–7.5	17	99%	77–118%	2117	MCPA-R054
Bovine kidney	MCPA	0.05–0.5	10	95%	81–108%	PTRL 1905	MCPA-R137
Bovine kidney	MCPA	0.05–75	17	94%	78–110%	2117	MCPA-R054
Bovine kidney	HMCPA	0.05–7.5	17	105%	74–116%	2117	MCPA-R054
Bovine fat	MCPA	0.05–0.5	9	88%	75–100%	PTRL 1905	MCPA-R137
Bovine fat	MCPA	0.05–5.0	17	83%	70–94%	2117	MCPA-R054
Bovine fat	HMCPA	0.05–5.0	17	103%	79–119%	2117	MCPA-R054
Bovine milk	MCPA	0.01–0.10	10	85%	63–107%	PTRL 1905	MCPA-R137
Bovine milk	MCPA	0.01–1.0	17	98%	77–119%	2117	MCPA-R054
Bovine milk	HMCPA	0.01–1.0	17	109%	93–117%	2117	MCPA-R054
Bovine cream	MCPA	0.05–5.0	17	85%	72–114%	2117	MCPA-R054
Bovine cream	HMCPA	0.05–5.0	17	105%	81–119%	2117	MCPA-R054
Pasture grass	MCPA	0.01–1.0	13	86%	72–96%	QMAM94008	MCPA-R041
Pasture grass	MCPA	0.01–1.0	18	80%	64–93%	QMAM94018	MCPA-R042
Wheat forage	MCPA	0.25–25	7	86%	74–97%	6698-107	MCPA-R043

Commodity	Compound fortified	Fortification, mg/kg	n	Mean recov %	Range recov %	Method	Ref
Wheat forage	HMCPA	0.25–25	7	83%	66–98%	6698-107	MCPA-R043
Wheat forage	CCPA	0.25–25	7	91%	68–112%	6698-107	MCPA-R043
Wheat forage	2-EHE	2.5	2	75%	73–76%	6698-107	MCPA-R043
Wheat grain	MCPA	0.01–1.0	10	89%	77–99%	6698-107	MCPA-R058
Wheat grain	HMCPA	0.01–1.0	10	82%	72–96%	6698-107	MCPA-R058
Wheat grain	CCPA	0.01–1.0	10	82%	66–100%	6698-107	MCPA-R058
Pea green plant	MCPA	0.05–250	15	97%	84–108%	ATM 592	MCPA-R046
Pea green plant	HMCPA	0.05–2.5	9	41%	32–47%	ATM 592	MCPA-R046
Pea green plant	HMCPA [a]	0.05–50	6	86%	–	ATM 592	MCPA-R046
Pea grain	MCPA	0.05–0.5	9	94%	71–119%	ATM 592	MCPA-R046
Pea grain	HMCPA	0.05–0.5	9	33%	8–61%	ATM 592	MCPA-R046
Pea grain	HMCPA [a]	0.05–1.0	6	86%	–	ATM 592	MCPA-R046
Pea haulm	MCPA	0.05–2.5	9	100%	85–108%	ATM 592	MCPA-R046
Pea haulm	HMCPA	0.05–2.5	9	33%	7–116%	ATM 592	MCPA-R046
Pea haulm	HMCPA [a]	0.05–0.5	6	92%	–	ATM 592	MCPA-R046
Maize green plants	MCPA	0.05–250	14	95%	72–112%	ATM 592	MCPA-R047
Maize green plants	HMCPA [b]	0.05–2.5	9	84%	70–98%	ATM 592	MCPA-R047
Maize cobs	MCPA	0.05–0.5	9	88%	72–109%	ATM 592	MCPA-R047
Maize cobs	HMCPA [c]	0.05–0.5	9	61%	41–86%	ATM 592	MCPA-R047
Maize grain	HMCPA [d]	0.05–0.5	2	84%	–	ATM 592	MCPA-R047
Cereal green plant	MCPA	0.05–250	15	98%	82–128%	ATM 592	MCPA-R048
Cereal green plant	HMCPA [c]	0.05–2.5	9	28%	21–39%	ATM 592	MCPA-R048
Cereal green plant	HMCPA [e]	0.05–250	15	81%	–	ATM 592	MCPA-R048
Cereal grain	MCPA	0.05–0.5	9	85%	62–123%	ATM 592	MCPA-R048
Cereal grain	HMCPA [b]	0.05–0.5	9	86%	60–127%	ATM 592	MCPA-R048
Cereal straw	MCPA	0.05–2.5	9	95%	80–113%	ATM 592	MCPA-R048
Cereal straw	HMCPA [b]	0.05–2.5	9	89%	76–109%	ATM 592	MCPA-R048
Grass	MCPA	0.05–250	15	102%	71–120%	ATM 592	MCPA-R049
Grass	HMCPA [c]	0.05–2.5	9	48%	28–63%	ATM 592	MCPA-R049
Grass	HMCPA [f]	0.05–400	11	88%	74–120%	ATM 592	MCPA-R049
Wheat grain	MCPA	0.05–0.5	8	99%	84–108%	1172	MCPA-R050
Barley grain	MCPA	0.05–0.5	8	98%	89–102%	1172	MCPA-R050
Wheat straw	MCPA	0.05–0.5	8	102%	94–107%	1172	MCPA-R050
Barley straw	MCPA	0.05–0.5	8	84%	71–94%	1172	MCPA-R050
Cereal whole plant	MCPA	0.05–1.0	12	93%	–	1172 a	MCPA-R051
Cereal grain	MCPA	0.05–1.0	12	84%	–	1172 a	MCPA-R051
Grass	MCPA	0.05–1.0	12	87%	–	1172 a	MCPA-R051
Hay	MCPA	0.05–1.0	11	94%	–	1172 a	MCPA-R051
Rape seed	MCPA	0.05–5.0	12	81%	72–99%	ATM 592	MCPA-R052

Commodity	Compound fortified	Fortification, mg/kg	n	Mean recov %	Range recov %	Method	Ref
Cereal grain	MCPA	0.05–0.5	12	83%	71–94%	ATM 592	MCPA-R053
Cereal straw	MCPA	0.05–0.5	12	89%	73–104%	ATM 592	MCPA-R053
Apples	MCPA	0.05–0.5	12	86%	72–101%	ATM 592	MCPA-R053
Soil (high organic)	MCPA	0.05–0.5	12	97%	93–108%	173 and 173/2	MCPA-R055
Soil (low organic)	MCPA	0.05–0.5	12	81%	75–106%	173 and 173/2	MCPA-R055

[a] Procedural recovery data for HMCPA from studies 9121 and 9122, after method modification.

[b] Procedural recovery data for HMCPA after method modification.

[c] Procedural recovery data for HMCPA before method modification.

[d] Procedural recovery data for HMCPA from study 9120, after method modification.

[e] Procedural recovery data for HMCPA from studies 9114, 9115 and 9116, after method modification.

[f] Procedural recovery data for HMCPA from studies 9117, 9118 and 9119, after method modification.

The multi-residue method for acids and phenols designated as Section 402 in the 3rd edition of the Pesticide Analytical Manual, Vol I (PAM I) has been regarded by EPA as an adequate enforcement method for MCPA and other acidic and phenolic compounds. The method can be used to determine MCPA in a variety of fatty and non-fatty commodities, including cereals, animal tissues, dairy products and legumes. The method was originally developed for chlorophenoxy compounds but has been found to be applicable to a larger number of acidic and phenolic compounds. Acidic and phenolic residues are extracted from commodities acidified with sulfuric acid by various techniques dictated by the type of commodity. The extract is cleaned up by gel permeation chromatography (GPC) and residues in the concentrated extract are methylated by ion pair alkylation and further cleaned up by Florisil column chromatography. The resulting methyl esters are determined by GC. Certain residues can be determined only by element-selective GC detectors. Using the above multi-residue method, extraction method E1, GPC clean-up and GC/ECD, recoveries were 78 to 89% for MCPA (PESTDATA, PAM Vol I, Appendix 1).

Stability of residues in stored analytical samples

The Meeting received information on the stability of residues of MCPA DMA, 2-HMCPA, CCPA and MCPA 2-EHE residues in cereals (forage, straw, grain and wheat flour) and pasture grass (hay and forage). In addition to these individual studies, storage stability determinations, together with procedural recovery analyses, were also carried out concurrently with the field trials samples and are reported in the residue trials reports.

A freezer storage stability study was conducted on wheat commodities (forage, straw, grain and flour) and pasture grass (forage and hay) in 1999–2001 (Eberhard, JS, *et al.*, 2001, MCPA-R058). Homogenized untreated samples were obtained from various magnitudes of residue studies. Approximately 5 g (wheat forage, wheat straw, pasture grass and pasture hay) or 10 g (wheat grain and wheat flour) samples were fortified with MCPA DMA, HMCPA and CCPA, at a concentration of 2.5 mg/kg acid equivalents (forage, straw and hay) or 0.1 mg/kg acid equivalents (grain and flour). Similarly, approximately 5 g (wheat forage, wheat straw, pasture grass and pasture hay) or 10 g (wheat grain and wheat flour) samples were separately fortified with MCPA 2-EHE at a concentration of 2.5 mg/kg acid equivalents (forage and straw, hay) or 0.1 mg/kg acid equivalents (grain and flour). The samples were then frozen at nominally -20 ± 10 °C for an interval of up to 1 year or longer. Wheat forage, straw and grain and pasture grass and hay samples were analysed at nominal 0, 45, 89, 174, 265 and 369 day intervals after fortification and freezing. Wheat flour samples were analysed at nominal 0, 56, 118, 188, 279, 406 and 541 day intervals after fortification and freezing.

At each time point, one untreated sample and three treated samples spiked just before analysis with MCPA DMA, HMCPA and CCPA at 2.5 mg/kg acid equivalents (forage, straw and hay) or

0.1 mg/kg acid equivalents (grain and flour) and three samples stored at -20 ± 10 °C until samples were analysed.

At each time point, one untreated sample and three untreated samples spiked just before analysis with MCPA 2-EHE at 2.5 mg/kg acid equivalents (forage, straw and hay) or 0.1 mg/kg acid equivalents (grain and flour) and three samples stored at -20 ± 10 °C until samples were analysed.

Residues were determined by GC-MSD using method 6698-107 (Hughes, D, *et al*, 1997, MCPA-R043) for forage and hay, which had been previously validated with an LOQ of 0.25 mg/kg acid equivalents for forage and hay, and 0.01 mg/kg acid equivalents for grain.

The results showed that residues of MCPA DMA, HMCPA, CCPA and MCPA 2-EHE were stable for up to 12 months in wheat forage, straw and grain and pasture grass forage and hay following storage at -20 ± 10 °C in Tables 27 to 38. Residues of MCPA DMA, HMCPA, CCPA and MCPA 2-EHE were also stable for up to 17.5 months in wheat flour following storage at -20 ± 10 °C.

Table 27 Stability of residues of MCPA DMA salt in wheat commodities following frozen storage (Eberhard, JS, *et al.*, 2001, MCPA-R058)

Time (days)	Wheat forage (n = 3)		Time	Wheat straw (n = 3)		Time	Wheat grain (n = 3)	
	Procedural recovery (%)	MCPA DMA salt after storage (% remaining)	(days)	Procedural recovery (%)	MCPA DMA salt after storage (% remaining)	(days)	Procedural recovery (%)	MCPA DMA salt after storage (% remaining)
0	105	105	0	89	89	0	88	88
45	107	102	37	86	88	78	93	79
90	105	100	91	90	88	140	101	90
168	101	97	176	89	86	182	99	84
267	109	106	267	94	91	274	93	87
371	108	105	371	88	90	378	96	79

Table 28 Stability of residues of MCPA DMA salt in grass commodities following frozen storage (Eberhard, JS, *et al.*, 2001, MCPA-R058)

Time (days)	Pasture grass hay (n = 3)		Time	Pasture grass forage (n = 3)	
	Procedural recovery (%)	MCPA DMA after storage (% remaining)	(days)	Procedural recovery (%)	MCPA DMA after storage (% remaining)
0	94	94	0	110	110
41	94	88	39	110	109
90	94	86	88	93	94
180	98	96	172	98	99
272	96	97	264	104	106
371	99	99	369	107	109

Table 29 Stability of residues of MCPA DMA salt in wheat flour following frozen storage (Eberhard, JS, *et al.*, 2001, MCPA-R058)

Time (days)	Wheat flour (n = 3)	
	Procedural recovery (%)	MCPA DMA after storage (% remaining)

Time (days)	Wheat flour (n = 3)	
	Procedural recovery (%)	MCPA DMA after storage (% remaining)
0	79	79
56	94	73
118	91	80
188	88	80
279	89	78
408	77	53
539	111	107

Table 30 Stability of residues of HMCPA in wheat commodities following frozen storage (Eberhard, JS, *et al.*, 2001, MCPA-R058)

Time (days)	Wheat forage (n = 3)		Time (days)	Wheat straw (n = 3)		Time (days)	Wheat grain (n = 3)	
	Procedural recovery (%)	HMCPA after storage (% remaining)		Procedural recovery (%)	HMCPA after storage (% remaining)		Procedural recovery (%)	HMCPA after storage (% remaining)
0	108	108	0	92	92	0	105	105
42	101	98	37	86	88	78	107	87
90	104	97	91	95	94	140	114	101
168	108	82	176	96	94	182	109	90
267	117	115	267	102	97	274	88	84
371	106	104	371	86	87	378	102	81

Table 31 Stability of residues of HMCPA in grass commodities following frozen storage (Eberhard, JS, *et al.*, 2001, MCPA-R058)

Time (days)	Pasture grass hay (n = 3)		Time (days)	Pasture grass forage (n = 3)	
	Procedural recovery (%)	HMCPA after storage (% remaining)		Procedural recovery (%)	HMCPA after storage (% remaining)
0	98	98	0	111	111
41	90	86	39	106	102
90	98	89	88	99	94
180	108	107	172	99	92
272	106	107	264	113	108
371	88	91	369	106	99

Table 32 Stability of residues of HMCPA in wheat flour following frozen storage (Eberhard, JS, *et al.,* 2001, MCPA-R058)

Time (days)	Wheat flour (n = 3)	
	Procedural recovery (%)	2-HMCPA after storage (% remaining)
0	72	72
56	100	78

Time (days)	Wheat flour (n = 3)	
	Procedural recovery (%)	2-HMCPA after storage (% remaining)
118	103	83
188	94	76
279	93	77
408	109	86
539	77	75

Table 33 Stability of residues of CCPA in wheat commodities following frozen storage (Eberhard, JS, *et al.,* 2001, MCPA-R058)

Time (days)	Wheat forage (n = 3)		Time (days)	Wheat straw (n = 3)		Time (days)	Wheat grain (n = 3)	
	Procedural recovery (%)	CCPA after storage (% remaining)		Procedural recovery (%)	CCPA after storage (% remaining)		Procedural recovery (%)	CCPA after storage (% remaining)
0	88	88	0	88	88	0	86	86
42	87	85	37	76	75	78	78	67
90	100	97	91	78	76	140	103	99
168	92	92	176	78	78	182	89	81
267	90	91	267	71	71	274	82	75
371	96	91	371	71	71	378	93	71

Table 34 Stability of residues of CCPA in grass commodities following frozen storage (Eberhard, JS, *et al.,* 2001, MCPA-R058)

Time (days)	Pasture grass hay (n = 3)		Time (days)	Pasture grass forage (n = 3)	
	Procedural recovery (%)	CCPA after storage (% remaining)		Procedural recovery (%)	CCPA after storage (% remaining)
0	106	106	0	94	94
41	78	79	39	96	97
90	84	77	88	77	79
180	82	82	172	94	97
272	82	81	264	87	94
371	72	73	369	92	89

Table 35 Stability of residues of CCPA in wheat flour following frozen storage (Eberhard, JS, *et al.,* 2001, MCPA-R058)

Time (days)	Wheat flour (n = 3)	
	Procedural recovery (%)	CCPA after storage (% remaining)
0	70	70
56	87	71

118	83	71
188	87	68
279	80	67
408	108	78
539	70	53

Table 36 Stability of residues of MCPA 2-EHE in wheat commodities following frozen storage (Eberhard, JS, *et al.*, 2001, MCPA-R058)

Time (days)	Wheat forage (n = 3)		Time	Wheat straw (n = 3)		Time	Wheat grain (n = 3)	
	Procedural recovery (%)	MCPA 2-EHE after storage (% remaining)	(days)	Procedural recovery (%)	MCPA 2-EHE after storage (% remaining)	(days)	Procedural recovery (%)	MCPA 2-EHE after storage (% remaining)
0	100	100	0	84	84	0	NA	NA
43	96	94	38	81	87	48	95	82
90	89	90	87	82	81	125	90	71
182	90	94	183	80	82	195	97	79
271	112	94	268	88	87	266	103	79
371	103	103	372	90	92	364	89	73

NA: not applicable.

Table 37 Stability of residues of MCPA 2-EHE in grass commodities following frozen storage (Eberhard, JS, *et al.*, 2001, MCPA-R058)

Time (days)	Pasture grass hay (n = 3)		Time	Pasture grass forage (n = 3)	
	Procedural recovery (%)	MCPA 2-EHE after storage (% remaining)	(days)	Procedural recovery (%)	MCPA 2-EHE after storage (% remaining)
0	88	88	0	88	88
42	87	84	40	95	99
91	92	88	89	97	108
182	86	84	173	90	94
280	88	89	265	103	104
377	96	96	370	102	102

Table 38 Stability of residues of MCPA 2-EHE in wheat flour following frozen storage (Eberhard, JS, *et al.,* 2001, MCPA-R058)

Time (days)	Wheat flour (n = 3)	
	Procedural recovery (%)	MCPA 2-EHE after storage (% remaining)
0	91	91
62	97	97

125	99	92
189	93	97
280	86	89
406	80	82
532	110	110

Another storage stability study on cereals (green plant, grain and straw) was conducted in 2000–2002 (Wasser, C, 2002, MCPA-R059). In this study samples were fortified with 0.05 mg/kg MCPA or HMCPA, stored at < -18 ºC, and analysed after intervals of nominally 0, 90, 180, 465 and 545 days. Concurrent recoveries were conducted at the same level of fortification using freshly spiked samples. At each time point two control samples, three fortified stored samples and one freshly fortified control sample were analysed. Residues of MCPA or HMCPA were determined by GC-MSD, following method ATM 592 (Wasser, C, 2000, MCPA-R048). The LOQ for the method was 0.05 mg/kg. The results (Tables 39, 40 and 41) show that MCPA and HMCPA residues in cereal green plants, grain and straw are stable for up to 18 months when stored frozen at < -18 ºC.

Table 39 Stability of residues of MCPA in cereal commodities following frozen storage (Wasser, C, 2002, MCPA-R059)

Time (days)	Cereal green plants (n = 3)		Cereal grain (n = 3)		Cereal straw (n = 3)	
	Procedural recovery (%)	MCPA after storage (% remaining)	Procedural recovery (%)	MCPA after storage (% remaining)	Procedural recovery (%)	MCPA after storage (% remaining)
0	88	88	105	105	82	82
90	109	87	105	86	91	87
180	76	71	90	74	89	84
365	93	97	81	71	78	81
545	101	81	93	81	89	83

Table 40 Stability of residues of HMCPA in cereal commodities following frozen storage (Wasser, C, 2002, MCPA-R059)

Time (days)	Cereal green plants (n = 3)		Cereal grain (n = 3)		Cereal straw (n = 3)	
	Procedural recovery (%)	HMCPA after storage (% remaining)	Procedural recovery (%)	HMCPA after storage (% remaining)	Procedural recovery (%)	HMCPA after storage (% remaining)
0	74	74	72	72	72	72
90	85	89	72	88	77	85
180	78	83	70	78	75	82
365	85	95	70	78	70	90
545	86	88	83	91	81	87

Residues in milk and animal tissues

The stability of MCPA residues in milk and animal tissues during frozen storage was investigated as part of the livestock metabolism and feeding studies. In the lactating goat metabolism study (Sabourin, PJ, and Koebel, DD, 1995, MCPA-R016), tissues and milk collected were stored at -20 ºC until extraction and analysis. The maximum period of storage from collection of samples to analysis was 198 days (about 28 weeks). To optimize stability the entire tissue samples were not homogenized; rather they were cut into small pieces and only a randomly selected sample was homogenized as needed. The concentrations of MCPA, MCPA-glycine (milk only) and triglycerides (remaining tissues) following frozen storage at about -20 ºC for up to about 46 weeks indicated that the metabolite profile in milk and tissues did not change significantly over the storage interval (Table 41).

Table 41 Residues in milk and tissue samples from goats treated with MCPA, following storage at -20 ºC (Sabourin, PJ, and Koebel, DD, 1995, MCPA-R016)

Tissue	Initial mean extractable residue [a] (% TRR)	Extractable residue after 46 weeks storage [b] (% TRR)	MCPA (mg/kg) [c]		Major metabolites (mg/kg) [c]	
			Initial	After storage	Initial	After storage
Milk	84.6	100.1	0.046	0.036	0.086	0.080 [d]
Muscle	76.2	87.6	0.020	0.023	0.048	0.035 [e]
Fat	94.4	119.1	0.042	0.085	0.042	0.040 [e]
Liver	63.4	75.0	0.011	0.016	0.239	0.316 [e]
Kidney	83.7	80.8	0.053	0.059	0.497	0.440 [e]

[a] Mean % TRR in methanol/water extract of tissue.

[b] Value from single extraction.

[c] Value from a single HPLC determination

[d] Glycine conjugate of MCPA

[e] Metabolite with retention time approximately 26 minutes

Stability of MCPA in milk and edible tissues was also determined as part of the cattle feeding study (Koch, DA, 2007, MCPA-R137). Cattle tissues were stored at -20 ºC for about 73 days from collection to analysis.

For storage stability tests at least five sets of samples were prepared for each matrix (milk, kidney, liver, fat and muscle). The first set of samples served as the Day 0 set of analyses and consisted of one control and three fortifications at 10× the LOQ for the respective matrix. For milk the 10× level was approximately 100 ppb, and for the tissues the 10× level was approximately 500 ppb. Each of the four stability sets consisted of samples weighed (25 g for milk and 5 g for the tissues) into 60 mL containers and were composed of one control, two controls were reserved for fortifying on the day of analysis and 2 fortified at 10× LOQ on Day 0. Following fortification the samples were placed in frozen storage until removal for analysis. One set per matrix was analysed approximately 1 to 2 months following fortification, and a second set was analysed at an interval which exceeded the maximum elapsed time between sampling and analysis for the treated study samples for that matrix. The remaining two sets functioned as backup samples, as well as reserves to extend the stability time intervals if desired.

MCPA was determined to be stable in storage up to at least 4 months in liver and milk, 5 months in kidney and fat, and 3 months in muscle samples (Table 42).

Table 42 Stability of MCPA in samples of milk and animal tissues stored at -20 ºC (Koch, DA, 2007, MCPA-R137)

Matrix	Storage interval (days)	Fortification (ppb MCPA)	Average Procedural recovery (%)	Average Recovery after storage (%)
Milk	0	101	95	95
	32	101	113	105

Matrix	Storage interval (days)	Fortification (ppb MCPA)	Average Procedural recovery (%)	Average Recovery after storage (%)
	120	101	96	97
Liver	0	504	111	111
	37	502	88	91
	134	507	100	118
Kidney	0	504	112	112
	37	504	96	86
	153	509	110	108
Muscle	0	505	99	99
	28	505	108	96
	112	506	104	116
Fat	0	505	100	100
	92	502	89	88
	172	505	87	105

Storage stability studies conducted on cereal and grass commodities demonstrated that MCPA DMA, 2-HMCPA, CCPA and MCPA 2-EHE are stable for up to 12 months in wheat forage, straw and grain, and grass forage and hay samples, and up to 17.5 months in wheat flour samples stored frozen at -20 ± 10 °C. Storage stability studies on cereal green plants, grain and straw showed that MCPA and HMCPA are stable in samples for up to 18 months when stored frozen at -18º C.

These crops are representative of the commodities covered in this submission. In most of the trials in this submission, the maximum period of frozen storage of samples prior to analysis falls within the stability period confirmed in these storage stability studies. In all of the field trial reports, recoveries from fortified stored samples, determined concurrently with field trial samples, confirmed stability of the residues of MCPA and the metabolites HMCPA and CCPA at the time of analysis.

In animal commodities the storage stability studies, conducted concurrently with the cattle feeding study, confirmed that residues of MCPA are stable when stored frozen up to at least 4 months in liver and milk, 5 months in kidney and fat, and 3 months in muscle samples. Samples from the metabolism study showed that MCPA, MCPA-glycine (milk only) and triglycerides (remaining tissues) were stable in frozen storage up to about 46 weeks.

USE PATTERN

Labels and English translations were available for all the uses. MCPA, which is applied either as an acid, its sodium, potassium or dimethylamine salts or its 2-ethylhexyl ester, is used for the control of broad-leaved weeds in cereals and grassland, peas and flax, in a number of soluble or emulsifiable concentrate formulations. A summary of the current approved label rates are provided in Table 43.

Table 43 Summary of registered uses of MCPA

Crop	Country	Formulation		Application				
		MCPA form applied	MCPA acid equiv. (g ae/L or kg) [a]	Method	Max. rate, kg ae/ha [a]	Water, L/ha (min–max)	No. or max kg ae/ha/ season	Growth stage
CEREAL GRAINS								

Crop	Country	Formulation		Application				
		MCPA form applied	MCPA acid equiv. (g ae/L or kg) [a]	Method	Max. rate, kg ae/ha [a]	Water, L/ha (min–max)	No. or max kg ae/ha/ season	Growth stage
Oats	Canada	2-EHE	600 EC	Foliar	0.54	50–200	1	3 leaf to early flag stage
Oats	Canada	DMA salt	600 SL	Foliar	0.54	50– 150	1	2-leaf to early flag-leaf stage
Wheat, Barley, Rye	Canada	2-EHE	500 EC 600 EC	Foliar	0.35–0.88	50–200	1	3 leaf to early flag stage
Wheat, Barley, Oats, Rye	Canada	Sodium salt	300 SL	Foliar	0.45–0.83	50–200	1	2-leaf to early flag leaf
Wheat, Barley, Oats, Rye	Canada	DMA salt	500 SL 600 SL	Foliar	0.63–0.88	100–150	1	Early flag leaf (shot blade) stage
Wheat, Barley	Spain	DMA salt	400 SL	Foliar	1.2	200	1	Before first node detectable
Wheat, Barley	Spain	Sodium or potassium salt	400 SL	Foliar	1.2	200	1	Before first node detectable
Wheat, Barley, Rye, Oats	UK	DMA salt	500 SL	Foliar	1.7	100–400	1	Before first node detectable
Wheat, Barley, Oats, Rye	USA	2-EHE	444 EC	Foliar	0.26–0.80	94	1	3–4 leaf up to early boot stage
Wheat, Barley, Oats, Rye	USA	DMA salt	480 SL	Foliar	0.84	94–1122	1	Early boot stage
Cereals under-seeded with alfalfa or trefoil	Canada	DMA salt	500 SL	Foliar	0.28	50–150	1	Early flag leaf (shot blade) stage
Cereals under-seeded with alfalfa or trefoil	Canada	DMA salt	600 SL	Ground	0.28	50–150	1	Early flag-leaf stage
Cereals under-seeded with legumes	Canada	Sodium salt	300 SL	Ground	0.45	50–200	1	Before cereals are at early flag leaf stage
Cereals under-seeded with red clover	UK	DMA salt	500 SL	Ground	0.7	100–400	1	–

Crop	Country	Formulation		Application				
		MCPA form applied	MCPA acid equiv. (g ae/L or kg) [a]	Method	Max. rate, kg ae/ha [a]	Water, L/ha (min–max)	No. or max kg ae/ha/ season	Growth stage
Cereals under-seeded with grass	UK	DMA salt	500 SL	Ground	1.4	100–400	1	–
Cereals Under-seeded with legumes	USA	DMA salt	400 SL	Foliar	0.28	94	1	Early boot stage
Cereals Under-seeded with legumes	USA	DMA salt	400 SL	Foliar	0.28	94	1	Early boot stage
Corn, field	Canada	DMA salt	500 SL	Ground	0.55	100	1	PHI = 15 days
Corn, field	Canada	DMA salt	600 SL	Ground	0.55	100	1	PHI = 15 days
Corn, field	Canada	Sodium salt	300 SL	Ground	0.6	100–200	1	PHI = 15 days
Corn, field	Spain	DMA salt	400 SL	Ground	0.8	200	1	From 4-leaf stage
Corn, field	Spain	Sodium or potassium salt	400 SL	Ground	0.8	200	1	From 4-leaf stage
LEGUMES								
Peas	Canada	DMA salt	500 SL	Foliar	0.25	150–200	1	Vines 10–20 cm but before flower buds formed
Peas	Canada	DMA salt	600 SL	Ground	0.25	150–200	1	Vines 10–20 cm but before flower buds formed
Peas	Canada	Sodium salt	300 SL	Ground	0.30	250–300		Peas 10–15 cm high but before flower buds formed
Peas	Spain	DMA salt	400 SL	Ground	1.6	200	1	Before bud forms
Peas	USA	DMA salt	400 SL	Foliar	0.14–0.42	47–280	1–2	3–7 inches but before first flowering
Peas	USA	2-EHE	440 EC	Broadcast	0.40	140	1	3–7 inches but before first flowering
OIL SEEDS								
Flax	Canada	DMA salt	500 SL	Foliar	0.875	100	1	Just before bud stage
Flax	Canada	DMA salt	600 SL	Ground	0.41	50–150	1	5 cm high to before bud stage
Flax	Canada	DMA salt	600 SL	Ground	0.50	50–150	1	5 cm high to before bud stage

Crop	Country	Formulation		Application				
		MCPA form applied	MCPA acid equiv. (g ae/L or kg) [a]	Method	Max. rate, kg ae/ha [a]	Water, L/ha (min–max)	No. or max kg ae/ha/ season	Growth stage
Flax	Canada	2-EHE	600 EC	Ground	0.42	50–150	1	5 cm to bud stage
Flax	Canada	Sodium salt	300 SL	Ground	0.53	100	1	5 cm to bud stage
Flax	Spain	DMA salt	400 SL	Ground	1.2		1	15 cm high
Flax	Spain	Sodium or potassium salt	400 SL	Ground	1.2		1	15 cm high
Flax	UK	DMA salt	500 SL	Ground	0.9	200–400	1	5–15 cm high
Flax	USA	2-EHE	440 EC	Ground	0.26	94	1	2–8 inches high
Flax	USA	DMA salt	480 EC	Ground	0.28	47–187	1	4–9 inches high
GRASSES								
Rangeland	Canada	DMA salt	500 SL	Foliar	1.7	50	2 at 90-day interval	Pre- to early bud stage
Pastures	Canada	DMA salt	500 SL	Foliar	1.7	50	2 at 90-day interval	Pre- to early bud stage
Pastures	Canada	DMA salt	600 SL	Ground	1.7	50	2 at 90-day interval	Pre- to early bud stage
Pastures	Canada	2-EHE	440 EC	Ground	1.7	100–300	2 at 90-day intervals	At time of rapid growth of weeds
Grasslands	Spain	DMA salt	400 g/L SL	Foliar	1.2-1.6	200–400	1	Weeds in active growth
Grassland	UK	DMA salt	500 SL	Ground	1.7-3.3	200–400	1–2 at 28 to 42 days interval	Majority of weeds are seedlings up to flower buds start forming
Grassed	UK	DMA salt	500 SL	Foliar	1.7	200–400	1	Grasses begin to tiller
Pastures/ rangeland	USA	DMA salt	480 SL	Foliar	1.7	19–1122	2	Early bud to full bloom
Rangeland/pastures	USA	2-EHE	440 EC	Ground	1.6-2.1	94	2 at least 21-day intervals	Prior to bud stage
Grasses grown for seeds	UK	DMA salt	500 SL	Ground	1.6	200	1	5 weeks before heading
Grasses grown for seeds	USA	DMA salt	480 SL	Foliar	1.7	19–1122	1	Before heads come to boot stage

Crop	Country	Formulation		Application				
		MCPA form applied	MCPA acid equiv. (g ae/L or kg) [a]	Method	Max. rate, kg ae/ha [a]	Water, L/ha (min–max)	No. or max kg ae/ha/ season	Growth stage
Grasses grown for seeds	USA	2-EHE	440 EC	Ground	1.0	94	1	Tiller to early bud stage

[a] ae = MCPA acid equivalent

The US label specifies the following additional restrictions:

Cereal grains:

Do not graze dairy animals on treated areas until 7 days after treatment.

Do not forage or graze meat animals on treated areas within 7 days of slaughter.

Peas:

Do not allow livestock to forage or graze treated fields.

Do not feed treated vines to livestock.

Do not allow dairy animals or meat animals being finished for slaughter to forage or graze treated areas within 7 days of application.

RESIDUES RESULTING FROM SUPERVISED TRIALS ON CROPS

The Meeting received information on supervised field trials for MCPA uses on the following crops.

Crop Group	Commodity	Country	Table No.
Cereals	Barley grain	Canada	Table 44
	Barley grain	France, Spain, Austria	Table 45
	Wheat grain	Canada, USA	Table 46
	Wheat grain	France, Spain, Austria	Table 47
	Corn grain	Canada	Table 48
Legume vegetables	Peas	Canada, USA	Table 49
Oilseeds	Flax	Canada, USA	Table 50
Legume animal feed	Pea forage	Canada, USA	Table 51
Straw, fodder and forages of cereal grains	Barley straw and hay	Canada, USA	Table 52
	Barley straw and forage	Austria, France, Spain, UK	Table 53
	Wheat forage, straw, and hay	Canada, USA	Table 54
	Wheat forage and straw	Austria, France, Spain, UK	Table 55
	Corn forage and stover	Canada	Table 56
Grasses (pasture, rangeland)	Grasses	Canada	Table 57
	Grasses	Austria, France, Spain, UK	Table 58

In addition to the description and details of the field trials, each report includes a summary of the analytical method(s) used, together with the corresponding procedural recoveries, and in most cases, concurrent recoveries in stored frozen samples. In the field trials where multiple analyses are conducted on a single sample or where multiple samples were taken from a single plot, the average residue value is reported. Where results from separate plots with distinguishing characteristics, such as different formulations, varieties or treatment schedules were reported, results are listed for each plot.

In the field trials MCPA was applied as either the 2-EHE, DMA salt or sodium or potassium salt formulations. Metabolism studies demonstrated that 2-EHE and DMA salt formulations dissociated into free MCPA. The sodium or potassium salts dissolved readily to form free MCPA. Analytical methods effectively measure “total” MCPA (and “total” HMCPA in animal products and crops) present as acid, salts, esters and conjugates (esters with natural compounds). Therefore, in all the Tables application rates were expressed as MCPA acid equivalent/ha (ae/ha), regardless of which formulation was applied. Residues from the trials were all reported as mg/kg MCPA-equivalent.

Results have not been corrected for concurrent method recoveries unless indicated. Residues and application rates have generally been rounded to two significant figures or, for residues near the LOQ, to one significant figure. Residue values from the trials conducted according to the maximum GAP have been used for the estimation of maximum residue levels. Those results included in the tables are single underlined. For purposes of MRL estimation and risk assessment in this report, ND values in the reports were considered as < LOQ.

A total of 36 supervised trials on barley were conducted in 12 sites in Canada from 2005 to 2006 (Jones, GL, 2007, MCPA-R072; Belcher, TI, 2008, MCPA-R073). Each trial consisted of one untreated plot and three treated plots. Each treated plot received either of these MCPA formulations: 2-EHE EC (444 g ae/L), DMA salt SL (480 g ae/L) or sodium salt (300 g ae/L). One application was made at the target rate of 0.875 kg ai/ha using either motorized or knap-sack sprayers. The application was made when the first leaf was fully expanded, until just before the first node was detectable. Duplicate samples of grain and straw were collected from each plot at crop maturity. Samples were also collected at 30 days after treatment for the decline trials. Duplicate samples of hay were cut at 28 days after treatment for the control plot and at 1, 3, 7, 14, 28, 42 and 56 days after treatment for the treated plots at the decline sites. All samples were stored frozen at -12 ºC to -35 ºC until analysis. The maximum period of frozen storage from harvest to analysis was 243, 223 and 200 days for hay, grain and straw. Residues of MCPA in barley grain, hay and straw were analysed by GC/MS, using method 6698-107, which had previously been validated with an LOQ of 0.01 mg/kg for grain and 0.25 mg/kg for hay and straw.

All 36 trials in Canada matched the GAP and resulted in non-detectable residues of MCPA and HMCPA in barley grain. Results of the trials in barley grain are summarized in Table 44, with residues matching the GAP underlined. Results for barley hay and straw are summarized in Table 44.

Table 44 MCPA acid equivalent residues in treated barley grain resulting from supervised trials in Canada and the USA (Jones, GL, 2007, MCPA-R072; Belcher, TI, 2008, MCPA-R073)

BARLEY GRAIN	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Elm Creek, MB, Canada, 2005 (AC Robust)	2-EHE 444 g/L EC	0.89	204	Zadoks 35-main shoot and 5 tillers	1	58	ND	ND	ND	Jones, GL, 2007, MCPA-R072
Elm Creek, MB, Canada, 2005 (AC Robust)	DMA salt 480 g/L SL	0.79	203	Zadoks 35-main shoot and 5 tillers	1	58	ND	ND	ND	

BARLEY GRAIN	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Elm Creek, MB, Canada, 2005 (AC Robust)	NA + K salt 300 L SL	0.90	205	Zadoks 35-main shoot and 5 tillers	1	58	ND	ND	ND	
St. Cesaire, QB, Canada, 2005 (Sabrina)	2-EHE 444 g/L EC	0.84	195	Zadoks 21-main shoot and 1 tiller	1	60	ND	ND	ND	Jones, GL, 2007, MCPA-R072
St. Cesaire, QB, Canada, 2005 (Sabrina)	DMA salt 480 g/L SL	0.88	201	Zadoks 21-main shoot and 1 tiller	1	60	ND	ND	ND	
St. Cesaire, QB, Canada, 2005 (Sabrina)	NA + K salt 300 L SL	0.90	207	Zadoks 21-main shoot and 1 tiller	1	60	ND	ND	ND	
Vanscoy, SK, Canada, 2005 (Metcalf)	2-EHE 444 g/L EC	0.90	203	Zadoks 31-1st node detectable	1	75	ND	ND	ND	Jones, GL, 2007, MCPA-R072
Vanscoy, SK, Canada, 2005 (Metcalf)	DMA Salt 480 g/L SL	0.90	206	Zadoks 31 1st node detectable	1	75	ND	ND	ND	
Vanscoy, SK, Canada, 2005 (Metcalf)	NA + K salt 300 L SL	0.89	203	Zadoks 31-1st node detectable	1	75	ND	ND	ND	
Innisfail, AB, Canada, 2005 (CDC Bold)	2-EHE 444 g/L EC	0.90	206	Zadoks 32–34: 2nd to 4th node detectable	1	30 79	< 0.01 ND	ND ND	0.011 ND	Jones, GL, 2007, MCPA-R072
Innisfail, AB, Canada, 2005 (CDC Bold)	DMA salt 480 g/L SL	0.90	205	Zadoks 32–34: 2nd to 4th node detectable	1	30 79	< 0.01 ND	ND ND	ND ND	
Innisfail, AB, Canada, 2005 (CDC Bold)	NA salt 300 L SL	0.93	212	Zadoks 32–34: 2nd to 4th node detectable	1	30 79	< 0.01 ND	ND ND	ND ND	
Rosthern, SK, Canada, 2005 (AC Metcalf)	2-EHE 444 g/L EC	0.90	206	Zadoks 23–24: main shoot and 3–4 tillers	1	73	ND	ND	ND	Jones, GL, 2007, MCPA-R072
Rosthern, SK, Canada, 2005 (AC Metcalf)	DMA salt 480 g/L SL	0.91	206	Zadoks 23–24: main shoot and 3–4 tillers	1	73	ND	ND	ND	
Rosthern, SK, Canada, 2005 (AC Metcalf)	NA salt 300 L SL	0.90	205	Zadoks 23–24: main shoot and 3–4 tillers	1	73	ND	ND	ND	

BARLEY GRAIN	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Minto, MB, Canada, 2006 (Conlon)	2-EHE 444 g/L EC	0.91	207	Zadoks 31–33	1	30 56	ND ND	ND ND	ND ND	Belcher, TI, 2008, MCPA-R073
Minto, MB, Canada, 2006 (Conlon)	DMA salt 480 g/L SL	0.91	208	Zadoks 31–33	1	30 56	ND ND	ND ND	ND ND	
Minto, MB, Canada, 2006 (Conlon)	NA salt 300 L SL	0.91	207	Zadoks 31–33	1	30 56	ND ND	ND ND	ND ND	
Boissevain, MB, Canada, 2006 (Newdale)	2-EHE 444 g/L EC	0.92	209	Zadoks 31	1	64	ND	ND	ND	Belcher, TI, 2008, MCPA-R073
Boissevain, MB, Canada, 2006 (Newdale)	DMA salt 480 g/L SL	0.91	209	Zadoks 31	1	64	ND	ND	ND	
Boissevain, MB, Canada, 2006 (Newdale)	NA salt 300 L SL	0.91	209	Zadoks 31	1	64	ND	ND	ND	
Innisfail, AB, Canada, 2005 (CDC Bold)	2-EHE 444 g/L EC	0.92	211	Zadoks 23–25: 24–29 cm	1	79	ND	ND	ND	Belcher, TI, 2008, MCPA-R073
Innisfail, AB, Canada, 2005 (CDC Bold)	DMA salt 480 g/L SL	0.93	211	Zadoks 23–25: 24–29 cm	1	79	ND	ND	ND	
Innisfail, AB, Canada, 2005 (CDC Bold)	NA salt 300 L SL	0.93	212	Zadoks 23–25: 24–29 cm	1	79	ND	ND	ND	
Spruceview, AB, Canada, 2006 (CDC Bold)	2-EHE 444 g/L EC	0.89	204	Zadoks 34–35: 37–40 cm	1	70	ND	ND	ND	Belcher, TI, 2008, MCPA-R073
Spruceview, AB, Canada, 2006 (CDC Bold)	DMA salt 480 g/L SL	0.91	207	Zadoks 34–35: 37–40 cm	1	70	ND	ND	ND	
Spruceview, AB, Canada, 2006 (CDC Bold)	NA salt 300 L SL	0.88	202	Zadoks 34–35: 37–40 cm	1	70	ND	ND	ND	
Rosthern, SK, Canada, 2006 (AC Metcalf)	2-EHE 444 g/L EC	0.91	207	Zadoks 22–23	1	72	ND	ND	ND	Belcher, TI, 2008, MCPA-R073
Rosthern, SK, Canada, 2006 (AC Metcalf)	DMA salt 480 g/L SL	0.90	206	Zadoks 22–23	1	72	ND	ND	ND	

BARLEY GRAIN	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Rosthern, SK, Canada, 2006 (AC Metcalf)	NA salt 300 L SL	0.87	203	Zadoks 22–23	1	72	ND	ND	ND	
Hepburn, SK, Canada, 2006 (CDC Copeland)	2-EHE 444 g/L EC	0.89	202	Zadoks 22–23	1	68	ND	ND	ND	Belcher, TI, 2008, MCPA-R073
Hepburn, SK, Canada, 2006 (CDC Copeland)	DMA salt 480 g/L SL	0.88	202	Zadoks 22–24	1	68	ND	ND	ND	
Hepburn, SK, Canada, 2006 (CDC Copeland)	NA salt 300 L SL	0.89	202	Zadoks 22–24	1	68	ND	ND	ND	
Spruceview, AB, Canada, 2006 (Metcalf)	2-EHE 444 g/L EC	0.88	201	Zadoks 34–37	1	78	ND	ND	ND	Belcher, TI, 2008, MCPA-R073
Spruceview, AB, Canada, 2006 (Metcalf)	DMA salt 480 g/L SL	0.88	202	Zadoks 34–37	1	78	ND	ND	ND	
Spruceview, AB, Canada, 2006 (Metcalf)	NA salt 300 L SL	0.88	202	Zadoks 34–37	1	78	ND	ND	ND	

ND = not detected.

LOD = 0.005 mg/kg for grain.

LOQ = 0.01 mg/kg for grain.

A total of six supervised trials were conducted in Northern Europe: two in Austria (Pfarl, DIC, 1994, MCPA-R070), two in France and two in the UK (Old, J and Venuti, J, 2001, MCPA-R062; Wasser, C, 2000, MCPA-R063; Old, J and Duncan, P, 2001, MCPA-R066; Perny, A, 2001, MCPA-R067). Whole barley plants were sampled at maturity. Frozen samples were transferred to the laboratory, where they were maintained frozen at -18 ºC until analysis.

Seven additional supervised trials were conducted in Southern Europe (two in Spain and five in France) from 1999 to 2001, using the potassium salt formulation of MCPA at the rate of 1.2 kg ae/ha MCPA, applied at BBCH 30, which matched the GAP in Spain (Old, J, etc., 2001, MCPA-R060; Wasser, C, 2000, MCPA-R061; Old, J, Duncan, P, 2001, MCPA-R064; Perny, A, 2001, MCPA-R065; Wardman, JP, and Mrti, S, 2002, MCPA-R069; Gallais, C, 2002, MCPA-R068). Three 1998 trials in France used the sodium salt formulation of MCPA (Rawle, NW, 2001, MCPA-R071). Whole barley plant samples were taken at maturity, threshed, separating grain from straw, and frozen at -20 ºC. The maximum storage period from sampling to analysis was 180 days, which was within the period of stability confirmed by a separate study on stability of grains, which was 369 days. Information on hydrolysis could be found in analytical methods parts. Results of the European trials in barley grain are summarized in Table 45 with residues matching the GAP underlined. Results for barley straw, hay and forage are summarized in Table 53.

Table 45 MCPA acid equivalent residues in treated barley grain resulting from supervised trials in Austria, UK, France and Spain (Pfarl, DIC, 1994, MCPA-R070; Old, J and Venuti, J, 2001, MCPA-

R062; Wasser, C, 2000, MCPA-R063; Old, J and Duncan, P, 2001, MCPA-R066; Perny, A, 2001, MCPA-R067; Old, J, etc., 2001, MCPA-R060; Wasser, C, 2000, MCPA-R061; Old, J, Duncan, P, 2001, MCPA-R064; Perny, A, 2001, MCPA-R065; Wardman, JP, and Mrti, S, 2002, MCPA-R069; Gallais, C, 2002, MCPA-R068; Rawle, NW, 2001, MCPA-R071)

BARLEY GRAIN	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form. (g ae/L)	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Ansfelden, Austria 1992 (Berta)	DMA salt 281 g/L SL	0.58	300	BBCH 31	1	63	< 0.05	–	–	Pfarl, DIC, 1994, MCPA-R070
Leonding, Austria, 1992 (Robin)	DMA salt 281 g/L SL	0.58	300	BBCH 31	1	60	< 0.05	–	–	
Chantillon sur Loire, France, 1999 (Sonja)	DMA salt 750 g/L SL	1.79	250	BBCH 30	1	106	ND[a]	ND	–	Old, J and Venuti, J, 2001, MCPA-R062; Wasser, C, 2000, MCPA-R063
East Lothian, UK, 1999 (Regina)	DMA Salt 750 g/L SL	1.89	263	BBCH 30	1	116	< 0.05	ND	–	
East Lothian, UK, 1999 (Regina)	DMA Salt 750 g/L SL	1.83	254	BBCH 30-31	1	121	ND	ND	–	Old, J and Duncan, P, 2001, MCPA-R066; Perny, A, 2001, MCPA-R067
Noiron sous Geverey, France, 1999 (Majestic)	DMA Salt 750 g/L SL	1.86	258	BBCH 30	1	99	ND	ND	–	
Janneyrias, France, 1999 (Platine)	K-salt 400 g/L SL	1.20	251	BBCH 30	1	95	ND	ND	–	Old, J, etc., 2001, MCPA-R060; Wasser, C, 2000, MCPA-R061
Menarguens, Spain, 1999 (Graphic)	K-salt 400 g/L SL	1.24	254	BBCH 30	1	86	ND	ND	–	
Janneyrias, France, 2000 (Pertine)	K-salt 400 g/L SL	1.25	254	BBCH 30	1	92	< 0.05	ND	–	Old, J, Duncan, P, 2001, MCPA-R064; Perny, A, 2001, MCPA-R065
Menarguens, Spain, 2001 (Graphic)	K-salt 400 g/L SL	1.20	248	BBCH 30-31	1	86	0.12	ND[b]	–	Gallais, C, 2002, MCPA-R068;Wardman, JP, and Mrti, S, 2002, MCPA-R069
Corbarieu, France, 1998 (Scarlet)	Na Salt 800 g/L SL	1.88	266	BBCH 32-33	1	77	< 0.05	–	–	Rawle, NW, 2001, MCPA-R071

BARLEY GRAIN	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form. (g ae/L)	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Pommevic, France, 1998 (Nevada)	Na Salt 800 g/L SL	1.86	265	BBCH 32	1	67	< 0.05	–	–	
Villeneuve, les Bouloc, France, 1998 (Volga)	Na Salt 800 g/L SL	1.82	259	BBCH 32	1	61	< 0.05	–	–	

[a] LOD = 0.008 mg/kg for other trials. LOQ = 0.05 mg/kg.

[b] LOD = 0.012 mg/kg for MCPA-R68 and R69.

A total of 45 supervised trials were conducted on wheat in 15 sites in Canada from 2001 to 2004 (Barney, WP, 2002, MCPA-R085 through MCPA-R089; Jones, GL, 2005, MCPA-R090 through MCPA-R092; and Jones, GL, 2006, MCPA-R098 through MCPA-R104). Another 21 trials in seven sites in the USA were conducted from 1998 to 2006 (Kludas, RS, 2000, MCPA-R081 through MCPA-R084; and Jones, GL, 2006, MCPA-R093 through MCPA-R097). Each trial received either of these MCPA formulations: 2-EHE EC (444 g ae/L), DMA salt SL (480 g ae/L) or sodium salt (300 g ae/L). One application was made at the target rate of 1.68 kg ae/ha.

Duplicate samples of grain and straw were collected from each plot at crop maturity. Samples were also collected at 30 days after treatment for the decline trials. Hay samples were collected 14 days after treatment from control plots and at 7, 14 and 21 days after treatment from treated plots. Forage samples were collected 14 days after harvest for control samples and at 0, 7, 14 and 21 days after treatment for treated samples. All samples were stored frozen at -20 ºC until analysis. The maximum period of frozen storage from harvest to analysis was 339 days. A freezer storage stability study for MCPA and metabolites demonstrates that MCPA and 2-HMCPA in selected plant matrices are stable up to 369 days.

Residues of MCPA in wheat grain, forage, hay and straw were analysed by GC/MS, using method 6698-107, which had previously been validated with an LOQ of 0.01 mg/kg for grain and 0.25 mg/kg for forage, straw and hay. Results of the trials in wheat grain are summarized in Table 46. Results on forage, straw and hay are summarized in Table 54.

Table 46 MCPA acid equivalent residues in treated wheat grain resulting from supervised trials in Canada and USA (Barney, WP, 2002, MCPA-R085 through MCPA-R089; Jones, GL, 2005, MCPA-R090 through MCPA-R092; and Jones, GL, 2006, MCPA-R098 through MCPA-R104; Kludas, RS, 2000, MCPA-R081 through MCPA-R084; and Jones, GL, 2006, MCPA-R093 through MCPA-R097)

WHEAT GRAIN	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
SPRING WHEAT										
Rosthern, SK, Canada, 2001 (Foremost CPS)	2-EHE 444 g/L EC	1.76	294	Pre-boot Zadoks 37–38	1	30 63	0.01 < 0.01	ND ND	< 0.01 ND	Barney, WP, 2002, MCPA-R085

WHEAT GRAIN	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Rosthern, SK, Canada, 2001 (Foremost CPS)	DMA salt 480 g/L SL	1.80	298	Pre-boot Zadoks 37	1	30 79	0.015 ND	ND ND	< 0.01 < 0.01	
Rosthern, SK, Canada, 2001 (Foremost CPS)	NA salt 300 g/L SL	1.76	293	Pre-boot Zadoks 37	1	30 79	0.016 ND	ND ND	< 0.01 ND	
Elm Creek, MB Canada, 2001 (Majestic)	2-EHE 444 g/L EC	1.65	271	Pre-boot Zadoks 32–34	1	30 63	0.01 ND	< 0.01 ND	0.022 0.013	Barney, WP, 2002, MCPA-R086
Elm Creek, MB Canada, 2001 (Majestic)	DMA salt 480 g/L SL	1.62	268	Pre-boot Zadoks 32–34	1	30 63	< 0.01 ND	< 0.01 ND	0.016 < 0.01	
Elm Creek, MB Canada, 2001 (Majestic)	NA salt 300 g/L SL	1.64	273	Pre-boot Zadoks 32–34	1	30 63	ND ND	ND ND	0.021 < 0.01	
Haywood, MB, Canada, 2001 (AC Cora)	2-EHE 444 g/L EC	1.65	282	Pre-boot Zadoks 31	1	30 81	ND ND	ND ND	< 0.01 < 0.01	Barney, WP, 2002, MCPA-R087
Haywood, MB, Canada, 2001 (AC Cora)	DMA salt 480 g/L SL	1.70	283	Pre-boot Zadoks 31	1	30 81	ND ND	ND ND	< 0.01 < 0.01	
Haywood, MB, Canada, 2001 (AC Cora)	NA salt 300 g/L SL	1.74	285	Pre-boot Zadoks 31	1	30 81	ND ND	ND ND	< 0.01 < 0.01	
Barnwell, AB Canada, 2001 (Soft White)	2-EHE 444 g/L EC	1.70	286	Pre-boot Zadoks 36–37	1	30 64	0.14 < 0.01	0.074 ND	0.064 ND	Barney, WP, 2002, MCPA-R088
Barnwell, AB Canada, 2001 (Soft White)	DMA salt 480 g/L SL	1.74	291	Pre-boot Zadoks 36–37	1	30 64	0.032 ND	< 0.01 ND	0.019 ND	

WHEAT GRAIN	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Barnwell, AB Canada, 2001 (Soft White)	NA salt 300 g/L SL	1.74	288	Pre-boot Zadoks 36–37	1	30 64	ND ND	ND ND	ND ND	
Fairview, AB, Canada, 2001 (Canadian Western White EXP3)	2-EHE 444 g/L EC	1.71	289	Pre-boot Zadoks 36–37	1	31 93	ND ND	< 0.01 ND	0.050 ND	Barney, WP, 2002, MCPA-R089
Fairview, AB, Canada, 2001 (Canadian Western White EXP3)	DMA Salt 480 g/L SL	1.70	287	Pre-boot Zadoks 36–37	1	31 93	ND ND	ND ND	0.097 ND	
Fairview, AB, Canada, 2001 (Canadian Western White EXP3)	Na Salt 300 g/L SL	1.76	289	Pre-boot Zadoks 36–37	1	31 93	ND ND	ND ND	0.09 ND	
Lacombe, AB, Canada, 2003 (CPS)	2-EHE 444 g/L EC	1.84	299	Pre-boot Zadoks 37	1	30 79	ND ND	ND ND	ND ND	Jones, GL, 2005, MCPA-R090
Lacombe, AB, Canada, 2003 (CPS)	DMA Salt 480 g/L SL	1.81	300	Pre-boot Zadoks 37	1	30 79	< 0.01 ND	ND ND	ND ND	
Lacombe, AB, Canada, 2003 (CPS)	Na Salt 300 g/L SL	1.85	300	Pre-boot Zadoks 37	1	30 79	ND ND	ND ND	ND ND	
Delisle, SK, Canada, 2003 (AC Cadillac)	2-EHE 444 g/L EC	1.79	295	Pre-Boot Zadoks 14–22	1	30 73	< 0.01 < 0.01	ND ND	ND ND	Jones, GL, 2005, MCPA-R091
Delisle, SK, Canada, 2003 (AC Cadillac)	DMA Salt 480 g/L SL	1.74	293	Pre-Boot Zadoks 14–22	1	30 73	< 0.01 < 0.01	ND ND	ND ND	
Delisle, SK, Canada, 2003 (AC Cadillac)	Na Salt 300 g/L SL	1.87	298	Pre-Boot Zadoks 14–22	1	30 73	0.024 ND	ND ND	ND ND	

WHEAT GRAIN	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Rosetown, SK, Canada, 2003 (AC Barrie)	2-EHE 444 g/L EC	1.77	291	Pre-Boot Zadoks 22–31	1	30 69	< 0.01 ND	ND ND	ND ND	Jones, GL, 2005, MCPA-R092
Rosetown, SK, Canada, 2003 (AC Barrie)	DMA Salt 480 g/L SL	1.71	287	Pre-Boot Zadoks 22–31	1	30 69	0.011 ND	ND ND	ND ND	
Rosetown, SK, Canada, 2003 (AC Barrie)	Na Salt 300 g/L SL	1.83	293	Pre-Boot Zadoks 22–31	1	30 69	0.013 ND	ND ND	ND ND	
Vanscoy, SK, Canada, 2004 (Intrepid)	2-EHE 444 g/L EC	1.86	275	Pre-Boot Zadoks 31–33	1	30 80	0.029 ND	ND ND	ND ND	Jones, GL, 2006, MCPA-R098
Vanscoy, SK, Canada, 2004 (Intrepid)	DMA Salt 480 g/L SL	1.83	277	Pre-Boot Zadoks 31–33	1	30 80	< 0.01 ND	ND ND	ND ND	
Vanscoy, SK, Canada, 2004 (Intrepid)	Na Salt 300 g/L SL	1.87	278	Pre-Boot Zadoks 31–33	1	30 80	0.013 ND	ND ND	ND ND	
Taber, AB, Canada, 2004 (Intrepid)	2-EHE 444 g/L EC	1.99	297	Pre-Boot Zadoks 31–33	1	33 92	< 0.01 ND	ND ND	ND ND	Jones, GL, 2006, MCPA-R099
Taber, AB, Canada, 2004 (Intrepid)	DMA Salt 480 g/L SL	1.98	295	Pre-Boot Zadoks 31–33	1	33 92	ND ND	ND ND	ND ND	
Taber, AB, Canada, 2004 (Intrepid)	Na Salt 300 g/L SL	2.21	293	Pre-Boot Zadoks 31–33	1	33 92	ND ND	ND ND	ND ND	
Minto, MB, Canada, 2004 (AC Barrie)	2-EHE 444 g/L EC	1.97	292	Pre-Boot Zadoks 34–37	1	30 85	ND ND	ND ND	ND ND	Jones, GL, 2006, MCPA-R100
Minto, MB, Canada, 2004 (AC Barrie)	DMA Salt 480 g/L SL	2.01	299	Pre-Boot Zadoks 34–37	1	30 85	0.014 0.011	ND ND	ND < 0.01	
Minto, MB, Canada, 2004 (AC Barrie)	Na Salt 300 g/L SL	1.98	294	Pre-Boot Zadoks 34–37	1	30 85	0.013 ND	ND ND	0.013 < 0.01	

WHEAT GRAIN	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Boissevain, MB, Canada, 2004 (AC Barrie)	2-EHE 444 g/L EC	1.94	288	Pre-boot Zadoks 37	1	30 85	ND ND	ND ND	ND ND	Jones, GL, 2006, MCPA-R101
Boissevain, MB, Canada, 2004 (AC Barrie)	DMA Salt 480 g/L SL	1.95	289	Pre-boot Zadoks 37	1	30 85	< 0.01 ND	ND ND	ND ND	
Boissevain, MB, Canada, 2004 (AC Barrie)	Na Salt 300 g/L SL	1.95	290	Pre-boot Zadoks 37	1	30 85	ND ND	ND ND	ND ND	
Rosthern, SK, Canada, 2004 (AC Intrepid)	2-EHE 444 g/L EC	1.94	287	Pre-boot Zadoks 37–39	1	30 80	ND ND	ND ND	0.034 0.012	Jones, GL, 2006, MCPA-R102
Rosthern, SK, Canada, 2004 (AC Intrepid)	DMA Salt 480 g/L SL	1.93	287	Pre-boot Zadoks 37–39	1	30 80	ND ND	ND ND	0.025 < 0.01	
Rosthern, SK, Canada, 2004 (AC Intrepid)	Na Salt 300 g/L SL	1.94	289	Pre-boot Zadoks 37–39	1	30 80	< 0.01 ND	< 0.01 ND	0.018 ND	
Hepburn, SK, Canada, 2004 (AC Barrie)	2-EHE 444 g/L EC	1.94	287	Pre-boot Zadoks 37–39	1	30 77	< 0.01 ND	ND ND	ND ND	Jones, GL, 2006, MCPA-R103
Hepburn, SK, Canada, 2004 (AC Barrie)	DMA Salt 480 g/L SL	1.88	286	Pre-boot Zadoks 37–39	1	30 77	0.039 0.010	< 0.01 ND	ND ND	
Hepburn, SK, Canada, 2004 (AC Barrie)	Na Salt 300 g/L SL	1.92	286	Pre-boot Zadoks 37–39	1	30 77	ND ND	ND ND	< 0.01 ND	
Innisfail, AB, Canada, 2004 (Foremost)	2-EHE 444 g/L EC	2.00	296	Pre-boot Zadoks 35	1	30 98	0.020 ND	ND ND	0.013 ND	Jones, GL, 2006, MCPA-R104
Innisfail, AB, Canada, 2004 (Foremost)	DMA Salt 480 g/L SL	1.94	288	Pre-boot Zadoks 35	1	30 98	ND ND	ND ND	0.011 ND	
Innisfail, AB, Canada, 2004 (Foremost)	Na Salt 300 g/L SL	1.96	292	Pre-boot Zadoks 35	1	30 98	ND ND	ND ND	< 0.01 ND	

WHEAT GRAIN	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
North Dakota, USA, 1998 (2375)	2-EHE 480 g/L EC	1.83	282	Pre-boot Zadoks 37–39	1	30 54	0.030 < 0.01	0.11 0.01	0.13 0.03	Kludas, RS, 2000, MCPA-R084
North Dakota, USA, 1998 (2375)	DMA Salt 480 g/L SL	1.79	281	Pre-boot Zadoks 37–39	1	30 54	0.04 < 0.01	0.06 0.01	0.14 0.06	Kludas, RS, 2000, MCPA-R083
WINTER WHEAT										
Kansas, USA 1997 (TAM 105)	DMA Salt 480 g/L SL	1.66	263	Pre-boot Zadoks 37	1	30 59	0.026 0.025	– 0.015	0.035 < 0.01	Kludas, RS, 2000, MCPA-R081
Oklahoma, USA 1997 (TAM 200)	DMA Salt 480 g/L SL	1.74	247	Pre-boot Zadoks 37	1	30 54	0.018 < 0.01	0.36 < 0.01	0.07 0.01	
Kansas, USA 1998 (Variety not reported)	2-EHE 480 g/L EC	1.76	278	Pre-boot Zadoks 37	1	30 59	< 0.01 0.015	< 0.01 0.015	0.020 0.010	Kludas, RS, 2000, MCPA-R082
Oklahoma, USA 1998 (Variety nor reported)	2-EHE 480 g/L EC	1.75	248	Pre-boot Zadoks 37	1	30 54	< 0.01 0.014	0.020 0.015	0.055 0.020	
New Holland, OH, USA, 2004 (SC 1358)	2-EHE 444 g/L EC	1.71	220	Pre-boot Zadoks 37	1	30 56	0.011 ND	ND ND	0.014 < 0.01	Jones, GJ, 2006, MCPA-R093
New Holland, OH, USA, 2004 (SC 1358)	DMA Salt 480 g/L SL	1.71	220	Pre-boot Zadoks 37	1	30 56	0.083 < 0.01	< 0.01 < 0.01	0.023 < 0.01	
New Holland, OH, USA, 2004 (SC 1358)	Na Salt 300 g/L SL	1.75	224	Pre-boot Zadoks 37	1	30 56	0.11 < 0.01	0.011 < 0.01	0.026 0.012	
Redfield, SD, USA, 2004 (Harding)	2-EHE 444 g/L EC	1.65	326	Pre-boot Zadoks 36–37	1	30 50	0.012 ND	ND ND	< 0.01 ND	Jones, GJ, 2006, MCPA-R094
Redfield, SD, USA, 2004 (Harding)	DMA Salt 480 g/L SL	1.65	326	Pre-boot Zadoks 36–37	1	30 50	ND ND	ND ND	ND < 0.01	

WHEAT GRAIN	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Redfield, SD, USA, 2004 (Harding)	Na Salt 300 g/L SL	1.71	325	Pre-boot Zadoks 36–37	1	30 50	ND ND	ND ND	< 0.01 < 0.01	
Larned, KS USA, 2004 (Jagalene)	2-EHE 444 g/L EC	1.78	285	Pre-boot Zadoks 39	1	30 70	0.27 < 0.01	0.059 ND	0.120 0.012	Jones, GJ, 2006, MCPA-R095
Larned, KS USA, 2004 (Jagalene)	DMA Salt 480 g/L SL	1.80	285	Pre-boot Zadoks 39	1	30 70	0.075 ND	0.020 ND	0.033 < 0.01	
Larned, KS USA, 2004 (Jagalene)	Na Salt 300 g/L SL	1.81	286	Pre-boot Zadoks 39	1	30 70	0.106 ND	0.030 ND	0.051 < 0.01	
Colony, OK USA, 2004 (Pioneer 2157)	2-EHE 444 g/L EC	1.63	276	Pre-boot Zadoks 39	1	30 53	< 0.01 0.023	ND ND	0.015 < 0.01	Jones, GJ, 2006, MCPA-R096
Colony, OK USA, 2004 (Pioneer 2157)	DMA Salt 480 g/L SL	1.65	278	Pre-boot Zadoks 39	1	30 53	0.078 < 0.01	0.013 ND	0.044 0.011	
Colony, OK USA, 2004 (Pioneer 2157)	Na Salt 300 g/L SL	1.73	282	Pre-boot Zadoks 39	1	30 53	0.013 < 0.01	ND ND	0.021 ND	
Groom, TX, USA, 2004 (Ogallala)	2-EHE 444 g/L EC	1.72	285	Pre-boot Zadoks 39	1	30 43	0.011 < 0.01	< 0.01 < 0.01	ND 0.022	Jones, GJ, 2006, MCPA-R097
Groom, TX, USA, 2004 (Ogallala)	DMA Salt 480 g/L SL	1.70	286	Pre-boot Zadoks 39	1	30 43	0.013 0.015	< 0.01 0.011	0.020 0.025	
Groom, TX, USA, 2004 (Ogallala)	Na Salt 300 g/L SL	1.69	285	Pre-boot Zadoks 39	1	30 43	0.011 0.012	< 0.01 < 0.01	0.023 0.023	

ND = not detected.

LOD = 0.005 mg/kg for grain.

LOQ = 0.01 mg/kg for grain.

– Analysis data for 2-HMCPA did not meet the acceptance criteria and were rejected.

Five supervised trials were conducted from 1998 to 2000 in Northern Europe (three in France and two in the UK) using the DMA salt formulation containing 750 g ae/L (Rawle, NW, 2001, MCPA

R071; Old, J and Venuti, J, 2001, MCPA-R062; Wasser, C, 2000, MCPA-R063; Old, J, and Duncan, P, 2001, MCPA-R066; Perny, A, 2001, MCPA-R067). Treated plots received a single application at growth stage BBCH 30-31 at the rate of 1.8 kg MCPA ae/ha using small plot sprayers. One trial was conducted in Austria (Pfarl, C, 1994, MCPA-R070).

Four additional supervised trials were conducted in Spain and France from 1999 to 2001, using the potassium salt formulation of MCPA at the rate of 1.2 kg ae/ha MCPA, applied at BBCH 30 (Old, J, *et al,* 2001, MCPA-R060; Wasser, C, 2000, MCPA-R061; Old, J, and Duncan, P, 2001, MCPA-R064; Perny, A, 2001, MCPA-R065).

Whole plant samples were taken at maturity, threshed, separating grain from straw, and frozen at -20 ºC. Forage samples were also taken at crop maturity and at 0, 7, 14 and 28 days after treatment. Frozen samples were transferred to the laboratory, where they were maintained frozen at – 18 ºC until analysis. The maximum storage period from sampling to analysis was 342 days, which is within the demonstrated freezer stability of 369 days. Residues of MCPA in wheat matrices were analysed by GC/MS. Results of the European trials in wheat grain are summarized in Table 47 and results on forage and straw are summarized in Table 55.

Table 47 MCPA acid equivalent residues in treated wheat grain resulting from supervised trials in Austria, UK, France and Spain (Pfarl, C, 1994, MCPA-R070; Rawle, NW, 2001, MCPA R071; Old, J and Venuti, J, 2001, MCPA-R062; Wasser, C, 2000, MCPA-R063; Old, J, and Duncan, P, 2001, MCPA-R066; Perny, A, 2001, MCPA-R067; Old, J, *et al,* 2001, MCPA-R060; Wasser, C, 2000, MCPA-R061; Old, J, and Duncan, P, 2001, MCPA-R064; Perny, A, 2001, MCPA-R065)

WHEAT GRAIN	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMPCA	CCPA	
WINTER WHEAT										
Ansfelden, Austria 1992 (Star A3)	DMA salt 281 g/L SL	0.58	200	BBCH 31	1	70	< 0.05	–	–	Pfarl, DIC, 1994, MCPA-R070
Montgaillard, France, 1998 (VIcto)	Na salt 800 g/L SL	1.87	259	BBCH 32-33	1	86	< 0.05	–	–	Rawle, NW, 2001, MCPA-R071
Lestious, France, 1999 (Isengrain)	DMA salt 750 g/L SL	1.77	248	BBCH 30	1	118	ND	ND	–	Old, J, Venuti, ., 2001, MCPA R062; Wasser, C, 2000, MCPA-R063
Suffolk, UK 1999 (Consort)	DMA salt 750 g/L SL	1.80	251	BBCH 30-31	1	109	ND	ND	–	
Essex, UK 2000 (Hereward)	DMA salt 750 g/L SL	1.75	244	BBCH 30	1	127	< 0.05	ND	–	Old, J, Duncan, P, 2001, MCPA-R066; Perny, A, 2001, MCPA-R067
Poncey les Athee, France, 2000 (Soissons)	DMA salt 750 g/L SL	1.84	255	BBCH 31	1	109	0.16	ND	–	

WHEAT GRAIN	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMPCA	CCPA	
Charantonnay, France, 1999 (Soissons)	K-salt 400 g/L SL	1.22	250	BBCH 30	1	111	ND	ND	–	Old J, *et. al.*, 2001, MCPA-R060; Wasser, C, 2000, MCPA-R061
St, Jordi de Muller, Spain (Soissons)	K-salt 400 g/L SL	1.21	248	BBCH 30	1	98	ND	ND	–	
Charantonnay, France, 2000 (Isengrain)	K-salt 400 g/L SL	1.26	258	BBCH 30	1	120	< 0.05	ND	–	Old, J, and Duncan, P, 2001, MCPA-R064; Perny, A., 2001, MCPA-R065
Olius, Spain 2000 (Tremier)	K-salt 400 g/L SL	1.24	252	BBCH 30-31	1	104	ND	ND	–	

ND = not detected.

LOD = 0.008 mg/kg. LOQ = 0.05 mg/kg.

Maize

A total of 24 supervised trials on maize (field) were conducted from 2005 to 2006 in key corn-growing areas in Canada (Jones, GL, 2007, MCPA-R077; Belcher, 2008, MCPA-R078). Each trial received one of the following MCPA formulations: 2-EHE, DMA salt or sodium salt. The target application rate for each treated plot was 0.85 kg ae/ha, at a spray volume of 200 L/ha.

Maize grain and stover were collected in duplicate at crop maturity. The stover samples consisted of dried stalks collected after grain harvest. Maize forage samples were collected when the plants were in the late dough to early dent stage. In addition for the decline trials, forage samples were collected at 14 days after treatment from the control plot and at 0, 1, 3, 7, 14, 28, 45, 60 and 75 days after treatment from treated plots. Samples were immediately frozen and were transferred to the laboratory, where they were maintained frozen at -12 ºC to -35 ºC until analysis. A maximum of 250, 225 and 167 days elapsed between harvest and residue extraction of samples for forage, grain and stover, respectively. A freezer storage stability study for MCPA and metabolites demonstrated that MCPA and HMCPA in selected plant matrices are stable up to 369 days. The trials on maize grain are summarized in Table 48. Trials on corn forage and stover are summarized in Table 56.

Table 48 MCPA acid equivalent residues in treated maize grain resulting from supervised trials in Canada (Jones, GL, 2007, MCPA-R077; Belcher, 2008, MCPA-R078)

MAIZE GRAIN	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	

MAIZE GRAIN	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year
country, year (variety)	Form.	kg ae/ha	water L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	Reference No.
Elm Creek, MB, Canada, 2005, (Cargill OKC2675)	2-EHE 444 g/L EC	0.89	209	15 cm height	1	114	ND	ND	ND	Jones, GL, 2007, MCPA-R077
Elm Creek, MB, Canada, 2005 , (Cargill OKC2675)	NA + K salt 300 g/L SL	0.87	206	15 cm height	1	114	ND	ND	ND	
Elm Creek, MB, Canada, 2005 , (Cargill OKC2675)	DMA salt 480 g/L SL	0.77	203	15 cm height	1	114	ND	ND	ND	
Carman, MB, Canada, 2005 (Monsanto DKC 27-12)	2-EHE 444 g/L EC	0.90	211	30 cm height	1	114	ND	ND	ND	Jones, GL, 2007, MCPA-R077
Carman, MB, Canada, 2005 (Monsanto DKC 27-12)	NA+K salt 300 g/L SL	0.89	210	30 cm height	1	114	ND	ND	ND	
Carman, MB, Canada, 2005 (Monsanto DKC 27-12)	DMA salt 480 g/L SL	0.80	211	30 cm height	1	114	ND	ND	ND	
Paris, ON, Canada, 2005 (DKB 37-80)	2-EHE 444 g/L EC	0.88	212	10–12 cm height	1	129	ND	ND	ND	Jones, GL, 2007, MCPA-R077
Paris, ON, Canada, 2005 (DKB 37-80)	NA + K salt 300 g/L SL	0.84	203	10–12 cm height	1	129	ND	ND	ND	
Paris, ON, Canada, 2005 (DKB 37-80)	DMA salt 480 g/L SL	0.88	210	10–12 cm height	1	129	ND	ND	ND	
St. Pie, QC, Canada, 2005 (2555NK)	2-EHE 444 g/L EC	0.90	216	10 cm	1	132	ND	ND	ND	Jones, GL, 2007, MCPA-R077

MAIZE GRAIN	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
St. Pie, QC, Canada, 2005 (2555NK)	NA + K salt 300 g/L SL	0.92	225	10 cm	1	132	ND	ND	ND	
St. Pie, QC, Canada, 2005 (2555NK)	DMA salt 480 g/L SL	0.89	212	10 cm	1	132	ND	ND	ND	
Elm Creek, MB, Canada, 2006, (6Cargill DKC27-12)	2-EHE 444 g/L EC	0.89	206	8–10 cm height	1	130	ND	ND	ND	Belcher, TI, 2008, MCPA-R078
Elm Creek, MB, Canada, 2006, (6Cargill DKC27-12)	NA+K salt 300 g/L SL	0.88	207	8–10 cm height	1	130	ND	ND	ND	
Elm Creek, MB, Canada, 2006, (6Cargill DKC27-12)	DMA salt 480 g/L SL	0.88	208	8–10 cm height	1	130	ND	ND	ND	
Thamesford, ON, Canada, 2006 (Pioneer 38A25)	2-EHE 444 g/L EC	0.86	203	10–15 cm height	1	146	ND	ND	ND	Belcher, TI, 2008, MCPA-R078
Thamesford, ON, Canada, 2006 (Pioneer 38A25)	NA + K salt 300 g/L SL	0.85	204	10–15 cm height	1	146	ND	ND	ND	
Thamesford, ON, Canada, 2006 (Pioneer 38A25)	DMA salt 480 g/L SL	0.87	205	10–15 cm height	1	146	ND	ND	ND	
Ingersoil, ON, Canada, 2006 Maizex 3888)	2-EHE 444 g/L EC	0.86	204	10–15 cm height	1	145	ND	ND	ND	Belcher, TI, 2008, MCPA-R078
Ingersoil, ON, Canada, 2006 Maizex 3888)	NA + K salt 300 g/L SL	0.85	203	10–15 cm height	1	145	ND	ND	ND	

MAIZE GRAIN	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Ingersoil, ON, Canada, 2006 Maizex 3888)	DMA salt 480 g/L SL	0.86	203	10–15 cm height	1	145	ND	ND	ND	
St. Pie, QB, Canada, 2006 (N22-T8)	2-EHE 444 g/L EC	0.90	214	8 cm height	1	135	ND	ND	ND	Belcher, TI, 2008, MCPA-R078
St. Pie, QB, Canada, 2006 (N22-T8)	NA + K salt 300 g/L SL	0.87	209	8 cm height	1	135	ND	ND	ND	
St. Pie, QB, Canada, 2006 (N22-T8)	DMA salt 480 g/L SL	0.91	213	8 cm height	1	135	ND	ND	ND	

ND = not detected.

LOD = 0.005 mg/kg, LOQ = 0.01 mg/kg.

Peas

Eight supervised trials on peas (dry) and two on green peas were conducted in Canada in 2005 using the sodium salt of MCPA (300 g ae/L) at the rate of 0.45 to 0.48 kg ae/ha (Jones, GL, 2007, MCPA-R132). In addition seven supervised trials were conducted on green peas in the US in 1996 (Barney, WP, 2007, MCPA-R130; Weisskopf, CP, 1999, MCPA-R131). Six of the trials used the MCPA DMA salt (380 g ae/L), and one trial used the sodium salt (300 g ae/L). A single post-emergence application was made to the treated plot when the plants were 10 to 15 cm tall.

In the Canadian trials dry pea samples were collected at normal crop maturity. In decline trials dry pea samples were collected when the plants were ready for desiccation, at normal harvest and 7 days after normal harvest. Information on hydrolysis could be found in the analytical methods parts. The results are shown in Table 49. Data on pea forage and hay are in Table 51.

Table 49 MCPA acid equivalent residues in treated peas resulting from supervised trials in Canada and the USA (Barney, WP, 2007, MCPA-R130; Weisskopf, CP, 1999, MCPA-R131; Jones, GL, 2007, MCPA-R132)

PEAS	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
PEA SEED										

PEAS	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Trial WA 24 Mt. Vernon, WA, USA, 1996 (Bolero)	DMA salt 480 g/L SL	0.44	273	Pre-bloom	1	38	< 0.01	< 0.01	< 0.01	Barney, WP, 2007, MCPA-R130; Weisskopf, CP, 1999, MCPA-R131
Trial WA 64 Prosser, WA, USA, 1996 (Dual)	DMA salt 480 g/L SL	0.41	214	Bloom	1	29	< 0.01	0.01	< 0.01	
Trial WA 64 Prosser, WA, USA, 1996 (Dual)	DMA salt 480 g/L SL	0.41	214	Bloom	1	29	< 0.01	< 0.01	< 0.01	
Trial WA 65 Prosser, WA, USA, 1996 (Dual)	DMA salt 480 g/L SL	0.41	214	Bloom	1	29	< 0.01	< 0.01	< 0.01	
Trial WA 65 Prosser, WA, USA, 1996 (Dual)	Na salt 300 g/L SL	0.40	297	Pre-bloom	1	29	< 0.01	< 0.01	< 0.01	
PODS WITH SEEDS										
Trial WA 64 Prosser, WA, USA, 1996 (Dual)	DMA salt 480 g/L SL	0.41	214	Bloom	1	29	< 0.01	0.02	< 0.01	Barney, WP, 2007, MCPA-R130; Weisskopf, CP, 1999, MCPA-R131
Trial WA 64 Prosser, WA, USA, 1996 (Dual)	DMA salt 480 g/L SL	0.41	214	Bloom	1	29	< 0.01	< 0.01	0.01	
Elm Creek, MB, Canada, 2005 (Venture)	NA salt 300 g/L SL	0.48	297	Pre-bloom	1	34	ND	ND	ND	Jones, GL, 2007, MCPA-R132
Carmen, MB, Canada, 2005 (Venture)	NA salt 300 g/L SL	0.47	294	Pre-bloom	1	35	ND	ND	ND	
DRY PEAS										
Elm Creek, MB, Canada, 2005 (Venture)	NA salt 300 g/L SL	0.48	297	Pre-bloom	1	62	ND	ND	ND	Jones, GL, 2007, MCPA-R132

PEAS	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Carmen, MB, Canada, 2005 (Venture)	NA salt 300 g/L SL	0.47	294	Pre-bloom	1	63	ND	ND	ND	
Minto, MB, Canada, 2005 (Mozart)	NA salt 300 g/L SL	0.46	289	Pre-bloom	1	60 74 81	ND ND ND	ND ND ND	ND ND ND	
Rosthern, SK, Canada, 2005 (Mozart)	NA salt 300 g/L SL	0.45	282	Pre-bloom	1	63 73 80	ND ND ND	ND ND ND	ND ND ND	
Hepburn, SK, Canada, 2005 (Eclipse)	NA salt 300 g/L SL	0.45	282	Pre-bloom	1	96	ND	ND	ND	
Innisfail, AB, Canada, 2005 (SW Capri)	NA salt 300 g/L SL	0.46	284	Pre-bloom	1	118	ND	ND	ND	
Penhold, AB Canada, 2005 (SW Capri)	NA salt 300 g/L SL	0.46	289	Pre-bloom	1	99	ND	ND	ND	
Fairview, AB, Canada, 2005 (SW Midas)	NA salt 300 g/L SL	0.47	296	Pre-bloom	1	63	ND	ND	ND	

ND = not detected.

LOD = 0.005 mg/kg, LOQ = 0.01 mg/kg.

Flax

Ten supervised trials with flax were conducted in the US from 1996 to 1997 (Arsenovic, M, and Kunkel, DL, 2004, MCPA-R129). Five trials used the 2-EHE formulation, and the other five used the DMA salt formulation. One of the treated plots received a single foliar application of the test substance at the nominal rate of 0.28 kg ae/ha and the other at the rate of 0.56 kg ae/ha.

Duplicate samples of mature flax seeds (about 1 to 1.4 kg) were collected from each plot. Samples were placed in plastic-lined cloth bags and frozen at about -20 ºC until analysis. The maximum storage period from harvest to analysis was 1255 days for seed and 1,241 days for meal. MCPA residues were stable in flax seed and meal up to 1205 and 1121 days, respectively, under frozen storage conditions. HMCPA residues are stable in flax seed up to 1206 days in frozen storage. The results showed HMCPA residues in flax meal degraded more than 30% when stored for 1208 days. Recoveries range for MCPA Ester were 7–83% at 0.025 mg/kg level and 27–68% at 0.10 mg/kg level, for MCPA DMA salt were 60–147% at 0.025 mg/kg level and 45–95% at 0.10 mg/kg level.

Twelve supervised trials were conducted in Canada in 2005, following the GAP in Canada (one application at a maximum rate of 0.875 kg ae/ha applied prior to bud stage) (Jones, GL, 2007, MCPA-R128). A freezer storage stability study was conducted and demonstrated that MCPA and its metabolites are stable in selected plant matrices for at least 369 days. Information on hydrolysis could be found in the analytical methods parts. The results (Table 50) show residues in all trials.

Table 50 MCPA acid equivalent residues in treated flax resulting from supervised trials in Canada and the USA (Arsenovic, M, and Kunkel, DL, 2004, MCPA-R129; Jones, GL, 2007, MCPA-R128)

FLAX SEED	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form. (Acid equiv)	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Fargo, North Dakota, USA, 1996 (Omega)	2-EHE 480 g/L EC	0.28 0.57	72 73	20 cm	1 1	100 100	< 0.025 < 0.025	< 0.025 < 0.025	< 0.025 < 0.025	Arsenovic M, and Kunkel, DL, 2004, MCPA-R129
Fargo, North Dakota, USA, 1996 (Omega)	DMA salt 480 g/L SL	0.28 0.56	73 72	20 cm	1 1	100 100	< 0.025 < 0.025	< 0.025 < 0.025	< 0.025 < 0.025	
Prosper, North Dakota, USA 1996 (Omega)	2-EHE 480 g/L EC	0.28 0.57	72 73	20 cm	1 1	71 71	< 0.025 < 0.025	< 0.025 < 0.025	< 0.025 < 0.025	Arsenovic M, and Kunkel, DL, 2004, MCPA-R129
Prosper, North Dakota, USA 1996 (Omega)	DMA salt 480 g/L SL	0.29 0.57	74 73	20 cm	1 1	71 71	< 0.025 < 0.025	< 0.025 < 0.025	< 0.025 < 0.025	
Fargo, North Dakota, USA, 1997 (Omega)	2-EHE 480 g/L EC	0.29 0.57	74 73	23 cm	1 1	90 90	< 0.025 < 0.025	< 0.025 < 0.025	< 0.025 < 0.025	Arsenovic M, and Kunkel, DL, 2004, MCPA-R129
Fargo, North Dakota, USA, 1997 (Omega)	DMA salt 480 g/L SL	0.28 0.57	72 74	23 cm	1 1	90 90	< 0.025 < 0.025	< 0.025 < 0.025	< 0.025 < 0.025	
Aurora, South Dakota, USA, 1996 (Prompt)	2-EHE 480 g/L EC	0.26 0.56	149 159	20–23 cm	1 1	63 63	< 0.025 < 0.025	< 0.025 < 0.025	< 0.025 < 0.025	Arsenovic M, and Kunkel, DL, 2004, MCPA-R129
Aurora, South Dakota, USA, 1996 (Prompt)	DMA salt 480 g/L SL	0.21 0.52	121 159	20–23 cm	1 1	63 63	< 0.025 < 0.025	< 0.025 < 0.025	< 0.025 < 0.025	
Aurora, South Dakota, USA, 1997 (Verne 93)	2-EHE 480 g/L EC	0.28 0.56	179 179	25.4cm	1 1	58 58	< 0.025 < 0.025	< 0.025 < 0.025	< 0.025 < 0.025	Arsenovic M, and Kunkel, DL, 2004, MCPA-R129
Aurora, South Dakota, USA, 1997 (Verne 93)	DMA salt 480 g/L SL	0.28 0.56	179 179	25.4cm	1 1	58 58	< 0.025 < 0.025	< 0.025 < 0.025	< 0.025 < 0.025	

FLAX SEED	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form. (Acid equiv)	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Vanscoy, SK, Canada, 2005 (Norlin)	2-EHE 444 g/L EC	0.90	204	9–12 cm	1	79 86 93 100 107	ND ND ND ND ND	ND ND ND ND ND	ND ND ND ND ND	Jones, GL, 2007, MCPA-R128
Vanscoy, SK, Canada, 2005 (Norlin)	DMA salt 480 g/L SL	0.90	204	9–12 cm	1	79 86 93 100 107	ND ND ND ND ND	ND ND ND ND ND	ND ND ND ND ND	
Minto, MB, Canada, 2005 (Solin 2047)	2-EHE 444 g/L EC	0.90	176	13–18 cm	1	75 82 89 96 103	ND ND ND ND ND	ND ND ND ND ND	ND ND ND ND ND	Jones, GL, 2007, MCPA-R128
Minto, MB, Canada, 2005 (Solin 2047)	DMA salt 480 g/L SL	0.93	180	13–18 cm	1	75 82 89 96 103	ND ND ND ND ND	ND ND ND ND ND	ND ND ND ND ND	
Boissevain, MB, Canada, 2005 (Solin 2047)	2-EHE 444 g/L EC	0.90	176	12–15 cm	1	82	ND	ND	ND	Jones, GL, 2007, MCPA-R128
Boissevain, MB, Canada, 2005 (Solin 2047)	DMA salt 480 g/L SL	0.87	172	12–15 cm	1	82	ND	ND	ND	
Rosthern, SK, Canada, 2005 (Solin 2047)	2-EHE 444 g/L EC	0.89	202	8–12 cm	1	111	ND	ND	ND	Jones, GL, 2007, MCPA-R128
Rosthern, SK, Canada, 2005 (Solin 2047)	DMA salt 480 g/L SL	0.89	203	8–12 cm	1	111	ND	ND	ND	
Hepburn, SK, Canada, 2005 (Solin 2047)	2-EHE 444 g/L EC	0.88	202	7–12 cm	1	106	ND	ND	ND	Jones, GL, 2007, MCPA-R128
Hepburn, SK, Canada, 2005 (Solin 2047)	DMA salt 480 g/L SL	0.89	203	7–12 cm	1	106	ND	ND	ND	

FLAX SEED	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form. (Acid equiv)	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Laird, SK, Canada, 2005 (Solin 2047)	2-EHE 444 g/L EC	0.90	204	6–10 cm	1	107	ND	ND	ND	Jones, GL, 2007, MCPA-R128
Laird, SK, Canada, 2005 (Solin 2047)	DMA salt 480 g/L SL	0.91	205	6–10 cm	1	107	ND	ND	ND	

ND = not detected (R-128).

For trials in Canada, LOD = 0.005 mg/kg; LOQ = 0.01 mg/kg (R-128).

LOQ = 0.025 mg/kg (R-129)

Table 51 MCPA acid equivalent residues in treated pea forage and hay resulting from supervised trials in Canada and the USA (Barney, WP, 2007, MCPA-R130; Weisskopf, CP, 1999, MCPA-R131; Jones, GL, 2007, MCPA-R132)

PEAS	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
PEA FORAGE										
Elm Creek, MB, Canada, 2005 (Venture)	NA salt 300 g/L SL	0.48	297	Pre-bloom	1	17	0.60	ND	ND	Jones, GL, 2007, MCPA-R132
Carmen, MB, Canada, 2005 (Venture)	NA salt 300 g/L SL	0.47	294	Pre-bloom	1	18	< 0.25	ND	ND	
Minto, MB, Canada, 2005 (Mozart)	NA salt 300 g/L SL	0.46	289	Pre-bloom	1	0	11.5	0.73	ND	
						1	4.52	1.69	ND	
						3	0.77	0.59	ND	
						7	0.42	< 0.25	ND	
						14	< 0.25	< 0.25	ND	
						28	ND	ND	ND	
Rosthern, SK, Canada, 2005 (Mozart)	NA salt 300 g/L SL	0.45	282	Pre-bloom	1	0	10.0	0.82	ND	
						1	6.71	1.09	ND	
						3	0.29	0.56	ND	
						7	< 0.25	< 0.25	ND	
						14	< 0.25	ND	ND	
						28	ND	ND	ND	

PEAS	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Hepburn, SK, Canada, 2005 (Eclipse)	NA salt 300 g/L SL	0.45	282	Pre-bloom	1	27	ND	ND	ND	
Innisfail, AB, Canada, 2005 (SW Capri)	NA salt 300 g/L SL	0.46	284	Pre-bloom	1	33	ND	ND	ND	
Penhold, AB Canada, 2005 (SW Capri)	NA salt 300 g/L SL	0.46	289	Pre-bloom	1	26	ND	ND	ND	
Fairview, AB, Canada, 2005 (SW Midas)	NA salt 300 g/L SL	0.47	296	Pre-bloom	1	21	< 0.25	< 0.25	ND	
PEA HAY (air dry)										
Elm Creek, MB, Canada, 2005 (Venture)	NA salt 300 g/L SL	0.48	297	Pre-bloom	1	17	0.27	0.51	ND	Jones, GL, 2007, MCPA-R132
Carmen, MB, Canada, 2005 (Venture)	NA salt 300 g/L SL	0.47	294	Pre-bloom	1	18	< 0.12	< 0.25	ND	
Minto, MB, Canada, 2005 (Mozart)	NA salt 300 g/L SL	0.46	289	Pre-bloom	1	1 3 7 14 28	15.7 3.61 1.97 0.84 < 0.25	15.8 7.15 2.85 0.74 0.36	1.68 1.18 0.43 ND ND	
Rosthern, SK, Canada, 2005 (Mozart)	NA salt 300 g/L SL	0.45	282	Pre-bloom	1	1 3 7 14 28	24.9 1.12 0.74 0.36 ND	7.08 2.68 1.27 1.09 < 0.25	0.47 < 0.25 < 0.25 ND ND	
Hepburn, SK, Canada, 2005 (Eclipse)	NA salt 300 g/L SL	0.45	282	Pre-bloom	1	27	ND	< 0.25	ND	
Innisfail, AB, Canada, 2005 (SW Capri)	NA salt 300 g/L SL	0.46	284	Pre-bloom	1	41	ND	ND	ND	
Penhold, AB Canada, 2005 (SW Capri)	NA salt 300 g/L SL	0.46	289	Pre-bloom	1	34	ND	< 0.25	ND	

PEAS	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Fairview, AB, Canada, 2005 (SW Midas)	NA salt 300 g/L SL	0.47	296	Pre-bloom	1	26	< 0.25	0.44	ND	

ND = not detected.

LOQ = 0.25 mg/kg for straw and hay.

LOD = 0.12 mg/kg for MCPA, 0.11 mg/kg for 2-HMCPA, and 0.10 mg/kg for CCPA.

Table 52 MCPA acid equivalent residues in treated barley straw and hay resulting from supervised trials in Canada and USA (Jones, GL, 2007, MCPA-R072; Belcher, TI, 2008, MCPA-R073)

BARLEY	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
Country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
BARLEY STRAW										
Elm Creek, MB, Canada, 2005 (AC Robust)	2-EHE 444 g/L EC	0.89	204	Zadoks 35-main shoot and 5 tillers	1	58	ND	< 0.25	ND	Jones, GL, 2007, MCPA-R072
Elm Creek, MB, Canada, 2005 (AC Robust)	DMA salt 480 g/L SL	0.79	203	Zadoks 35-main shoot and 5 tillers	1	58	ND	ND	ND	
Elm Creek, MB, Canada, 2005 (AC Robust)	NA + K salt 300 L SL	0.90	205	Zadoks 35-main shoot and 5 tillers	1	58	ND	ND	ND	
St. Cesaire, QB, Canada, 2005 (Sabrina)	2-EHE 444 g/L EC	0.84	195	Zadoks 21-main shoot and 1 tiller	1	60	ND	ND	ND	
St. Cesaire, QB, Canada, 2005 (Sabrina)	DMA salt 480 g/L SL	0.88	201	Zadoks 21-main shoot and 1 tiller	1	60	ND	ND	ND	
St. Cesaire, QB, Canada, 2005 (Sabrina)	NA + K salt 300 L SL	0.90	207	Zadoks 21-main shoot and 1 tiller	1	60	ND	ND	ND	
Vanscoy, SK, Canada, 2005 (Metcalf)	2-EHE 444 g/L EC	0.90	203	Zadoks 31–1st node detectable	1	75	ND	ND	ND	

BARLEY	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
Country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Vanscoy, SK, Canada, 2005 (Metcalf)	DMA salt 480 g/L SL	0.90	206	Zadoks 31–1st node detectable	1	75	ND	ND	ND	
Vanscoy, SK, Canada, 2005 (Metcalf)	NA + K salt 300 L SL	0.89	203	Zadoks 31–1st node detectable	1	75	ND	ND	ND	
Innisfail, AB, Canada, 2005 (CDC Bold)	2-EHE 444 g/L EC	0.90	206	Zadoks 32–34: 2nd to 4th node detectable	1	30 79	0.95 ND	0.71 ND	0.26 ND	
Innisfail, AB, Canada, 2005 (CDC Bold)	DMA salt 480 g/L SL	0.90	205	Zadoks 32–34: 2nd to 4th node detectable	1	30 79	0.26 ND	0.32 ND	< 0.25 ND	
Innisfail, AB, Canada, 2005 (CDC Bold)	NA + K salt 300 L SL	0.93	212	Zadoks 32–34: 2nd to 4th node detectable	1	30 79	< 0.25 ND	ND ND	ND ND	
Rosthern, SK, Canada, 2005 (AC Metcalf)	2-EHE 444 g/L EC	0.90	206	Zadoks 23–24: main shoot and 3–4 tillers	1	73	ND	ND	ND	
Rosthern, SK, Canada, 2005 (AC Metcalf)	DMA salt 480 g/L SL	0.91	206	Zadoks 23–24: main shoot and 3–4 tillers	1	73	ND	ND	ND	
Rosthern, SK, Canada, 2005 (AC Metcalf)	NA + K salt 300 L SL	0.90	205	Zadoks 23–24: main shoot and 3–4 tillers	1	73	ND	ND	ND	
Minto, MB, Canada, 2006 (Conlon)	2-EHE 444 g/L EC	0.91	207	Zadoks 31–33	1	30 56	0.34 ND	0.36 ND	< 0.25 ND	Belcher, TI, 2008, MCPA-R073
Minto, MB, Canada, 2006 (Conlon)	DMA salt 480 g/L SL	0.91	208	Zadoks 31–33	1	30 56	0.31 ND	0.32 ND	< 0.25 ND	
Minto, MB, Canada, 2006 (Conlon)	NA + K salt 300 L SL	0.91	207	Zadoks 31–33	1	30 56	0.30 0.25	0.27 ND	< 0.25 ND	
Boissevain, MB, Canada, 2006 (Newdale)	2-EHE 444 g/L EC	0.92	209	Zadoks 31	1	64	ND	ND	ND	
Boissevain, MB, Canada, 2006 (Newdale)	DMA salt 480 g/L SL	0.91	209	Zadoks 31	1	64	ND	ND	ND	

BARLEY	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
Country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Boissevain, MB, Canada, 2006 (Newdale)	NA + K salt 300 L SL	0.91	209	Zadoks 31	1	64	ND	ND	ND	
Innisfail, AB, Canada, 2005 (CDC Bold)	2-EHE 444 g/L EC	0.92	211	Zadoks 23–25: 24–29 cm	1	79	< 0.25	ND	ND	
Innisfail, AB, Canada, 2005 (CDC Bold)	DMA salt 480 g/L SL	0.93	211	Zadoks 23–25: 24–29 cm	1	79	< 0.25	ND	ND	
Innisfail, AB, Canada, 2005 (CDC Bold)	NA + K salt 300 L SL	0.93	212	Zadoks 23–25: 24–29 cm	1	79	< 0.25	ND	ND	
Spruceview, AB, Canada, 2006 (CDC Bold)	2-EHE 444 g/L EC	0.89	204	Zadoks 34–35: 37–40 cm	1	70	0.29	ND	ND	
Spruceview, AB, Canada, 2006 (CDC Bold)	DMA salt 480 g/L SL	0.91	207	Zadoks 34–35: 37–40 cm	1	70	ND	ND	< 0.25	
Spruceview, AB, Canada, 2006 (CDC Bold)	NA + K salt 300 L SL	0.88	202	Zadoks 34–35: 37–40 cm	1	70	< 0.25	ND	ND	
Rosthern, SK, Canada, 2006 (AC Metcalf)	2-EHE 444 g/L EC	0.91	207	Zadoks 22–23	1	72	< 0.25	ND	ND	
Rosthern, SK, Canada, 2006 (AC Metcalf)	DMA salt 480 g/L SL	0.90	206	Zadoks 22–23	1	72	ND	ND	ND	
Rosthern, SK, Canada, 2006 (AC Metcalf)	NA + K salt 300 L SL	0.87	203	Zadoks 22–23	1	72	< 0.25	ND	ND	
Hepburn, SK, Canada, 2006 (CDC Copeland)	2-EHE 444 g/L EC	0.89	202	Zadoks 22–23	1	68	< 0.25	ND	ND	
Hepburn, SK, Canada, 2006 (CDC Copeland)	DMA salt 480 g/L SL	0.88	202	Zadoks 22–24	1	68	< 0.25	ND	ND	

BARLEY	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
Country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Hepburn, SK, Canada, 2006 (CDC Copeland)	NA + K salt 300 L SL	0.89	202	Zadoks 22–24	1	68	< 0.25	ND	ND	
Spruceview, AB, Canada, 2006 (Metcalf)	2-EHE 444 g/L EC	0.88	201	Zadoks 34–37	1	78	ND	ND	ND	
Spruceview, AB, Canada, 2006 (Metcalf)	DMA salt 480 g/L SL	0.88	202	Zadoks 34–37	1	78	ND	ND	ND	
Spruceview, AB, Canada, 2006 (Metcalf)	NA + K salt 300 L SL	0.88	202	Zadoks 34–37	1	78	ND	ND	ND	
BARLEY HAY										
Elm Creek, MB, Canada, 2005 (AC Robust)	2-EHE 444 g/L EC	0.89	204	Zadoks 35-main shoot and 5 tillers	1	26	ND	0.57	0.30	Jones, GL, 2007, MCPA-R072
Elm Creek, MB, Canada, 2005 (AC Robust)	DMA salt 480 g/L SL	0.79	203	Zadoks 35-main shoot and 5 tillers	1	26	ND	< 0.25	ND	
Elm Creek, MB, Canada, 2005 (AC Robust)	NA + K salt 300 L SL	0.90	205	Zadoks 35-main shoot and 5 tillers	1	26	ND	< 0.25	ND	
St. Cesaire, QB, Canada, 2005 (Sabrina)	2-EHE 444 g/L EC	0.84	195	Zadoks 21-main shoot and 1 tiller	1	34	ND	0.36	ND	
St. Cesaire, QB, Canada, 2005 (Sabrina)	DMA salt 480 g/L SL	0.88	201	Zadoks 21-main shoot and 1 tiller	1	34	ND	ND	ND	
St. Cesaire, QB, Canada, 2005 (Sabrina)	NA + K salt 300 L SL	0.90	207	Zadoks 21-main shoot and 1 tiller	1	34	ND	0.26	ND	

BARLEY	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
Country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Vanscoy, SK, Canada, 2005 (Metcalf)	2-EHE 444 g/L EC	0.90	203	Zadoks 31–1st node detectable	1	28	0.67	0.84	0.25	
Vanscoy, SK, Canada, 2005 (Metcalf)	DMA salt 480 g/L SL	0.90	206	Zadoks 31–1st node detectable	1	28	< 0.25	0.39	ND	
Vanscoy, SK, Canada, 2005 (Metcalf)	NA + K salt 300 L SL	0.89	203	Zadoks 31–1st node detectable	1	28	< 0.25	0.33	ND	
Innisfail, AB, Canada, 2005 (CDC Bold)	2-EHE 444 g/L EC	0.90	206	Zadoks 32–34: 2nd to 4th node detectable	1	1 3 7 14 28 42 56	31.1 11.0 6.61 0.34 0.25 ND 0.46	17.7 23.4 11.9 1.62 0.73 ND ND	8.38 4.84 3.06 0.62 0.28 ND < 0.25	
Innisfail, AB, Canada, 2005 (CDC Bold)	DMA salt 480 g/L SL	0.90	205	Zadoks 32–34: 2nd to 4th node detectable	1	1 3 7 14 28 42 56	18.2 3.70 1.93 < 0.25 ND ND ND	7.73 6.84 4.29 0.85 0.26 ND ND	5.04 1.99 1.45 < 0.25 < 0.25 ND ND	
Innisfail, AB, Canada, 2005 (CDC Bold)	NA + K salt 300 L SL	0.93	212	Zadoks 32–34: 2nd to 4th node detectable	1	1 3 7 14 28 42 56	20.0 3.10 2.21 ND ND ND ND	6.28 5.93 3.51 0.79 0.34 ND ND	2.94 1.34 0.85 0.29 < 0.25 ND ND	
Rosthern, SK, Canada, 2005 (AC Metcalf)	2-EHE 444 g/L EC	0.90	206	Zadoks 23–24: main shoot and 3–4 tillers	1	30	0.69	0.86	0.28	
Rosthern, SK, Canada, 2005 (AC Metcalf)	DMA salt 480 g/L SL	0.91	206	Zadoks 23–24: main shoot and 3–4 tillers	1	30	0.29	0.50	< 0.25	
Rosthern, SK, Canada, 2005 (AC Metcalf)	NA + K salt 300 L SL	0.90	205	Zadoks 23–24: main shoot and 3–4 tillers	1	30	ND	< 0.25	ND	

BARLEY	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
Country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Minto, MB, Canada, 2006 (Conlon)	2-EHE 444 g/L EC	0.91	207	Zadoks 31–33	1	1 3 7 14 28 42 56	42.4 8.62 5.18 1.89 0.38 ND ND	16.2 10.4 5.02 1.54 1.45 0.26 ND	11.8 8.75 4.94 1.50 0.40 ND ND	Belcher, TI, 2008, MCPA-R073
Minto, MB, Canada, 2006 (Conlon)	DMA salt 480 g/L SL	0.91	208	Zadoks 31–33	1	1 3 7 14 28 42 56	101 6.82 4.43 1.11 0.26 ND ND	11.8 6.60 3.94 1.13 0.66 < 0.25 ND	12.0 5.96 3.70 0.98 < 0.25 ND ND	
Minto, MB, Canada, 2006 (Conlon)	NA + K salt 300 L SL	0.91	207	Zadoks 31–33	1	1 3 7 14 28 42 56	99.5 4.04 1.56 0.66 0.30 ND ND	12.8 4.52 2.28 0.71 0.68 < 0.25 ND	9.07 4.18 1.90 0.71 0.30 ND ND	
Boissevain, MB, Canada, 2006 (Newdale)	2-EHE 444 g/L EC	0.92	209	Zadoks 31	1	35	< 0.25	0.50	< 0.25	
Boissevain, MB, Canada, 2006 (Newdale)	DMA salt 480 g/L SL	0.91	209	Zadoks 31	1	35	< 0.25	0.46	< 0.25	
Boissevain, MB, Canada, 2006 (Newdale)	NA + K salt 300 L SL	0.91	209	Zadoks 31	1	35	ND	0.28	ND	
Innisfail, AB, Canada, 2005 (CDC Bold)	2-EHE 444 g/L EC	0.92	211	Zadoks 23–25: 24–29 cm	1	33	ND	< 0.25	< 0.25	
Innisfail, AB, Canada, 2005 (CDC Bold)	DMA salt 480 g/L SL	0.93	211	Zadoks 23–25: 24–29 cm	1	33	ND	ND	ND	

BARLEY	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
Country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Innisfail, AB, Canada, 2005 (CDC Bold)	NA + K salt 300 L SL	0.93	212	Zadoks 23–25: 24–29 cm	1	33	ND	ND	ND	
Spruceview, AB, Canada, 2006 (CDC Bold)	2-EHE 444 g/L EC	0.89	204	Zadoks 34–35: 37–40 cam	1	40	0.55	0.98	0.46	
Spruceview, AB, Canada, 2006 (CDC Bold)	DMA salt 480 g/L SL	0.91	207	Zadoks 34–35: 37–40 cm	1	40	0.35	0.63	< 0.25	
Spruceview, AB, Canada, 2006 (CDC Bold)	NA + K salt 300 L SL	0.88	202	Zadoks 34–35: 37–40 cm	1	40	< 0.25	0.41	< 0.25	
Rosthern, SK, Canada, 2006 (AC Metcalf)	2-EHE 444 g/L EC	0.91	207	Zadoks 22–23	1	38	ND	ND	ND	
Rosthern, SK, Canada, 2006 (AC Metcalf)	DMA salt 480 g/L SL	0.90	206	Zadoks 22–23	1	38	ND	ND	ND	
Rosthern, SK, Canada, 2006 (AC Metcalf)	NA + K salt 300 L SL	0.87	203	Zadoks 22–23	1	38	ND	ND	ND	
Hepburn, SK, Canada, 2006 (CDC Copeland)	2-EHE 444 g/L EC	0.89	202	Zadoks 22–23	1	36	ND	ND	ND	
Hepburn, SK, Canada, 2006 (CDC Copeland)	DMA salt 480 g/L SL	0.88	202	Zadoks 22–24	1	36	ND	ND	ND	
Hepburn, SK, Canada, 2006 (CDC Copeland)	NA + K salt 300 L SL	0.89	202	Zadoks 22–24	1	36	ND	ND	ND	
Spruceview, AB, Canada, 2006 (Metcalf)	2-EHE 444 g/L EC	0.88	201	Zadoks 34–37	1	37	ND	ND	ND	
Spruceview, AB, Canada, 2006 (Metcalf)	DMA salt 480 g/L SL	0.88	202	Zadoks 34–37	1	37	< 0.25	< 0.25	ND	

BARLEY	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
Country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Spruceview, AB, Canada, 2006 (Metcalf)	NA + K salt 300 L SL	0.88	202	Zadoks 34–37	1	37	< 0.25	< 0.25	ND	

ND = not detected.

Table 53 MCPA acid equivalent residues in treated barley straw and forage resulting from supervised trials in Austria, UK, France and Spain (Pfarl, DIC, 1994, MCPA-R070; Old, J and Venuti, J, 2001, MCPA-R062; Wasser, C, 2000, MCPA-R063; Old, J and Duncan, P, 2001, MCPA-R066; Perny, A, 2001, MCPA-R067; Old, J, etc., 2001, MCPA-R060; Wasser, C, 2000, MCPA-R061; Old, J, Duncan, P, 2001, MCPA-R064; Perny, A, 2001, MCPA-R065; Wardman, JP, and Mrti, S, 2002, MCPA-R069; Gallais, C, 2002, MCPA-R068; Rawle, NW, 2001, MCPA-R071)

BARLEY	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
BARLEY STRAW										
Ansfelden, Austria, 1992 (Berta)	DMA salt 281 g/L SL	0.58	300	BBCH 31	1	63	–	–	–	Pfarl, DIC, 1994, MCPA-R070
Leonding, Austria, 1992 (Robin)	DMA salt 281 g/L SL	0.58	300	BBCH 31	1	60	< 0.05	–	–	
Chantillon sur Loire, France, 1999 (Sonja)	DMA salt 750 g/L SL	1.79	250	BBCH 30	1	106	ND[a]	0.05	–	Old, J and Venuti, J, 2001, MCPA-R062; Wasser, C, 2000, MCPA-R063
East Lothian, UK, 1999 (Regina)	DMA salt 750 g/L SL	1.89	263	BBCH 30	1	116	0.07	< 0.05	–	
East Lothian, UK, 1999 (Regina)	DMA salt 750 g/L SL	1.83	254	BBCH 30-31	1	121	ND	ND	–	Old, J and Duncan, P, 2001, MCPA-R066; Perny, A, 2001, MCPA-R067
Noiron sous Geverey, France, 1999 (Majestic)	DMA salt 750 g/L SL	1.86	258	BBCH 30	1	99	ND	ND	–	
Janneyrias, France, 1999 (Platine)	K-salt 400 g/L SL	1.22	251	BBCH 30	1	95	ND	ND	–	Old, J, etc., 2001, MCPA-R060; Wasser, C, 2000,

BARLEY	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Menarguens, Spain, 1999 (Graphic)	K-salt 400 g/L SL	1.24	254	BBCH 30	1	86	ND	ND		MCPA-R061
Janneyrias, France, 2000 (Pertine)	K-salt 400 g/L SL	1.25	254	BBCH 30	1	92	ND	ND		Old, J, Duncan, P., 2001, MCPA-R064; Perny, A, 2001, MCPA-R065
Menarguens, Spain, 2000 (Graphic)	K-salt 400 g/L SL	1.20	248	BBCH 30-31	1	NR	ND	ND		
Menarguens, Spain, 2001 (Graphic)	K-salt 400 g/L SL	1.20	248	BBCH 30-31	1	86	0.24	0.18		Gallais, C, 2002, MCPA-R068;Wardman, JP, and Mrti, S, 2002, MCPA-R069
Corbarieu, France, 1998 (Scarlet)	NA salt 800 g/L SL	1.88	266	BBCH 32-33	1	77	0.22	–	–	Rawle, NW, 2001, MCPA-R071
Pommevic, France, 1998 (Nevada)	NA salt 800 g/L SL	1.86	265	BBCH 32	1	67	0.28	–	–	
Villeneuve, les Bouloc, France, 1998 (Volga)	NA salt 800 g/L SL	1.82	259	BBCH 32	1	61	1.04	–	–	
BARLEY FORAGE										
GAP, UK	DMA salt, 500 SL	1.7	100-400	BBCH 30	1	–	MCPA	HMCPA	CCPA	
Ansfelden, Austria 1992 (Berta)	DMA salt 281 g/L SL	0.58	300	BBCH 31	1	0 15 28	12.6 0.17 < 0.05	–	–	Pfarl, DIC, 1994, MCPA-R070
Leonding, Austria, 1992 (Robin)	DMA salt 281 g/L SL	0.58	300	BBCH 31	1	0 13 26	17.5 0.09 < 0.05	–	–	
Chantillon sur Loire, France, 1999 (Sonja)	DMA salt 750 g/L SL	1.79	250	BBCH 30	1	0 7 14 28	53.0 4.20 0.79 0.09	0.51 0.29 0.14 < 0.05		Old, J and Venuti, J, 2001, MCPA-R062; Wasser, C, 2000, MCPA-R063

BARLEY	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
East Lothian, UK, 1999 (Regina)	DMA salt 750 g/L SL	1.89	263	BBCH 30	1	0 7 14 28	31.0 4.30 1.80 0.56	0.43 0.24 0.05 < 0.05		
East Lothian, UK, 1999 (Regina)	DMA salt 750 g/L SL	1.83	254	BBCH 30-31	1	0	69.0	0.10		Old, J and Duncan, P, 2001, MCPA-R066; Perny, A, 2001, MCPA-R067
Noiron sous Geverey, France, 1999 (Majestic)	DMA salt 750 g/L SL	1.86	258	BBCH 30	1	0	46.0	0.26		
Janneyrias, France, 1999 (Platine)	K-salt 400 g/L SL	1.22	251	BBCH 30	1	0 7 14 28	20.0 0.60 0.09 < 0.05	0.14 0.05 < 0.05 ND [b]		Old, J, etc., 2001, MCPA-R060; Wasser, C, 2000, MCPA-R061
Menarguens, Spain, 1999 (Graphic)	K-salt 400 g/L SL	1.24	254	BBCH 30	1	0 7 14 28	25.0 5.10 0.53 0.21	0.42 0.32 0.06 0.09		
Janneyrias, France, 2000 (Pertine)	K-salt 400 g/L SL	1.25	254	BBCH 30	1	0	19.0	0.14		Old, J, Duncan, P, 2001, MCPA-R064; Perny, A, 2001, MCPA-R065
Menarguens, Spain, 2000 (Graphic)	K-salt 400 g/L SL	1.20	248	BBCH 30-31	1	0	19.0	0.11		
Menarguens, Spain, 2001 (Graphic)	K-salt 400 g/L SL	1.20	248	BBCH 30-31	1	0	29.0	0.67	–	Gallais, C, 2002, MCPA-R068;Wardman, JP, and Mrti, S, 2002, MCPA-R069

[a] LOD = 0.016mg/kg for straw.

[b] LOD = 0.008 mg/kg for green plants.

Table 54 MCPA acid equivalent residues in treated wheat forage, straw and hay resulting from supervised trials in Canada and USA (Barney, WP, 2002, MCPA-R085 through MCPA-R089; Jones, GL, 2005, MCPA-R090 through MCPA-R092; and Jones, GL, 2006, MCPA-R098 through MCPA-R104; Kludas, RS, 2000, MCPA-R081 through MCPA-R084; and Jones, GL, 2006, MCPA-R093 through MCPA-R097)

WHEAT	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
WHEAT FORAGE										
Rosthern, SK, Canada, 2001 (Foremost CPS)	2-EHE 444 g/L EC	1.76	294	Pre-boot Zadoks 37–38	1	0	108	0.72	< 0.10	Barney, WP, 2002, MCPA-R085
						7	7.73	1.26	1.56	
						14	3.08	2.21	0.69	
						21	3.07	1.52	0.61	
Rosthern, SK, Canada, 2001 (Foremost CPS)	DMA salt 480 g/L SL	1.80	298	Pre-boot Zadoks 37	1	0	89	2.23	0.17	
						7	6.27	1.62	1.39	
						14	3.04	0.70	0.75	
						21	2.43	0.46	0.60	
Rosthern, SK, Canada, 2001 (Foremost CPS)	NA salt 300 g/L SL	1.76	293	Pre-boot Zadoks 37	1	0	113	5.51	0.24	
						7	3.90	2.22	1.01	
						14	2.28	0.82	0.58	
						21	1.91	0.95	0.50	
Haywood, MB, Canada, 2001 (AC Cora)	2-EHE 444 g/L EC	1.65	282	Pre-boot Zadoks 31	1	0	89.4	5.85	0.33	Barney, WP, 2002, MCPA-R087
						7	8.3	0.87	0.45	
						14	4.47	2.54	0.26	
						21	0.88	0.82	0.15	
Haywood, MB, Canada, 2001 (AC Cora)	DMA salt 480 g/L SL	1.70	284	Pre-boot Zadoks 31	1	0	83.5	10.5	0.31	
						7	5.34	1.73	0.35	
						14	3.23	1.49	0.19	
						21	0.44	0.63	0.11	
Haywood, MB, Canada, 2001 (AC Cora)	NA salt 300 g/L SL	1.74	285	Pre-boot Zadoks 31	1	0	91.1	6.26	0.24	
						7	6.44	1.22	0.47	
						14	2.12	1.39	0.17	
						21	0.19	0.25	ND	
Elm Creek, MB Canada, 2001 (Majestic)	2-EHE 444 g/L EC	1.65	271	Pre-boot Zadoks 32–34	1	0	73.1	4.48	0.44	Barney, WP, 2002, MCPA-R086
						7	7.14	1.34	0.95	
						14	4.02	2.46	0.45	
						21	1.59	0.72	< 0.25	
Elm Creek, MB Canada, 2001 (Majestic)	DMA salt 480 g/L SL	1.62	268	Pre-boot Zadoks 32–34	1	0	75.4	1.95	0.01	
						7	3.92	1.23	0.90	
						14	1.54	0.82	0.34	
						21	0.37	0.27	< 0.25	

WHEAT	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Elm Creek, MB Canada, 2001 (Majestic)	NA salt 300 g/L SL	1.64	273	Pre-boot Zadoks 32–34	1	0	65.8	5.34	0.26	
						7	4.61	1.71	0.84	
						14	1.19	0.74	< 0.25	
						21	0.27	< 0.25	ND	
Barnwell, AB Canada, 2001 (Soft White)	2-EHE 444 g/L EC	1.70	286	Pre-boot Zadoks 36–37	1	0	51.3	1.76	0.10	Barney, WP, 2002, MCPA-R088
						7	5.82	1.83	1.36	
						14	5.43	0.54	0.64	
						21	3.09	0.49	0.37	
Barnwell, AB Canada, 2001 (Soft White)	DMA salt 480 g/L SL	1.74	291	Pre-boot Zadoks 36–37	1	0	112	1.94	ND	
						7	5.53	0.19	0.77	
						14	2.52	0.48	0.49	
						21	1.27	0.31	0.33	
Barnwell, AB Canada, 2001 (Soft White)	NA salt 300 g/L SL	1.74	288	Pre-boot Zadoks 36–37	1	0	83.1	2.00	ND	
						7	3.95	0.74	0.48	
						14	1.39	0.28	< 0.25	
						21	0.90	< 0.25	< 0.25	
Fairview, AB, Canada, 2001 (Canadian Western White EXP3)	2-EHE 444 g/L EC	1.71	289	Pre-boot Zadoks 36–37	1	0	76.7	5.45	< 0.25	Barney, WP, 2002, MCPA-R089
						7	7.94	1.19	0.97	
						14	3.59	3.62	0.48	
						21	1.70	1.84	< 0.25	
Fairview, AB, Canada, 2001 (Canadian Western White EXP3)	DMA salt 480 g/L SL	1.70	287	Pre-boot Zadoks 36–37	1	0	87.4	8.74	0.36	
						7	5.90	0.89	1.15	
						14	2.65	0.44	0.59	
						21	1.21	0.30	0.38	
Fairview, AB, Canada, 2001 (Canadian Western White EXP3)	NA salt 300 g/L SL	1.76	289	Pre-boot Zadoks 36–37	1	0	64.6	5.99	< 0.25	
						7	5.36	3.03	0.76	
						14	2.02	1.92	0.36	
						21	1.27	0.71	0.25	
Lacombe, AB, Canada, 2003 (CPS)	2-EHE 444 g/L EC	1.84	299	Pre-boot Zadoks 37	1	0	104	0.26	< 0.25	Jones, GL, 2005, MCPA-R090
						7	12.6	1.79	1.48	
						14	5.32	1.55	0.70	
						21	4.28	0.72	0.55	
Lacombe, AB, Canada, 2003 (CPS)	DMA salt 480 g/L SL	1.81	300	Pre-boot Zadoks 37	1	0	94.5	1.04	< 0.25	
						7	6.68	1.45	0.93	
						14	4.15	1.08	0.64	
						21	2.69	1.04	0.60	

WHEAT	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Lacombe, AB, Canada, 2003 (CPS)	NA salt 300 g/L SL	1.85	300	Pre-boot Zadoks 37	1	0	83.8	0.63	< 0.25	
						7	5.96	1.33	0.71	
						14	2.73	0.67	0.45	
						21	2.86	1.24	0.77	
Delisle, SK, Canada, 2003 (AC Cadillac)	2-EHE 444 g/L EC	1.79	295	Pre-Boot Zadoks 14–22	1	0	145.5	1.97	ND	Jones, GL, 2005, MCPA-R091
						7	3.93	1.63	1.29	
						14	1.08	0.43	0.29	
						21	0.50	< 0.25	< 0.25	
Delisle, SK, Canada, 2003 (AC Cadillac)	DMA salt 480 g/L SL	1.74	293	Pre-Boot Zadoks 14–22	1	0	175.0	4.10	ND	
						7	4.13	1.13	0.86	
						14	0.82	0.48	0.28	
						21	0.33	0.26	ND	
Delisle, SK, Canada, 2003 (AC Cadillac)	NA salt 300 g/L SL	1.87	298	Pre-Boot Zadoks 14–22	1	0	158.5	2.23	ND	
						7	1.92	0.67	0.67	
						14	0.43	< 0.25	< 0.25	
						21	ND	ND	ND	
Rosetown, SK, Canada, 2003 (AC Barrie)	2-EHE 444 g/L EC	1.77	291	Pre-Boot Zadoks 22–31	1	0	111.5	0.39	ND	Jones, GL, 2005, MCPA-R092
						7	10.2	1.47	0.66	
						14	4.43	0.48	0.31	
						21	2.71	0.38	< 0.25	
Rosetown, SK, Canada, 2003 (AC Barrie)	DMA salt 480 g/L SL	1.71	287	Pre-Boot Zadoks 22–31	1	0	174.5	0.88	ND	
						7	13.6	1.30	1.12	
						14	4.50	0.91	0.45	
						21	1.96	0.59	< 0.25	
Rosetown, SK, Canada, 2003 (AC Barrie)	NA salt 300 g/L SL	1.83	293	Pre-Boot Zadoks 22–31	1	0	145.5	0.47	ND	
						7	13.2	2.82	1.46	
						14	6.18	1.25	0.57	
						21	3.88	0.78	0.37	
Vanscoy, SK, Canada, 2004 (Intrepid)	2-EHE 444 g/L EC	1.86	275	Pre-Boot Zadoks 31–33	1	0	86.7	0.57	ND	Jones, GL, 2006, MCPA-R098
						7	7.15	0.87	0.53	
						14	3.64	0.45	0.30	
						21	1.83	< 0.25	0.17	
Vanscoy, SK, Canada, 2004 (Intrepid)	DMA salt 480 g/L SL	1.83	277	Pre-Boot Zadoks 31–33	1	0	78.4	0.86	ND	
						7	4.42	0.72	0.44	
						14	2.10	0.35	< 0.25	
						21	1.54	< 0.25	< 0.25	

WHEAT	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Vanscoy, SK, Canada, 2004 (Intrepid)	NA salt 300 g/L SL	1.87	278	Pre-Boot Zadoks 31–33	1	0	82.7	0.57	ND	
						7	2.77	0.63	0.38	
						14	1.19	0.26	< 0.25	
						21	0.59	< 0.25	< 0.25	
Taber, AB, Canada, 2004 (Intrepid)	2-EHE 444 g/L EC	1.99	297	Pre-Boot Zadoks 31–33	1	0	128	4.18	0.16	Jones, GL, 2006, MCPA-R099
						7	5.55	0.67	0.53	
						14	0.26	ND	< 0.25	
						21	ND	ND	ND	
Taber, AB, Canada, 2004 (Intrepid)	DMA salt 480 g/L SL	1.98	295	Pre-Boot Zadoks 31–33	1	0	109	4.79	< 0.25	
						7	0.63	< 0.25	< 0.25	
						14	ND	ND	ND	
						21	ND	ND	ND	
Taber, AB, Canada, 2004 (Intrepid)	NA salt 300 g/L SL	2.21	293	Pre-Boot Zadoks 31–33	1	0	85.4	1.68	ND	
						7	0.78	ND	ND	
						14	ND	ND	ND	
						21	ND	ND	ND	
Minto, MB, Canada, 2004 (AC Barrie)	2-EHE 444 g/L EC	1.97	292	Pre-Boot Zadoks 34–37	1	0	95.5	4.22	0.20	Jones, GL, 2006, MCPA-R100
						7	11.0	1.51	0.93	
						14	5.60	0.84	0.53	
						21	3.47	0.71	0.35	
Minto, MB, Canada, 2004 (AC Barrie)	DMA salt 480 g/L SL	2.01	299	Pre-Boot Zadoks 34–37	1	0	81.6	7.70	0.22	
						7	10.7	2.12	1.50	
						14	6.97	2.07	0.81	
						21	4.24	1.73	0.58	
Minto, MB, Canada, 2004 (AC Barrie)	NA salt 300 g/L SL	1.98	294	Pre-Boot Zadoks 34–37	1	0	71.7	4.90	0.17	
						7	7.31	1.35	1.03	
						14	4.62	1.03	0.59	
						21	2.21	0.62	0.37	
Boissevain, MB, Canada, 2004 (AC Barrie)	2-EHE 444 g/L EC	1.94	288	Pre-boot Zadoks 37	1	0	59.9	1.19	ND	Jones, GL, 2006, MCPA-R101
						7	3.46	0.87	0.52	
						14	1.36	0.36	0.26	
						21	0.79	0.27	< 0.25	
Boissevain, MB, Canada, 2004 (AC Barrie)	DMA salt 480 g/L SL	1.95	289	Pre-boot Zadoks 37	1	0	57.8	1.81	ND	
						7	2.69	0.53	0.41	
						14	1.07	0.30	< 0.25	
						21	0.57	< 0.25	< 0.25	

WHEAT	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Boissevain, MB, Canada, 2004 (AC Barrie)	NA salt 300 g/L SL	1.95	290	Pre-boot Zadoks 37	1	0	55.2	2.53	ND	
						7	1.94	0.34	0.34	
						14	0.81	0.30	< 0.25	
						21	0.35	< 0.25	< 0.25	
Rosthern, SK, Canada, 2004 (AC Intrepid)	2-EHE 444 g/L EC	1.94	287	Pre-boot Zadoks 37–39	1	0	76.0	0.96	ND	Jones, GL, 2006, MCPA-R102
						7	6.37	1.09	1.39	
						14	3.41	0.62	0.68	
						21	3.09	0.52	0.61	
Rosthern, SK, Canada, 2004 (AC Intrepid)	DMA salt 480 g/L SL	1.93	287	Pre-boot Zadoks 37–39	1	0	69.8	1.59	ND	
						7	4.33	1.03	0.99	
						14	2.55	0.59	0.63	
						21	2.42	0.59	0.61	
Rosthern, SK, Canada, 2004 (AC Intrepid)	NA salt 300 g/L SL	1.94	289	Pre-boot Zadoks 37–39	1	0	62.3	1.84	ND	
						7	3.10	0.81	0.69	
						14	1.72	0.44	0.44	
						21	1.40	0.47	0.35	
Hepburn, SK, Canada, 2004 (AC Barrie)	2-EHE 444 g/L EC	1.94	287	Pre-boot Zadoks 37–39	1	0	54.0	1.20	ND	Jones, GL, 2006, MCPA-R103
						7	7.86	1.13	0.70	
						14	6.75	1.27	0.73	
						21	4.89	0.98	0.56	
Hepburn, SK, Canada, 2004 (AC Barrie)	DMA salt 480 g/L SL	1.88	286	Pre-boot Zadoks 37–39	1	0	50.5	3.26	ND	
						7	8.74	1.64	0.74	
						14	5.14	1.10	0.58	
						21	3.43	0.78	0.45	
Hepburn, SK, Canada, 2004 (AC Barrie)	NA salt 300 g/L SL	1.92	286	Pre-boot Zadoks 37–39	1	0	52.4	1.95	ND	
						7	5.53	0.87	0.66	
						14	2.74	0.49	0.39	
						21	2.22	0.43	0.30	
Innisfail, AB, Canada, 2004 (Foremost)	2-EHE 444 g/L EC	2.00	296	Pre-boot Zadoks 35	1	0	89.2	1.60	ND	Jones, GL, 2006, MCPA-R104
						7	12.0	2.88	1.26	
						14	4.20	1.22	0.42	
						21	3.82	1.10	0.51	
Innisfail, AB, Canada, 2004 (Foremost)	DMA salt 480 g/L SL	1.94	288	Pre-boot Zadoks 35	1	0	77.2	3.98	< 0.25	
						7	14.5	2.24	0.90	
						14	4.40	1.46	0.47	
						21	2.29	0.88	0.30	

WHEAT	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Innisfail, AB, Canada, 2004 (Foremost)	NA salt 300 g/L SL	1.96	292	Pre-boot Zadoks 35	1	0	93.2	2.97	ND	
						7	21.2	3.46	1.42	
						14	3.64	0.88	0.67	
						21	2.26	0.52	0.45	
New Holland, OH, USA, 2004 (SC 1358)	2-EHE 444 g/L EC	1.71	220	Pre-boot Zadoks 37	1	0	57.3	1.02	ND	Jones, GL, 2006, MCPA-R093
						2	11.4	1.14	0.78	
						14	10.0	1.43	0.72	
						22	10.1	1.31	0.79	
New Holland, OH, USA, 2004 (SC 1358)	DMA salt 480 g/L SL	1.71	220	Pre-boot Zadoks 37	1	0	55.1	2.38	ND	
						2	12.8	0.79	0.70	
						14	5.29	0.73	0.58	
						22	5.71	0.95	0.62	
New Holland, OH, USA, 2004 (SC 1358)	NA salt 300 g/L SL	1.75	224	Pre-boot Zadoks 37	1	0	45.5	1.31	ND	
						2	6.76	1.10	0.58	
						14	4.16	0.84	0.52	
						22	3.93	0.71	0.51	
Redfield, SD, USA, 2004 (Harding)	2-EHE 444 g/L EC	1.65	326	Pre-boot Zadoks 36–37	1	0	85.6	0.75	ND	Jones, GL, 2006, MCPA-R094
						7	3.18	1.48	0.64	
						14	1.70	1.00	0.55	
						21	1.51	0.74	0.28	
Redfield, SD, USA, 2004 (Harding)	DMA salt 480 g/L SL	1.65	326	Pre-boot Zadoks 36–37	1	0	101.5	1.94	< 0.25	
						7	1.49	0.67	0.38	
						14	1.11	0.93	0.31	
						21	0.97	0.46	0.27	
Redfield, SD, USA, 2004 (Harding)	NA salt 300 g/L SL	1.71	325	Pre-boot Zadoks 36–37	1	0	89.8	1.15	ND	
						7	2.16	0.84	0.61	
						14	1.18	0.40	0.25	
						21	1.13	0.50	0.31	
Larned, KS USA, 2004 (Jagalene)	2-EHE 444 g/L EC	1.78	285	Pre-boot Zadoks 39	1	0	44.8	1.42	< 0.25	Jones, GL, 2006, MCPA-R095
						7	5.38	1.83	1.52	
						14	3.29	1.52	1.46	
						21	3.11	1.53	1.50	
Larned, KS USA, 2004 (Jagalene)	DMA salt 480 g/L SL	1.80	285	Pre-boot Zadoks 39	1	0	56.3	2.03	< 0.25	
						7	3.57	1.10	0.74	
						14	2.54	0.78	0.61	
						21	2.74	0.77	0.70	

WHEAT	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Larned, KS USA, 2004 (Jagalene)	NA salt 300 g/L SL	1.81	286	Pre-boot Zadoks 39	1	0	49.4	0.87	ND	
						7	1.71	0.67	0.64	
						14	1.13	0.40	0.47	
						21	1.37	0.45	0.50	
Colony, OK USA, 2004 (Pioneer 2157)	2-EHE 444 g/L EC	1.63	276	Pre-boot Zadoks 39	1	0	49.1	1.45	< 0.25	Jones, GL, 2006, MCPA-R096
						7	4.93	1.95	2.41	
						14	5.18	2.35	2.77	
						21	3.78	3.24	2.55	
Colony, OK USA, 2004 (Pioneer 2157)	DMA salt 480 g/L SL	1.65	278	Pre-boot Zadoks 39	1	0	62.8	4.20	< 0.25	
						7	7.36	1.97	1.90	
						14	5.68	1.61	1.78	
						21	5.31	1.85	1.52	
Colony, OK USA, 2004 (Pioneer 2157)	NA salt 300 g/L SL	1.73	282	Pre-boot Zadoks 39	1	0	54.5	2.32	ND	
						7	6.90	1.79	2.73	
						14	5.35	0.96	2.01	
						21	4.33	1.67	1.93	
Groom, TX, USA, 2004 (Ogallala)	2-EHE 444 g/L EC	1.72	285	Pre-boot Zadoks 39	1	0	28.6	1.16	< 0.25	Jones, GL, 2006, MCPA-R097
						7	5.27	1.65	1.01	
						14	5.21	2.86	1.33	
						21	5.79	4.75	1.50	
Groom, TX, USA, 2004 (Ogallala)	DMA salt 480 g/L SL	1.70	286	Pre-boot Zadoks 39	1	0	45.3	2.42	ND	
						7	9.12	3.89	1.89	
						14	6.68	1.89	1.05	
						21	4.87	1.15	0.74	
Groom, TX, USA, 2004 (Ogallala)	NA salt 300 g/L SL	1.69	285	Pre-boot Zadoks 39	1	0	37.0	2.65	ND	
						7	7.15	1.35	1.00	
						14	7.32	2.72	1.52	
						21	6.86	3.21	1.55	
Kansas, USA 1998 (Variety not reported)	2-EHE 480 g/L EC	1.76	278	Pre-boot Zadoks 37	1	0	44.8	5.63	0.47	Kludas, R. S., 2000, MCPA-R082
						7	9.02	4.22	0.57	
						14	5.42	8.17	0.52	
						21	4.78	6.49	0.44	
Oklahoma, USA 1998 (Variety nor reported)	2-EHE 480 g/L EC	1.75	248	Pre-boot Zadoks 37	1	0	64.8	1.35	< 0.25	
						7	5.48	6.37	0.41	
						14	3.45	5.63	0.40	
						21	2.94	0.79	0.33	

WHEAT	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
North Dakota, USA, 1998 (2375)	2-EHE 480 g/L EC	1.83	282	Pre-boot Zadoks 37–39	1	0	56.0	0.64	ND	Kludas, RS, 2000, MCPA-R084
						7	9.75	4.30	1.69	
						14	6.98	8.80	1.72	
						21	6.85	7.60	1.94	
Kansas, USA 1997 (TAM 105)	DMA salt 480 g/L SL	1.66	263	Pre-boot Zadoks 37	1	0	51.1	5.92	0.41	Kludas, RS, 2000, MCPA-R081
						7	9.79	6.36	0.63	
						14	6.14	3.17	0.47	
						21	4.31	4.43	0.37	
Oklahoma, USA 1997 (TAM 200)	DMA salt 480 g/L SL	1.74	247	Pre-boot Zadoks 37	1	0	72.3	1.71	< 0.25	
						7	3.08	0.76	0.27	
						14	2.05	0.55	< 0.25	
						21	1.81	0.35	< 0.25	
North Dakota, USA, 1998 (2375)	DMA salt 480 g/L SL	1.79	281	Pre-boot Zadoks 37–39	1	0	49.7	2.20	< 0.25	Kludas, RS, 2000, MCPA-R083
						7	6.88	9.72	2.34	
						14	5.69	8.76	2.25	
						21	4.59	8.02	2.22	
WHEAT STRAW										
Haywood, MB, Canada, 2001 (AC Cora)	2-EHE 444 g/L EC	1.65	282	Pre-boot Zadoks 31	1	30	< 0.25	< 0.25	ND	Barney, WP, 2002, MCPA-R087
						81	ND	< 0.25	< 0.25	
Haywood, MB, Canada, 2001 (AC Cora)	DMA salt 480 g/L SL	1.70	283	Pre-boot Zadoks 31	1	30	ND	ND	ND	
						81	ND	< 0.25	< 0.25	
Haywood, MB, Canada, 2001 (AC Cora)	NA salt 300 g/L SL	1.74	285	Pre-boot Zadoks 31	1	30	ND	ND	ND	
						81	ND	< 0.25	< 0.25	
Elm Creek, MB Canada, 2001 (Majestic)	2-EHE 444 g/L EC	1.65	271	Pre-boot Zadoks 32–34	1	30	1.11	1.76	0.46	Barney, WP, 2002, MCPA-R086
						63	0.37	0.94	0.48	
Elm Creek, MB Canada, 2001 (Majestic)	DMA salt 480 g/L SL	1.62	268	Pre-boot Zadoks 32–34	1	30	0.46	0.66	0.25	
						63	0.29	1.06	0.35	
Elm Creek, MB Canada, 2001 (Majestic)	NA salt 300 g/L SL	1.64	273	Pre-boot Zadoks 32–34	1	30	< 0.25	0.31	< 0.25	
						63	< 0.25	0.64	0.27	
Barnwell, AB Canada, 2001 (Soft White)	2-EHE 444 g/L EC	1.70	286	Pre-boot Zadoks 36–37	1	30	5.09	0.80	0.52	Barney, WP, 2002, MCPA-R088
						64	3.98	1.73	0.49	

WHEAT	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Barnwell, AB Canada, 2001 (Soft White)	DMA salt 480 g/L SL	1.74	291	Pre-boot Zadoks 36–37	1	30	2.43	0.30	0.39	
						64	1.79	0.95	0.34	
Barnwell, AB Canada, 2001 (Soft White)	NA salt 300 g/L SL	1.74	288	Pre-boot Zadoks 36–37	1	30	1.79	< 0.25	< 0.25	
						64	0.76	0.51	ND	
Fairview, AB, Canada, 2001 (Canadian Western White EXP3)	2-EHE 444 g/L EC	1.71	289	Pre-boot Zadoks 36–37	1	31	0.89	0.42	< 0.25	Barney, WP, 2002, MCPA-R089
						93	ND	ND	ND	
Fairview, AB, Canada, 2001 (Canadian Western White EXP3)	DMA salt 480 g/L SL	1.70	287	Pre-boot Zadoks 36–37	1	31	0.70	0.32	< 0.25	
						93	ND	ND	ND	
Fairview, AB, Canada, 2001 (Canadian Western White EXP3)	NA salt 300 g/L SL	1.76	289	Pre-boot Zadoks 36–37	1	31	0.42	< 0.25	< 0.25	
						93	ND	ND	ND	
Rosthern, SK, Canada, 2001 (Foremost CPS)	2-EHE 444 g/L EC	1.76	294	Pre-boot Zadoks 37–38	1	30	6.47	4.54	1.28	Barney, WP, 2002, MCPA-R085
						63	1.62	2.27	0.59	
Rosthern, SK, Canada, 2001 (Foremost CPS)	DMA salt 480 g/L SL	1.80	298	Pre-boot Zadoks 37	1	30	4.51	3.88	0.81	
						79	1.02	1.68	0.50	
Rosthern, SK, Canada, 2001 (Foremost CPS)	NA salt 300 g/L SL	1.76	293	Pre-boot Zadoks 37	1	30	3.21	2.17	0.71	
						79	0.66	1.32	0.38	
Lacombe, AB, Canada, 2003 (CPS)	2-EHE 444 g/L EC	1.84	299	Pre-boot Zadoks 37	1	30	6.05	0.96	0.55	Jones, GL, 2005, MCPA-R090
						79	2.99	2.18	0.27	
Lacombe, AB, Canada, 2003 (CPS)	DMA salt 480 g/L SL	1.81	300	Pre-boot Zadoks 37	1	30	4.66	0.99	0.69	
						79	2.45	1.76	0.34	
Lacombe, AB, Canada, 2003 (CPS)	NA salt 300 g/L SL	1.85	300	Pre-boot Zadoks 37	1	30	2.61	0.62	048.	
						79	1.10	1.42	ND	
Delisle, SK, Canada, 2003 (AC Cadillac)	2-EHE 444 g/L EC	1.79	295	Pre-Boot Zadoks 14–22	1	30	ND	ND	ND	Jones, GL, 2005, MCPA-R091
						73	ND	ND	ND	
Delisle, SK, Canada, 2003 (AC Cadillac)	DMA salt 480 g/L SL	1.74	293	Pre-Boot Zadoks 14–22	1	30	ND	ND	ND	
						73	ND	ND	ND	

WHEAT	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Delisle, SK, Canada, 2003 (AC Cadillac)	NA salt 300 g/L SL	1.87	298	Pre-Boot Zadoks 14–22	1	30 73	ND ND	ND ND	ND ND	
Rosetown, SK, Canada, 2003 (AC Barrie)	2-EHE 444 g/L EC	1.77	291	Pre-Boot Zadoks 22–31	1	30 69	2.69 0.31	0.64 ND	0.23 ND	Jones, GL, 2005, MCPA-R092
Rosetown, SK, Canada, 2003 (AC Barrie)	DMA salt 480 g/L SL	1.71	287	Pre-Boot Zadoks 22–31	1	30 69	2.69 < 0.25	0.86 ND	0.28 < 0.25	
Rosetown, SK, Canada, 2003 (AC Barrie)	NA salt 300 g/L SL	1.83	293	Pre-Boot Zadoks 22–31	1	30 69	4.17 0.29	1.06 0.26	0.43 ND	
Vanscoy, SK, Canada, 2004 (Intrepid)	2-EHE 444 g/L EC	1.86	275	Pre-Boot Zadoks 31–33	1	31 80	2.98 0.42	0.37 0.54	0.30 ND	Jones, GL, 2006, MCPA-R098
Vanscoy, SK, Canada, 2004 (Intrepid)	DMA salt 480 g/L SL	1.83	277	Pre-Boot Zadoks 31–33	1	30 80	2.34 0.26	0.39 0.34	0.32 ND	
Vanscoy, SK, Canada, 2004 (Intrepid)	NA salt 300 g/L SL	1.87	278	Pre-Boot Zadoks 31–33	1	30 80	0.90 < 0.25	< 0.25 0.26	< 0.25 ND	
Taber, AB, Canada, 2004 (Intrepid)	2-EHE 444 g/L EC	1.99	297	Pre-Boot Zadoks 31–33	1	40 92	ND ND	ND ND	ND ND	Jones, GL, 2006, MCPA-R099
Taber, AB, Canada, 2004 (Intrepid)	DMA salt 480 g/L SL	1.98	295	Pre-Boot Zadoks 31–33	1	40 92	ND ND	ND ND	ND ND	
Taber, AB, Canada, 2004 (Intrepid)	NA salt 300 g/L SL	2.21	293	Pre-Boot Zadoks 31–33	1	33 92	ND ND	ND ND	ND ND	
Minto, MB, Canada, 2004 (AC Barrie)	2-EHE 444 g/L EC	1.97	292	Pre-Boot Zadoks 34–37	1	30 85	3.41 ND	1.53 < 0.25	0.54 < 0.25	Jones, GL, 2006, MCPA-R100
Minto, MB, Canada, 2004 (AC Barrie)	DMA salt 480 g/L SL	2.01	299	Pre-Boot Zadoks 34–37	1	30 85	2.65 ND	1.73 0.28	0.45 < 0.25	
Minto, MB, Canada, 2004 (AC Barrie)	NA salt 300 g/L SL	1.98	294	Pre-Boot Zadoks 34–37	1	30 85	2.22 ND	1.32 0.25	0.44 < 0.25	
Boissevain, MB, Canada, 2004 (AC Barrie)	2-EHE 444 g/L EC	1.94	288	Pre-boot Zadoks 37	1	30 85	1.05 ND	0.89 ND	0.41 ND	Jones, GL, 2006, MCPA-R101

WHEAT	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Boissevain, MB, Canada, 2004 (AC Barrie)	DMA salt 480 g/L SL	1.95	289	Pre-boot Zadoks 37	1	30 85	0.64 0.82	0.42 ND	0.36 ND	
Boissevain, MB, Canada, 2004 (AC Barrie)	NA salt 300 g/L SL	1.95	290	Pre-boot Zadoks 37	1	30 85	0.49 0.41	0.36 ND	0.20 ND	
Rosthern, SK, Canada, 2004 (AC Intrepid)	2-EHE 444 g/L EC	1.94	287	Pre-boot Zadoks 37–39	1	30 80	3.12 0.65	1.17 ND	0.78 0.26	Jones, GL, 2006, MCPA-R102
Rosthern, SK, Canada, 2004 (AC Intrepid)	DMA salt 480 g/L SL	1.93	287	Pre-boot Zadoks 37–39	1	30 80	2.08 0.35	0.85 < 0.25	0.67 < 0.25	
Rosthern, SK, Canada, 2004 (AC Intrepid)	NA salt 300 g/L SL	1.94	289	Pre-boot Zadoks 37–39	1	30 80	1.45 < 0.25	0.78 < 0.25	0.50 0.27	
Hepburn, SK, Canada, 2004 (AC Barrie)	2-EHE 444 g/L EC	1.94	287	Pre-boot Zadoks 37–39	1	30 77	6.18 1.09	1.95 0.66	0.63 < 0.25	Jones, GL, 2006, MCPA-R103
Hepburn, SK, Canada, 2004 (AC Barrie)	DMA salt 480 g/L SL	1.88	286	Pre-boot Zadoks 37–39	1	30 77	2.62 0.49	1.07 0.34	0.34 < 0.25	
Hepburn, SK, Canada, 2004 (AC Barrie)	NA salt 300 g/L SL	1.92	286	Pre-boot Zadoks 37–39	1	30 77	2.11 2.51	0.70 < 0.25	0.35 ND	
Innisfail, AB, Canada, 2004 (Foremost)	2-EHE 444 g/L EC	2.00	296	Pre-boot Zadoks 35	1	30 98	3.66 0.34	0.70 0.36	0.37 < 0.25	Jones, GL, 2006, MCPA-R104
Innisfail, AB, Canada, 2004 (Foremost)	DMA salt 480 g/L SL	1.94	288	Pre-boot Zadoks 35	1	30 98	1.99 ND	0.51 < 0.25	0.31 < 0.25	
Innisfail, AB, Canada, 2004 (Foremost)	NA salt 300 g/L SL	1.96	292	Pre-boot Zadoks 35	1	30 98	1.09 ND	0.32 < 0.25	0.28 < 0.25	
Kansas, USA 1997 (TAM 105)	DMA salt 480 g/L SL	1.66	263	Pre-boot Zadoks 37	1	30 59	12.4 11.3	9.53 8.91	1.13 0.99	Kludas, RS, 2000, MCPA-R081
Oklahoma, USA 1997 (TAM 200)	DMA salt 480 g/L SL	1.74	247	Pre-boot Zadoks 37	1	30 54	3.11 1.72	4.93 4.31	0.44 0.44	

WHEAT	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Kansas, USA 1998 (Variety not reported)	2-EHE 480 g/L EC	1.76	278	Pre-boot Zadoks 37	1	30	10.4	13.4	1.18	Kludas, RS, 2000, MCPA-R082
						59	7.19	9.27	0.93	
Oklahoma, USA 1998 (Variety nor reported)	2-EHE 480 g/L EC	1.75	248	Pre-boot Zadoks 37	1	30	5.50	10.8	0.84	
						54	3.65	9.43	0.90	
North Dakota, USA, 1998 (2375)	DMA salt 480 g/L SL	1.79	281	Pre-boot Zadoks 37–39	1	30	2.96	3.93	1.42	Kludas, RS, 2000, MCPA-R083
						54	0.68	2.52	1.14	
North Dakota, USA, 1998 (2375)	2-EHE 480 g/L EC	1.83	282	Pre-boot Zadoks 37–39	1	30	5.54	4.03	1.33	Kludas, RS, 2000, MCPA-R084
						54	1.16	2.67	0.94	
New Holland, OH, USA, 2004 (SC 1358)	2-EHE 444 g/L EC	1.71	220	Pre-boot Zadoks 37	1	30	9.07	2.41	1.11	Jones, GL, 2006, MCPA-R093
						56	1.73	0.96	0.46	
New Holland, OH, USA, 2004 (SC 1358)	DMA salt 480 g/L SL	1.71	220	Pre-boot Zadoks 37	1	30	4.22	0.42	0.49	
						56	0.92	0.62	0.35	
New Holland, OH, USA, 2004 (SC 1358)	NA salt 300 g/L SL	1.75	224	Pre-boot Zadoks 37	1	30	4.49	0.74	0.56	
						56	1.35	0.91	0.32	
Redfield, SD, USA, 2004 (Harding)	2-EHE 444 g/L EC	1.65	326	Pre-boot Zadoks 36–37	1	30	ND	ND	ND	Jones, GL, 2006, MCPA-R094
						50	ND	ND	< 0.25	
Redfield, SD, USA, 2004 (Harding)	DMA salt 480 g/L SL	1.65	326	Pre-boot Zadoks 36–37	1	30	0.34	ND	< 0.25	
						50	ND	ND	< 0.25	
Redfield, SD, USA, 2004 (Harding)	NA salt 300 g/L SL	1.71	325	Pre-boot Zadoks 36–37	1	30	< 0.25	ND	< 0.25	
						50	ND	ND	< 0.25	
Larned, KS USA, 2004 (Jagalene)	2-EHE 444 g/L EC	1.78	285	Pre-boot Zadoks 39	1	30	3.26	2.74	1.00	Jones, GL, 2006, MCPA-R095
						70	1.30	0.53	< 0.25	
Larned, KS USA, 2004 (Jagalene)	DMA salt 480 g/L SL	1.80	285	Pre-boot Zadoks 39	1	30	3.73	1.28	0.50	
						70	1.04	0.41	< 0.25	

WHEAT	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Larned, KS USA, 2004 (Jagalene)	NA salt 300 g/L SL	1.81	286	Pre-boot Zadoks 39	1	30 70	1.45 0.80	0.82 < 0.25	0.59 ND	
Colony, OK USA, 2004 (Pioneer 2157)	2-EHE 444 g/L EC	1.63	276	Pre-boot Zadoks 39	1	30 53	4.26 0.28	5.43 0.44	2.00 ND	Jones, GL, 2006, MCPA-R096
Colony, OK USA, 2004 (Pioneer 2157)	DMA salt 480 g/L SL	1.65	278	Pre-boot Zadoks 39	1	30 53	7.88 1.16	4.81 0.54	2.17 0.28	
Colony, OK USA, 2004 (Pioneer 2157)	NA salt 300 g/L SL	1.73	282	Pre-boot Zadoks 39	1	30 53	5.23 0.32	5.27 0.54	2.02 < 0.25	
Groom, TX, USA, 2004 (Ogallala)	2-EHE 444 g/L EC	1.72	285	Pre-boot Zadoks 39	1	30 43	6.44 4.74	9.26 6.52	1.28 0.94	Jones, GL, 2006, MCPA-R097
Groom, TX, USA, 2004 (Ogallala)	DMA salt 480 g/L SL	1.70	286	Pre-boot Zadoks 39	1	30 43	5.91 4.93	7.29 5.81	1.08 0.97	
Groom, TX, USA, 2004 (Ogallala)	NA salt 300 g/L SL	1.69	285	Pre-boot Zadoks 39	1	30 43	5.68 4.49	5.78 4.82	0.96 0.90	
WHEAT HAY										
Haywood, MB, Canada, 2001 (AC Cora)	2-EHE 444 g/L EC	1.65	282	Pre-boot Zadoks 31	1	7 14 21	49.3 11.1 1.52	39.6 14.7 1.51	6.76 3.58 0.42	Barney, WP, 2002, MCPA-R087
Haywood, MB, Canada, 2001 (AC Cora)	DMA salt 480 g/L SL	1.70	283	Pre-boot Zadoks 31	1	7 14 21	36.2 13.6 1.27	32.5 11.5 1.76	3.08 3.24 0.35	
Haywood, MB, Canada, 2001 (AC Cora)	NA salt 300 g/L SL	1.74	285	Pre-boot Zadoks 31	1	7 14 21	24.9 6.79 0.59	19.0 7.27 0.78	2.86 3.06 < 0.25	
Elm Creek, MB Canada, 2001 (Majestic)	2-EHE 444 g/L EC	1.65	271	Pre-boot Zadoks 32–34	1	7 14 21	13.5 8.52 3.75	8.95 14.8 5.60	1.33 2.97 1.09	Barney, WP, 2002, MCPA-R086
Elm Creek, MB Canada, 2001 (Majestic)	DMA salt 480 g/L SL	1.62	268	Pre-boot Zadoks 32–34	1	7 14 21	9.65 3.07 1.20	10.5 6.87 2.49	2.34 2.22 0.54	

WHEAT	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Elm Creek, MB Canada, 2001 (Majestic)	NA salt 300 g/L SL	1.64	273	Pre-boot Zadoks 32–34	1	7	8.24	7.11	1.99	
						14	2.73	4.39	1.93	
						21	1.31	2.62	0.30	
Barnwell, AB Canada, 2001 (Soft White)	2-EHE 444 g/L EC	1.70	286	Pre-boot Zadoks 36–37	1	7	21.6	2.67	3.31	Barney, WP, 2002, MCPA-R088
						14	11.1	1.78	1.37	
						21	5.59	0.38	0.61	
Barnwell, AB Canada, 2001 (Soft White)	DMA salt 480 g/L SL	1.74	291	Pre-boot Zadoks 36–37	1	7	16.0	2.04	2.66	
						14	5.23	0.35	0.81	
						21	2.55	0.25	0.48	
Barnwell, AB Canada, 2001 (Soft White)	NA salt 300 g/L SL	1.74	288	Pre-boot Zadoks 36–37	1	7	10.8	1.36	1.54	
						14	2.52	0.30	0.32	
						21	0.81	< 0.25	< 0.25	
Fairview, AB, Canada, 2001 (Canadian Western White EXP3)	2-EHE 444 g/L EC	1.71	289	Pre-boot Zadoks 36–37	1	7	10.2	1.94	1.64	Barney, WP, 2002, MCPA-R089
						14	5.32	0.69	0.89	
						21	5.14	1.24	0.92	
						31	ND	ND	0.050	
Fairview, AB, Canada, 2001 (Canadian Western White EXP3)	DMA salt 480 g/L SL	1.70	287	Pre-boot Zadoks 36–37	1	7	10.5	2.07	2.10	
						14	2.50	0.36	0.57	
						21	1.89	0.60	0.69	
						31	ND	ND	0.10	
Fairview, AB, Canada, 2001 (Canadian Western White EXP3)	NA salt 300 g/L SL	1.76	289	Pre-boot Zadoks 36–37	1	7	14.6	2.28	3.24	
						14	7.18	1.62	1.73	
						21	1.34	0.41	0.36	
						31	ND	ND	0.090	
Rosthern, SK, Canada, 2001 (Foremost CPS)	2-EHE 444 g/L EC	1.76	294	Pre-boot Zadoks 36–37	1	7	15.7	2.88	4.07	Barney, WP, 2002, MCPA-R085
						14	8.41	1.75	1.85	
						21	3.82	2.13	0.56	
Rosthern, SK, Canada, 2001 (Foremost CPS)	DMA salt 480 g/L SL	1.80	298	Pre-boot Zadoks 37	1	7	14.8	2.62	3.62	
						14	8.75	1.82	2.01	
						21	6.43	2.37	1.30	
Rosthern, SK, Canada, 2001 (Foremost CPS)	NA salt 300 g/L SL	1.76	293	Pre-boot Zadoks 37	1	7	9.82	1.09	2.16	
						14	5.55	1.09	1.20	
						21	2.24	1.58	0.45	
Lacombe, AB, Canada, 2003 (CPS)	2-EHE 444 g/L EC	1.84	299	Pre-boot Zadoks 37	1	7	30.7	8.75	3.63	Jones, GL, 2005, MCPA-R090
						14	14.7	3.81	1.76	
						21	8.90	2.08	1.01	

WHEAT	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Lacombe, AB, Canada, 2003 (CPS)	DMA salt 480 g/L SL	1.81	300	Pre-boot Zadoks 37	1	7	17.9	3.69	1.87	
						14	6.02	1.63	1.21	
						21	5.54	1.86	1.14	
Lacombe, AB, Canada, 2003 (CPS)	NA salt 300 g/L SL	1.85	300	Pre-boot Zadoks 37	1	7	13.4	2.85	1.94	
						14	6.87	1.97	1.52	
						21	3.55	1.11	0.43	
Delisle, SK, Canada, 2003 (AC Cadillac)	2-EHE 444 g/L EC	1.79	295	Pre-Boot Zadoks 14–22	1	7	11.3	9.18	1.73	Jones, GL, 2005, MCPA-R091
						14	3.72	1.48	0.99	
						21	0.90	0.44	0.32	
Delisle, SK, Canada, 2003 (AC Cadillac)	DMA salt 480 g/L SL	1.74	293	Pre-Boot Zadoks 14–22	1	7	6.17	5.95	1.43	
						14	2.36	1.15	0.95	
						21	0.67	0.50	0.53	
Delisle, SK, Canada, 2003 (AC Cadillac)	NA salt 300 g/L SL	1.87	298	Pre-Boot Zadoks 14–22	1	7	3.63	3.45	0.99	
						14	1.69	0.41	0.41	
						21	0.43	0.26	0.69	
Rosetown, SK, Canada, 2003 (AC Barrie)	2-EHE 444 g/L EC	1.77	291	Pre-Boot Zadoks 22–31	1	7	32.0	7.01	2.30	Jones, GL, 2005, MCPA-R092
						14	10.9	1.07	0.86	
						21	3.64	0.76	0.45	
Rosetown, SK, Canada, 2003 (AC Barrie)	DMA salt 480 g/L SL	1.71	287	Pre-Boot Zadoks 22–31	1	7	30.4	7.27	2.68	
						14	11.6	2.25	0.93	
						21	3.37	0.80	0.49	
Rosetown, SK, Canada, 2003 (AC Barrie)	NA salt 300 g/L SL	1.83	293	Pre-Boot Zadoks 22–31	1	7	50.5	9.12	4.64	
						14	15.3	2.66	1.33	
						21	6.68	1.35	0.77	
Vanscoy, SK, Canada, 2004 (Intrepid)	2-EHE 444 g/L EC	1.86	275	Pre-Boot Zadoks 31–33	1	7	26.5	4.13	2.22	Jones, GL, 2006, MCPA-R098
						14	14.3	1.87	1.27	
						21	4.20	0.53	0.45	
Vanscoy, SK, Canada, 2004 (Intrepid)	DMA salt 480 g/L SL	1.83	277	Pre-Boot Zadoks 31–33	1	7	18.8	2.92	1.84	
						14	7.36	1.18	0.78	
						21	3.44	0.52	0.37	
Vanscoy, SK, Canada, 2004 (Intrepid)	NA salt 300 g/L SL	1.87	278	Pre-Boot Zadoks 31–33	1	7	10.4	1.95	1.23	
						14	3.89	0.87	0.66	
						21	1.12	< 0.25	0.25	
Taber, AB, Canada, 2004 (Intrepid)	2-EHE 444 g/L EC	1.99	297	Pre-Boot Zadoks 31–33	1	7	11.3	10.0	2.53	Jones, GL, 2006, MCPA-R099
						14	1.57	1.51	0.44	
						21	ND	ND	ND	

WHEAT	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Taber, AB, Canada, 2004 (Intrepid)	DMA salt 480 g/L SL	1.98	295	Pre-Boot Zadoks 31–33	1	7 14 21	2.14 < 0.25 ND	1.49 ND ND	0.88 < 0.25 ND	
Taber, AB, Canada, 2004 (Intrepid)	NA salt 300 g/L SL	2.21	293	Pre-Boot Zadoks 31–33	1	7 14 21	2.48 < 0.25 ND	2.29 ND ND	0.83 ND ND	
Minto, MB, Canada, 2004 (AC Barrie)	2-EHE 444 g/L EC	1.97	292	Pre-Boot Zadoks 34–37	1	7 14 21	54.4 25.6 11.8	8.23 4.57 4.22	5.78 2.66 1.81	Jones, GL, 2006, MCPA-R100
Minto, MB, Canada, 2004 (AC Barrie)	DMA salt 480 g/L SL	2.01	299	Pre-Boot Zadoks 34–37	1	7 14 21	66.0 28.8 16.2	11.9 6.99 8.03	7.93 3.88 2.23	
Minto, MB, Canada, 2004 (AC Barrie)	NA salt 300 g/L SL	1.98	294	Pre-Boot Zadoks 34–37	1	7 14 21	43.9 15.5 11.6	8.31 3.90 6.06	5.35 2.70 2.38	
Boissevain, MB, Canada, 2004 (AC Barrie)	2-EHE 444 g/L EC	1.94	288	Pre-boot Zadoks 37	1	7 14 21	15.7 5.15 3.56	8.24 6.28 1.00	2.89 1.55 0.52	Jones, GL, 2006, MCPA-R101
Boissevain, MB, Canada, 2004 (AC Barrie)	DMA salt 480 g/L SL	1.95	289	Pre-boot Zadoks 37	1	7 14 21	11.0 5.07 1.94	6.19 3.09 0.73	1.91 1.10 0.41	
Boissevain, MB, Canada, 2004 (AC Barrie)	NA salt 300 g/L SL	1.95	290	Pre-boot Zadoks 37	1	7 14 21	8.79 3.09 0.86	3.48 2.47 0.36	1.85 0.78 0.28	
Rosthern, SK, Canada, 2004 (AC Intrepid)	2-EHE 444 g/L EC	1.94	287	Pre-boot Zadoks 37–39	1	7 14 21	4.38 2.93 1.67	4.09 2.90 2.08	1.30 0.73 0.74	Jones, GL, 2006, MCPA-R102
Rosthern, SK, Canada, 2004 (AC Intrepid)	DMA salt 480 g/L SL	1.93	287	Pre-boot Zadoks 37–39	1	7 14 21	3.74 2.60 2.23	3.86 2.68 2.64	1.08 0.75 0.89	
Rosthern, SK, Canada, 2004 (AC Intrepid)	NA salt 300 g/L SL	1.94	289	Pre-boot Zadoks 37–39	1	7 14 21	6.68 4.01 2.12	6.21 5.05 2.71	1.33 1.24 0.73	
Hepburn, SK, Canada, 2004 (AC Barrie)	2-EHE 444 g/L EC	1.94	287	Pre-boot Zadoks 37–39	1	7 14 21	35.5 11.0 5.00	7.23 14.7 3.89	4.64 1.33 0.74	Jones, GL, 2006, MCPA-R103

WHEAT	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Hepburn, SK, Canada, 2004 (AC Barrie)	DMA salt 480 g/L SL	1.88	286	Pre-boot Zadoks 37–39	1	7	22.5	4.04	2.60	
						14	7.73	8.43	0.91	
						21	3.92	2.32	0.65	
Hepburn, SK, Canada, 2004 (AC Barrie)	NA salt 300 g/L SL	1.92	286	Pre-boot Zadoks 37–39	1	7	12.4	3.02	2.12	
						14	4.71	4.94	0.79	
						21	1.82	1.50	0.45	
Innisfail, AB, Canada, 2004 (Foremost)	2-EHE 444 g/L EC	2.00	296	Pre-boot Zadoks 35	1	7	32.7	7.99	3.31	Jones, GL, 2006, MCPA-R104
						14	15.7	3.72	2.12	
						21	10.5	2.71	1.48	
Innisfail, AB, Canada, 2004 (Foremost)	DMA salt 480 g/L SL	1.94	288	Pre-boot Zadoks 35	1	7	32.0	11.2	3.79	
						14	9.79	2.06	1.42	
						21	8.11	1.46	1.30	
Innisfail, AB, Canada, 2004 (Foremost)	NA salt 300 g/L SL	1.96	292	Pre-boot 16.1Zadoks 35	1	7	32.3	25.6	4.77	
						14	7.67	2.74	1.70	
						21	5.17	1.06	1.38	
New Holland, OH, USA, 2004 (SC 1358)	2-EHE 444 g/L EC	1.71	220	Pre-boot Zadoks 37	1	7	30.6	6.84	2.83	Jones, GL, 2006, MCPA-R093
						14	25.1	3.96	2.53	
						21	16.1	3.11	1.60	
New Holland, OH, USA, 2004 (SC 1358)	DMA salt 480 g/L SL	1.71	220	Pre-boot Zadoks 37	1	7	26.8	4.33	2.49	
						14	14.3	2.73	1.92	
						21	8.74	2.41	1.42	
New Holland, OH, USA, 2004 (SC 1358)	NA salt 300 g/L SL	1.75	224	Pre-boot Zadoks 37	1	7	23.3	3.92	2.03	
						14	10.7	1.98	1.49	
						21	7.74	1.85	0.98	
Redfield, SD, USA, 2004 (Harding)	2-EHE 444 g/L EC	1.65	326	Pre-boot Zadoks 36–37	1	7	5.02	4.17	1.29	Jones, GL, 2006, MCPA-R094
						14	3.12	2.39	1.07	
						21	3.56	1.89	0.80	
Redfield, SD, USA, 2004 (Harding)	DMA salt 480 g/L SL	1.65	326	Pre-boot Zadoks 36–37	1	7	7.34	4.60	1.79	
						14	1.98	1.50	0.39	
						21	2.74	2.36	0.59	
Redfield, SD, USA, 2004 (Harding)	NA salt 300 g/L SL	1.71	325	Pre-boot Zadoks 36–37	1	7	6.86	2.93	2.28	
						14	2.56	1.11	0.66	
						21	2.01	0.72	0.57	
Larned, KS USA, 2004 (Jagalene)	2-EHE 444 g/L EC	1.78	285	Pre-boot Zadoks 39	1	7	10.9	3.81	3.21	Jones, GL, 2006, MCPA-R095
						14	5.87	1.71	2.00	
						21	6.22	3.44	2.48	

WHEAT	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Larned, KS USA, 2004 (Jagalene)	DMA salt 480 g/L SL	1.80	285	Pre-boot Zadoks 39	1	7	6.95	1.92	1.85	
						14	5.71	1.59	1.78	
						21	5.84	1.50	1.57	
Larned, KS USA, 2004 (Jagalene)	NA salt 300 g/L SL	1.81	286	Pre-boot Zadoks 39	1	7	2.20	0.88	0.87	
						14	1.66	0.66	0.74	
						21	1.53	0.75	0.74	
Colony, OK USA, 2004 (Pioneer 2157)	2-EHE 444 g/L EC	1.63	276	Pre-boot Zadoks 39	1	7	15.6	5.65	6.06	Jones, GL, 2006, MCPA-R096
						14	11.2	5.61	6.76	
						21	9.27	5.52	5.48	
Colony, OK USA, 2004 (Pioneer 2157)	DMA salt 480 g/L SL	1.65	278	Pre-boot Zadoks 39	1	7	30.9	5.89	8.08	
						14	17.8	3.78	5.12	
						21	7.09	2.86	3.20	
Colony, OK USA, 2004 (Pioneer 2157)	NA salt 300 g/L SL	1.73	282	Pre-boot Zadoks 39	1	7	24.7	7.13	7.70	
						14	13.1	4.28	4.92	
						21	11.4	5.52	4.66	
Groom, TX, USA, 2004 (Ogallala)	2-EHE 444 g/L EC	1.72	285	Pre-boot Zadoks 39	1	7	16.6	4.41	2.63	Jones, GL, 2006, MCPA-R097
						14	8.73	2.08	1.98	
						21	9.01	3.90	2.20	
Groom, TX, USA, 2004 (Ogallala)	DMA salt 480 g/L SL	1.70	286	Pre-boot Zadoks 39	1	7	20.9	2.58	2.16	
						14	14.0	3.73	2.00	
						21	8.20	2.53	1.40	
Groom, TX, USA, 2004 (Ogallala)	NA salt 300 g/L SL	1.69	285	Pre-boot Zadoks 39	1	7	17.9	3.57	2.55	
						14	13.2	3.92	2.54	
						21	11.0	6.05	2.31	
Kansas, USA 1998 (Variety not reported)	2-EHE 480 g/L EC	1.76	278	Pre-boot Zadoks 37	1	7	16.7	18.4	1.24	Kludas, RS, 2000, MCPA-R082
						14	7.27	8.98	0.74	
						21	5.85	8.12	0.66	
Oklahoma, USA 1998 (Variety nor reported)	2-EHE 480 g/L EC	1.75	248	Pre-boot Zadoks 37	1	7	8.09	10.6	1.04	
						14	5.30	8.53	0.70	
						21	8.35	13.3	0.84	
North Dakota, USA, 1998 (2375)	2-EHE 480 g/L EC	1.83	282	Pre-boot Zadoks 37–39	1	7	23.3	26.7	4.67	Kludas, RS, 2000, MCPA-R084
						14	11.6	15.1	3.20	
						21	9.58	13.6	3.09	
Kansas, USA 1997 (TAM 105)	DMA salt 480 g/L SL	1.66	263	Pre-boot Zadoks 37	1	7	19.8	14.5	1.64	Kludas, RS, 2000, MCPA-R081
						14	11.7	11.1	1.27	
						21	7.22	7.85	0.70	

WHEAT	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Oklahoma, USA 1997 (TAM 200)	DMA salt 480 g/L SL	1.74	247	Pre-boot Zadoks 37	1	7 14 21	4.25 4.11 4.73	4.10 4.93 5.64	0.42 0.40 0.48	
North Dakota, USA, 1998 (2375)	DMA salt 480 g/L SL	1.79	281	Pre-boot Zadoks 37–39	1	7 14 21	18.7 13.1 9.42	22.0 19.5 15.2	5.68 6.83 4.22	Kludas, RS, 2000, MCPA-R083

ND = not detected.

LOQ = 0.25 mg/kg for straw and hay.

LOD = 0.12 mg/kg for MCPA, 0.11 mg/kg for 2-HMCPA, and 0.10 mg/kg for CCPA.

Table 55 MCPA acid equivalent residues in treated wheat forage and straw resulting from supervised trials in Austria, the UK, France and Spain (Pfarl, C, 1994, MCPA-R070; Rawle, NW, 2001, MCPA R071; Old, J and Venuti, J, 2001, MCPA-R062; Wasser, C, 2000, MCPA-R063; Old, J, and Duncan, P, 2001, MCPA-R066; Perny, A, 2001, MCPA-R067; Old, J, *et al.*, 2001, MCPA-R060; Wasser, C, 2000, MCPA-R061; Old, J, and Duncan, P, 2001, MCPA-R064; Perny, A, 2001, MCPA-R065)

WHEAT	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMPCA	CCPA	
WHEAT FORAGE										
Ansfelden, Austria 1992 (Star A3)	DMA salt 281 g/L SL	0.8	200	BBCH 31	1	0 15 28	16.2 0.71 0.09	–	–	Pfarl, DIC, 1994, MCPA-R070
Lestious, France, 1999 (Isengrain)	DMA salt 750 g/L SL	1.77	248	BBCH 30	1	0 7 14 28	89.0 7.50 0.99 0.87	0.82 0.45 0.45 0.10	–	Old, J, Venuti, J, 2001, MCPA R062; Wasser, C, 2000, MCPA-R063
Suffolk, UK 1999 (Consort)	DMA salt 750 g/L SL	1.80	251	BBCH 30-31	1	0 7 14 28	66.0 23.0 5.90 1.40	1.20 1.00 0.43 0.19	–	
Essex, UK 2000 (Hereward)	DMA salt 750 g/L SL	1.75	244	BBCH 30	1	0	113	0.25		Old, J, Duncan, P, 2001, MCPA-R066; Perny, A, 2001, MCPA-R067

WHEAT	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMPCA	CCPA	
Poncey les Athee, France, 2000 (Soissons)	DMA salt 750 g/L SL	1.84	255	BBCH 31	1	0	57	ND		
Charantonnay, France, 1999 (Soissons)	K-salt 400 g/L SL	1.22	250	BBCH 30	1	0 7 14 28	37.0 1.10 0.40 0.06	0.99 0.57 ND ND	–	Old J, *et. al.*, 2001, MCPA-R060; Wasser, C, 2000, MCPA-R061
St, Jordi de Muller, Spain (Soissons)	K-salt 400 g/L SL	1.21	248	BBCH 30	1	0 7 14 28	24.0 1.40 0.50 0.13	0.20 0.05 0.07 ND		
Charantonnay, France, 2000 (Isengrain)	K-salt 400 g/L SL	1.26	258	BBCH 30	1	0	61	0.17		Old, J, and Duncan, P, 2001, MCPA-R064; Perny, A, 2001, MCPA-R065
Olius, Spain 2000 (Tremier)	K-salt 400 g/L SL	1.24	252	BBCH 30-31	1	0	45	0.27		
WHEAT STRAW										
Ansfelden, Austria 1992 (Star A3)	DMA salt 281 g/L SL	0.8	200	BBCH 31	1	70	< 0.05	–	–	Pfarl, DIC, 1994 MCPA-R070
Montgaillard, France, 1998 (Victo)	Na Salt 800 g/L SL	1.87	259	BBCH 32-33	1	86	0.22	–	–	Rawle, NW, 2001 MCPA-R071
Lestious, France, 1999 (Isengrain)	DMA salt 750 g/L SL	1.77	248	BBCH 30	1	118	0.09	ND	–	Old, J, Venuti, J, 2001, MCPA R062; Wasser, C, 2000, MCPA-R063
Suffolk, UK 1999 (Consort)	DMA salt 750 g/L SL	1.80	251	BBCH 30-31	1	109	0.05	ND	–	
Essex, UK 2000 (Hereward)	DMA salt 750 g/L SL	1.75	244	BBCH 30	1	127	ND	ND	–	Old, J, Duncan, P, 2001, MCPA-R066; Perny, A, 2001, MCPA-R067
Poncey les Athee, France, 2000 (Soissons)	DMA salt 750 g/L SL	1.84	255	BBCH 31	1	109	< 0.05	ND	–	

WHEAT	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMPCA	CCPA	
Charantonnay, France, 1999 (Soissons)	K-salt 400 g/L SL	1.22	250	BBCH 30	1	111	ND	ND	–	Old J, *et. al.,* 2001, MCPA-R060; Wasser, C, 2000, MCPA-R061
St, Jordi de Muller, Spain (Soissons)	K-salt 400 g/L SL	1.21	248	BBCH 30	1	98	ND	< 0.05		
Charantonnay, France, 2000 (Isengrain)	K-salt 400 g/L SL	1.26	258	BBCH 30	1	120	< 0.05	< 0.05	–	Old, J, and Duncan, P, 2001, MCPA-R064; Perny, A, 2001, MCPA-R065
Olius, Spain 2000 (Tremier)	K-salt 400 g/L SL	1.24	252	BBCH 30-31	1	104	< 0.05	ND	–	

ND = not detected.

LOQ = 0.25 mg/kg for straw and hay.

LOD = 0.12 mg/kg for MCPA, 0.11 mg/kg for 2-HMCPA, and 0.10 mg/kg for CCPA.

Table 56 MCPA acid equivalent residues in treated maize forage and stover resulting from supervised trials in Canada and the USA (Jones, GL, 2007, MCPA-R077; Belcher, 2008, MCPA-R078)

MAIZE	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
CORN FORAGE										
Elm Creek, MB, Canada, 2005 , (Cargill OKC2675)	2-EHE 444 g/L EC	0.89	209	15 cm height	1	0 1 3 7 14 28 45 60 75	54.9 14.0 6.30 1.81 0.47 ND ND ND ND	1.04 1.00 0.51 < 0.25 ND ND ND ND ND	ND < 0.25 < 0.25 ND ND ND ND ND ND	Jones, GL, 2007, MCPA-R077

MAIZE	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
Elm Creek, MB, Canada, 2005 , (Cargill OKC2675)	DMA salt 480 g/L SL	0.87	206	15 cm height	1	0	60.8	1.26	ND	
						1	34.3	1.75	< 0.25	
						3	8.42	0.53	< 0.25	
						7	1.28	< 0.25	ND	
						14	0.33	ND	ND	
						28	ND	ND	ND	
						45	ND	ND	ND	
						60	ND	ND	ND	
						75	ND	ND	ND	
Elm Creek, MB, Canada, 2005 , (Cargill OKC2675)	NA + K salt 300 g/L SL	0.77	203	15 cm height	1	0	73.1	1.01	ND	
						1	46.8	1.55	< 0.25	
						3	12.7	0.65	< 0.25	
						7	1.86	< 0.25	ND	
						14	0.51	ND	ND	
						28	ND	ND	ND	
						45	ND	ND	ND	
						60	ND	ND	ND	
						75	ND	ND	ND	
Carman, MB, Canada, 2005 (Monsanto DKC 27-12)	2-EHE 444 g/L EC	0.90	211	30 cm height	1	87	ND	ND	ND	Jones, GL, 2007, MCPA-R077
Carman, MB, Canada, 2005 (Monsanto DKC 27-12)	DMA salt 480 g/L SL	0.89	210	30 cm height	1	87	ND	ND	ND	
Carman, MB, Canada, 2005 (Monsanto DKC 27-12)	NA + K salt 300 g/L SL	0.80	211	30 cm height	1	87	ND	ND	ND	
Paris, ON, Canada, 2005 (DKB 37-80)	2-EHE 444 g/L EC	0.88	212	10–12 cm height	1	98	ND	ND	ND	Jones, GL, 2007, MCPA–R077
Paris, ON, Canada, 2005 (DKB 37-80)	DMA salt 480 g/L SL	0.84	203	10–12 cm height	1	98	ND	ND	ND	
Paris, ON, Canada, 2005 (DKB 37-80)	NA + K salt 300 g/L SL	0.88	210	10–12 cm height	1	98	ND	ND	ND	

MAIZE	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
St. Pie, QC, Canada, 2005 (2555NK)	2-EHE 444 g/L EC	0.90	216	10 cm	1	90	ND	ND	ND	Jones, GL, 2007, MCPA–R077
St. Pie, QC, Canada, 2005 (2555NK)	DMA salt 480 g/L SL	0.92	225	10 cm	1	90	ND	ND	ND	
St. Pie, QC, Canada, 2005 (2555NK)	NA + K salt 300 g/L SL	0.89	212	10 cm	1	90	ND	ND	ND	
Elm Creek, MB, Canada, 2006 , (Cargill DKC27-12)	2-EHE 444 g/L EC	0.89	206	8–10 cm height	1	14 75	0.26 ND	ND ND	ND ND	Belcher, TI, 2008, MCPA-R078
Elm Creek, MB, Canada, 2006 , (Cargill DKC27-12)	DMA salt 480 g/L SL	0.88	207	8–10 cm height	1	14 75	ND ND	ND ND	ND ND	
Elm Creek, MB, Canada, 2006 , (Cargill DKC27-12)	NA + K salt 300 g/L SL	0.88	208	8–10 cm height	1	14 75	< 0.25 ND	ND ND	ND ND	
Thamesford, ON, Canada, 2006 (Pioneer 38A25)	2-EHE 444 g/L EC	0.86	203	10–15 cm height	1	96	ND	ND	ND	Belcher, TI, 2008, MCPA-R078
Thamesford, ON, Canada, 2006 (Pioneer 38A25)	DMA salt 480 g/L SL	0.85	204	10–15 cm height	1	96	ND	ND	ND	
Thamesford, ON, Canada, 2006 (Pioneer 38A25)	NA + K salt 300 g/L SL	0.87	205	10–15 cm height	1	96	ND	ND	ND	
Ingersoil, ON, Canada, 2006 Maizex 3888)	2-EHE 444 g/L EC	0.86	204	10–15 cm height	1	90	ND	ND	ND	Belcher, TI, 2008, MCPA-R078
Ingersoil, ON, Canada, 2006 Maizex 3888)	DMA salt 480 g/L SL	0.85	203	10–15 cm height	1	96	ND	ND	ND	
Ingersoil, ON, Canada, 2006 Maizex 3888)	NA + K salt 300 g/L SL	0.86	203	10-15 cm height	1	96	ND	ND	ND	

MAIZE	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
St. Pie, QC, Canada, 2006 (N22-T8)	2-EHE 444 g/L EC	0.90	214	8 cm height	1	90	ND	ND	ND	Belcher, TI, 2008, MCPA-R078
St. Pie, QC, Canada, 2006 (N22-T8)	DMA salt 480 g/L SL	0.87	209	8 cm height	1	90	ND	ND	ND	
St. Pie, QC, Canada, 2006 (N22-T8)	NA + K salt 300 g/L SL	0.91	213	8 cm height	1	90	ND	ND	ND	
CORN STOVER										
Elm Creek, MB, Canada, 2005 , (Cargill OKC2675)	2-EHE 444 g/L EC	0.89	209	15 cm height	1	114	ND	ND	ND	Jones, GL, 2007, MCPA–R077
Elm Creek, MB, Canada, 2005 , (Cargill OKC2675)	DMA salt 480 g/L SL	0.87	206	15 cm height	1	114	ND	ND	ND	
Elm Creek, MB, Canada, 2005 , (Cargill OKC2675)	NA + K salt 300 g/L SL	0.77	203	15 cm height	1	114	ND	ND	ND	
Carman, MB, Canada, 2005 (Monsanto DKC 27-12)	2-EHE 444 g/L EC	0.90	211	30 cm height	1	114	ND	ND	ND	Jones, GL, 2007, MCPA-R077
Carman, MB, Canada, 2005 (Monsanto DKC 27-12)	DMA salt 480 g/L SL	0.89	210	30 cm height	1	114	ND	ND	ND	
Carman, MB, Canada, 2005 (Monsanto DKC 27-12)	NA + K salt 300 g/L SL	0.80	211	30 cm height	1	114	ND	ND	ND	
Paris, ON, Canada, 2005 (DKB 37-80)	2-EHE 444 g/L EC	0.88	212	10–12 cm height	1	129	ND	ND	ND	Jones, GL, 2007, MCPA-R077
Paris, ON, Canada, 2005 (DKB 37-80)	DMA salt 480 g/L SL	0.84	203	10–12 cm height	1	129	ND	ND	ND	
Paris, ON, Canada, 2005 (DKB 37-80)	NA + K salt 300 g/L SL	0.88	210	10–12 cm height	1	129	ND	ND	ND	

MAIZE	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
St. Pie, QC, Canada, 2005 (2555NK)	2-EHE 444 g/L EC	0.90	216	10 cm	1	132	ND	ND	ND	Jones, GL, 2007, MCPA-R077
St. Pie, QC, Canada, 2005 (2555NK)	DMA salt 480 g/L SL	0.92	225	10 cm	1	132	ND	ND	ND	
St. Pie, QC, Canada, 2005 (2555NK)	NA + K salt 300 g/L SL	0.89	212	10 cm	1	132	ND	ND	ND	
Elm Creek, MB, Canada, 2006 , (Cargill DKC27-12)	2-EHE 444 g/L EC	0.89	206	8–10 cm height	1	130	ND	ND	ND	Belcher, TI, 2008, MCPA-R078
Elm Creek, MB, Canada, 2006 , (Cargill DKC27-12)	DMA salt 480 g/L SL	0.88	207	8–10 cm height	1	130	ND	ND	ND	
Elm Creek, MB, Canada, 2006 , (Cargill DKC27-12)	NA + K salt 300 g/L SL	0.88	208	8–10 cm height	1	130	ND	ND	ND	
Thamesford, ON, Canada, 2006 (Pioneer 38A25)	2-EHE 444 g/L EC	0.86	203	10–15 cm height	1	146	ND	ND	ND	Belcher, TI, 2008, MCPA-R078
Thamesford, ON, Canada, 2006 (Pioneer 38A25)	DMA salt 480 g/L SL	0.85	204	10–15 cm height	1	146	ND	ND	ND	
Thamesford, ON, Canada, 2006 (Pioneer 38A25)	NA + K salt 300 g/L SL	0.87	205	10–15 cm height	1	146	ND	ND	ND	
Ingersoil, ON, Canada, 2006 Maizex 3888)	2-EHE 444 g/L EC	0.86	204	10–15 cm height	1	145	ND	ND	< 0.25	Belcher, TI, 2008, MCPA-R078
Ingersoil, ON, Canada, 2006 Maizex 3888)	DMA salt 480 g/L SL	0.85	203	10–15 cm height	1	145	ND	ND	ND	
Ingersoil, ON, Canada, 2006 Maizex 3888)	NA + K salt 300 g/L SL	0.86	203	10–15 cm height	1	145	ND	ND	< 0.25	

MAIZE	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
St. Pie, QC, Canada, 2006 (N22-T8)	2-EHE 444 g/L EC	0.90	214	8 cm height	1	135	ND	ND	< 0.25	Belcher, TI, 2008, MCPA-R078
St. Pie, QC, Canada, 2006 (N22-T8)	DMA salt 480 g/L SL	0.87	209	8 cm height	1	135	ND	ND	< 0.25	
St. Pie, QC, Canada, 2006 (N22-T8)	NA + K salt 300 g/L SL	0.91	213	8 cm height	1	135	ND	ND	ND	

ND = not detected.

LOQ = 0.25 mg/kg for straw and hay.

LOD = 0.12 mg/kg for MCPA, 0.11 mg/kg for 2-HMCPA, and 0.10 mg/kg for CCPA.

Grass forage and hay

A total of eight supervised field trials were conducted on pasture and rangeland to determine the residues of MCPA and its metabolites in grass forage and hay following treatment with either the DMA salt or 2-EHE formulation, each containing 480 g/L MCPA acid equivalent (Kludas, RS, 1999, MCPA-R111; Kludas, RS, 2000, MCPA-R112, MCPA-R123 and MCPA-R124). Four trials (two pasture grass and two rangeland) were conducted using the 2-EHE formulation, and another four trials (two pasture grass and two rangeland) were conducted using the DMA salt formulation. Each plot received two applications of either formulation at the rate of 2.24 kg ai/ha at intervals of 90 days. Pasture grass and rangeland forage and hay (air dried in the field) were harvested 7, 14 and 21 days after the first application and 7, 14, 21 and 30 days following the second application.

Samples were frozen and maintained frozen until analysis. Information on hydrolysis could be found in the analytical methods parts. Table 57 summarizes the storage interval conditions. The storage stability study indicates that residues of MCPA and its metabolites are stable for up to 369 days of freezer storage in pasture grass forage or hay. Although the maximum storage intervals for grass hay exceeded the maximum intervals utilized in the storage stability study, it should be noted that the majority of grass hay samples were within the supported storage interval.

Table 57 Summary of storage conditions (Kludas, RS, 1999, MCPA-R111; Kludas, RS, 2000, MCPA-R112, MCPA-R123 and MCPA-R124)

Matrix	Storage temp, ºC	Actual storage duration, days	Limit of demonstrated stability
Pasture grass, forage	-30 ºC to -10 ºC	126–391 days	Storage stability data indicate that residues of MCPA and its metabolites were stable for up to 369 days of freezer storage in pasture grass forage or hay.)
Pasture grass, hay		152–431 days	
Rangeland grass, forage		70–353 days	
Rangeland grass, hay		195–454 days	

Results of trials on pasture and rangeland grasses are summarized in Table 58.

Table 58 MCPA acid equivalent residues in treated pasture and rangeland grasses resulting from supervised trials in Canada and USA (Kludas, RS, 1999, MCPA-R111; Kludas, RS, 2000, MCPA-R112, MCPA-R123 and MCPA-R124)

GRASSES	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year
country, year (variety)	Form.	kg ae/ha	water, l/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	Reference No.
GRASS FORAGE										
Missouri, USA 1997 (Fescue)	2-EHE (480 g/L EC)	2.41	227	4–6” grass/ weeds	1st	7	31.6	3.49	0.57	Kludas, RS, 2000, MCPA-R112
						14	38.7	4.88	0.64	
						21	21.9	2.85	0.37	
		2.40	278	6–8” grass/ weeds	2nd (After 3 months)	7	94.3	10.1	2.91	
						14	31.3	8.82	2.90	
						21	21.7	4.13	1.54	
						30	24.7	5.04	1.18	
Texas, USA, 1997 (Bermuda)	2-EHE (480 g/L EC)	2.52	291	6” tall grass	1st	7	31.0	23.2	2.44	Kludas, RS, 2000, MCPA-R112
						14	19.6	15.2	3.05	
						21	10.3	7.38	1.59	
		2.54	294	6” tall grass	2nd (After 3 months)	7	16.4	11.6	2.37	
						14	9.94	7.04	1.86	
						21	4.54	3.14	0.85	
						30	3.19	1.88	0.54	
South Dakota, USA. 1997 (Bluegrass, Brome grass)	2-EHE (480 g/L EC)	2.42	279	Before or at seed head (grass)	1st	0	147	1.27	0.09	Kludas, RS, 2000, MCPA-R124
						7	18.3	15.5	2.08	
						14	9.34	14.1	1.64	
		2.41	278	No seed heads (grass)	2nd (After 3 months)	0	208	3.84	0.25	
						7	22.2	19.1	4.66	
						14	10.7	17.9	3.35	
						21	5.50	8.51	1.24	
Oklahoma, USA, 1997 (Brome grass, Fescue, Bermuda native grasses)	2-EHE (480 g/L EC)	2.44	283	3”tall blades (grass); 8-12” tall weeds	1st	0	216	2.73	0.09	Kludas, RS, 2000, MCPA-R124
						7	70.2	8.23	0.09	
						14	17.2	2.95	0.09	
		2.45	284	6–10” tall grasses	2nd (After 3 months)	0	234	0.89	0.22	
						7	53.5	8.70	0.37	
						21	22.5	5.44	0.22	
						30	9.98	2.33	0.09	
Missouri, USA, 1997 (Fescue)	DMA salt (480 g/L SL)	2.43	283	4–6” tall grass/weeds	1st	7	30.9	4.15	0.40	Kludas, RS, 1999, MCPA-
						14	40.5	5.23	0.48	
						21	38.8	4.37	0.43	

GRASSES	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year
country, year (variety)	Form.	kg ae/ha	water, l/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	Reference No.
		2.37	274	6–8” tall grass/weeds	2nd (After 3 months)	7	38.5	4.65	0.76	R111
						14	17.5	3.54	0.53	
						21	12.1	2.02	0.28	
						30	16.0	2.35	0.39	
Texas, USA 1997 (Bermuda)	DMA salt (480 g/L SL)	2.52	294	6” tall grass	1st	7	19.9	11.1	3.22	Kludas, RS, 1999, MCPA-R111
						14	7.64	4.16	1.61	
						21	8.45	5.14	1.65	
		2.53	296	6” tall grass	2nd (After 3 months)	7	14.7	9.68	1.99	
						14	7.55	5.95	1.60	
						21	2.97	2.49	0.64	
						30	2.57	1.81	0.63	
South Dakota, USA, 1997 (Bluegrass, Brome grass)	DMA salt (480 g/L SL)	2.35	274	Prior to grass seed head formation	1st	0	195	1.60	0.22	Kludas, RS, 2000, MCPA-R123
						7	21.0	9.91	1.39	
						21	6.85	8.72	0.93	
		2.41	282	Grass, vegetative	2nd (After 3 months	0	327	3.23	0.22	
						7	31.0	24.8	8.16	
						21	18.3	38.7	5.40	
						30	15.8	16.4	3.31	
Oklahoma, USA, 1997 (Brome grass, Fescue, Bermuda native grass)	DMA salt (480 g/L SL)	2.42	283	Grass, 3” tall blades	1st	0	267	5.14	0.09	Kludas, RS, 2000, MCPA-R123
						7	108	9.39	0.39	
						21	32.7	4.10	0.16	
		2.43	284	Grass, 6–10” tall	2nd (After 3 months	0	248	1.81	0.09	
						7	49.5	6.04	0.22	
						21	22.1	3.57	0.22	
						30	18.7	3.81	0.16	
GRASS HAY										
Missouri, USA 1997 (Fescue)	2-EHE (480 g/L EC)	2.41	227	4–6” grass/ weeds	1st	7	102	7.63	2.95	Kludas, RS, 2000, MCPA-R112
						14	49.9	4.45	1.27	
						21	48.8	7.19	1.31	
		2.40	278	6–8” grass/ weeds	2nd (After 3 months)	7	68.0	6.42	2.37	
						14	46.1	4.36	1.32	
						21	51.7	13.3	4.41	
						30	49.7	8.33	1.87	
Texas, USA, 1997 (Bermuda)	2-EHE (480 g/L EC)	2.52	291	6” tall grass	1st	7	80.7	64.0	13.5	Kludas, RS, 2000, MCPA-
						14	35.5	22.7	7.23	
						21	19.9	12.6	3.19	

GRASSES	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year
country, year (variety)	Form.	kg ae/ha	water, l/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	Reference No.
		2.54	294	6” tall grass	2nd (After 3 months)	7	35.1	25.3	4.79	R112
						14	19.0	14.4	3.80	
						21	11.5	9.05	2.35	
						30	4.22	2.32	1.17	
South Dakota, USA. 1997 (Bluegrass, Brome grass)	2-EHE (480 g/L EC)	2.42	279	Before or at seed head (grass)	1st	0	190	15.0	0.87	Kludas, RS, 2000, MCPA-R124
						7	42.5	29.0	2.82	
						14	17.0	27.7	2.42	
		2.41	278	No seed heads (grass)	2nd (After 3 months)	0	248	5.51	0.09	
						7	27.6	21.2	6.03	
						21	14.8	16.8	3.95	
						30	10.8	8.40	3.16	
Oklahoma, USA, 1997 (Brome grass, Fescue, Bermuda native grasses)	2-EHE (480 g/L EC)	2.44	283	3”tall blades (grass); 8-12” tall weeds	1st	0	153	4.49	0.87	Kludas, RS, 2000, MCPA-R124
						7	97.4	13.8	0.87	
						14	34.4	5.93	0.87	
		2.45	284	6–10” tall grasses	2nd (After 3 months)	0	176	6.78	0.87	
						7	94.8	12.7	0.87	
						21	34.2	7.10	0.87	
						30	19.0	2.72	0.09	
24.6 Missouri, USA, 1997 (Fescue)	DMA salt (480 g/L SL)	2.43	283	4–6” tall grass/weeds	1st	7	196	14.9	2.19	Kludas, RS, 1999, MCPA-R111
						14	86.3	7.20	0.98	
						21	94.7	6.09	0.82	
		2.37	274	6–8” tall grass/weeds	2nd (After 3 months)	7	29.9	3.24	0.85	
						14	25.1	5.06	1.16	
						21	39.4	6.27	1.40	
						30	24.8	3.83	1.30	
Texas, USA 1997 (Bermuda)	DMA salt (480 g/L SL)	2.52	294	6” tall grass	1st	7	54.8	37.6	10.3	Kludas, RS, 1999 MCPA-R111
						14	19.9	12.7	5.77	
						21	10.9	7.05	2.14	
		2.53	296	6” tall grass	2nd (After 3 months)	7	37.4	19.7	4.35	
						14	21.4	13.8	3.87	
						21	11.6	7.63	2.29	
						30	4.18	2.70	1.26	

GRASSES	Application					PHI	Residues mg/kg, (MCPA acid equiv)			Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, l/ha	Growth stage	no.	days	MCPA	HMCPA	CCPA	
South Dakota, USA, 1997 (Bluegrass, Brome grass)	DMA salt (480 g/L SL)	2.35	274	Prior to grass seed head formation	1st	0 7 21	326 31.9 12.4	8.44 14.5 15.8	< 0.87 2.74 2.37	Kludas, RS, 2000, MCPA-R123
		2.41	282	Grass, vegetative	2nd (After 3 months	0 7 21 30	523 40.3 24.6 12.5	3.51 14.7 12.8 16.5	0.87 13.2 7.81 3.60	
Oklahoma, USA, 1997 (Brome grass, Fescue, Bermuda native grass)	DMA salt (480 g/L SL)	2.42	283	Grass, 3” tall blades	1st	0 7 21	273 217 79.2	7.82 16.6 5.85	1.08 1.00 0.87	Kludas, RS, 2000, MCPA-R123
		2.43	284	Grass, 6–10” tall	2nd (After 3 months	0 7 21 30	134 81.0 33.3 25.4	7.11 8.10 3.74 3.76	0.87 0.87 0.87 0.87	

Grasslands

A total of six supervised trials were conducted on grasslands in Europe (three in Northern France and three in the UK) (Old, J, and Venuti, J, 2001, MCPA-R119; Gallais, C, 2001, MCPA-R120; Old, J, and Duncan, P, 2001, MCPA-R115; Perny, A, 2001, MCPA-R116). An additional four trials were conducted in Southern Europe (two in France and two in Spain) (Old, J, and Orpella, M, 2001, MCPA-R121; Gallais, C, 2001, MCPA-R122; Old, J, *et al.*, 2001, MCPA-R117; Perny, A, 2001, MCPA-R118).

Samples of whole plants were collected from each trial immediately after application and again at 7, 14, 28 and 56 days after the application. Samples were stored frozen (-20 ºC). The storage period from collection to analysis ranged from 230 to 434 days. The storage stability study indicates that residues of MCPA and its metabolites are stable for up to 369 days of freezer storage in pasture grass forage or hay. Information on hydrolysis could be found in the analytical methods parts. Results are summarized in Table 59.

Table 59 MCPA acid equivalent residues in treated grasses resulting from supervised trials in Austria, the UK, France and Spain (Old, J, and Venuti, J, 2001, MCPA-R119; Gallais, C, 2001, MCPA-R120; Old, J, and Duncan, P, 2001, MCPA-R115; Perny, A, 2001, MCPA-R116; Old, J, and Orpella, M, 2001, MCPA-R121; Gallais, C, 2001, MCPA-R122; Old, J, *et al,* 2001, MCPA-R117; Perny, A, 2001, MCPA-R118)

GRASSES	Application					PHI	Residues mg/kg, (MCPA acid equiv)	Reference Author, year Reference No.
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days		
GRASS FORAGE								

GRASSES	Application					PHI	Residues mg/kg,			Reference
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	(MCPA acid equiv)			Author, year Reference No.
Ports sur Vienne, France, 1999 (Fescue, Cocksfoot, Ryegrass, Timothy)	DMA salt 750 g/L SL	1.81	253	BBCH 31-33	1	0	80.0	1.30	–	Old, J, and Venuti, J, 2001, MCPA-R119; Gallais, C, 2001, MCPA-R120
						7	6.70	0.15	–	
						14	5.60	< 0.05	–	
						28	1.40	< 0.05	–	
						56	0.20	< 0.05	–	
East Lothian, UK, 1999 (Rye, clover)	DMA salt 750 g/L SL	1.74	242	BBCH 24-60	1	0	98.0	0.05	–	
						7	4.90	< 0.05	–	
						14	1.10	< 0.05	–	
						28	0.76	< 0.05	–	
						56	0.38	< 0.05	–	
Kent, UK 2000 (Timothy, Rye)	DMA salt 750 g/L SL	1.79	249	BBCH 24-26	1	0	128	0.12	–	Old, J, and Duncan, P, 2001, MCPA-R115; Perny, A, 2001, MCPA-R116
						7	8.10	0.24	–	
						14	4.60	0.12	–	
						28	0.78	< 0.05	–	
						56	< 0.05	ND	–	
East Lothian, UK 2000 (Rye and meadow grass)	DMA salt 750 g/L SL	1.82	252	BBCH 25-30	1	0	85.0	< 0.05	–	
						7	9.50	0.12	–	
						14	5.10	0.08	–	
						28	0.90	ND	–	
						56	0.08	ND	–	
La Genete, France, 2000 (Rye grass)	DMA salt 750 g/L SL	1.84	256	BBCH 24-29	1	0	59.0	0.31	–	Old, J, and Duncan, P, 2001, MCPA-R115; Perny, A, 2001, MCPA-R116
						7	13.0	0.20	–	
						14	5.60	0.16	–	
						28	3.20	0.08	–	
						56	1.40	0.14	–	
Noiron sous, Gervey, France, 2000 (Rye grass)	DMA salt 750 g/L SL	1.80	250	BBCH 32-61	1	0	10.0	0.28	–	
						7	40.0	0.56	–	
						14	5.60	0.60	–	
						28	1.70	0.36	–	
						55	0.62	0.16	–	
GAP, Spain (grassland)	DMA, 400 g/L SL	1.2–1.6	200	Weeds in active growth	1	–	MCPA	HMCPA	CCPA	

GRASSES	Application					PHI	Residues mg/kg,			Reference
country, year (variety)	Form.	kg ae/ha	water, L/ha	Growth stage	no.	days	(MCPA acid equiv)			Author, year Reference No.
Velleches, France, 1999 (Fescue)	K-salt 400 g/L SL	1.62	250	BBCH 34-59	1	0	138	0.27	–	Old, J, and Orpella, M, 2001, MCPA-R121; Gallais, C, 2001, MCPA-R122
						7	19.0	0.12	–	
						14	11.0	0.05	–	
						28	7.50	< 0.05	–	
						56	3.00	< 0.05	–	
Termens, Spain, 1999 (Rye grass)	K-salt 400 g/L SL	1.66	255	10–15 cm	1	0	31.0	0.39	–	
						7	7.40	0.27	–	
						14	6.60	0.15	–	
						28	3.00	0.16	–	
						56	0.66	0.05	–	
Cras sur Reyssouze, France, 2000 (Clover mix/RGA)	K-salt 400 g/L SL	1.63	254	BBCH 35	1	0	135	0.10	–	Old, J, *et al,* 2001, MCPA R117; Perny, A, 2001, MCPA-R118
						7	19.0	0.18	–	
						14	19.0	0.15	–	
						28	3.7	< 0.05	–	
						56	0.33	ND	–	
Vila-sana, Spain, 2000 (Lolium spp/Ilerda)	K-salt 400 g/L SL	1.60	250	BBCH 32	1	0	208	0.08	–	
						7	21.0	0.15	–	
						14	3.70	< 0.05	–	
						28	2.00	< 0.05	–	
						56	0.55	ND	–	

ND = not detected.

LOD = 0.016 mg/kg.

FATES OF RESIDUES IN STORAGE AND PROCESSING

Information and Data from Trials on Stored Products

MCPA is not used in stored products.

Information and Data from Residues in Processed Commodities

Wheat

Two processing studies on wheat were conducted in the US using either the 2-EHE EC formulation or the DMA salt SL formulation (Kludas, RS, 2000, MCPA-R133 and MCPA-R134). Samples of wheat grain that were used for processing were obtained from two field trials conducted during the 1998 growing season in the US. Wheat grain (RAC) were collected 53 days following a single broadcast application of the DMA salt SL formulation containing 480 g ae/L MCPA or the 2-EHE EC formulation containing 480 g ae/L MCPA at the exaggerated rate of 6.9 to 7.0 kg ae/ha in 245 to 246 L of water/ha using ground boom sprayer.

Bulk samples of treated and control wheat grain for processing were collected and stored at the field facility under ambient conditions for 28 days and then shipped to the processing facility, where the samples were stored frozen prior to processing. Wheat grain was processed using simulated commercial procedures into germ, bran, middlings, shorts and flour within 63 to 94 days of harvest. A brief description of the processing procedure follows.

Wheat grain samples were circulated through a dust-generating apparatus consisting of a bucket conveyor, drag conveyors and holding bins. After the aspirated grain fraction was separated, the wheat grain was cleaned by aspiration. A portion of the cleaned grain was adjusted to 16% moisture, broken into small pieces in a corrugated rolling mill and sieved to separate bran from germ (including endosperm). A second portion of cleaned wheat grain was again adjusted to 16% moisture, broken four times in corrugated roller mills and sieved to produce bran, middlings, low-grade flour and patent flour. Middlings were reduced in a smooth roller mill and sieved to separate shorts, low-grade flour and patent flour. Low-grade and patent flour were combined with the flour from the other break steps. Processing samples were shipped to the laboratory for analysis. The processing flow chart is presented in Figure 2 and represents the procedures used for both the DMA salt and 2-EHE treated grain samples.

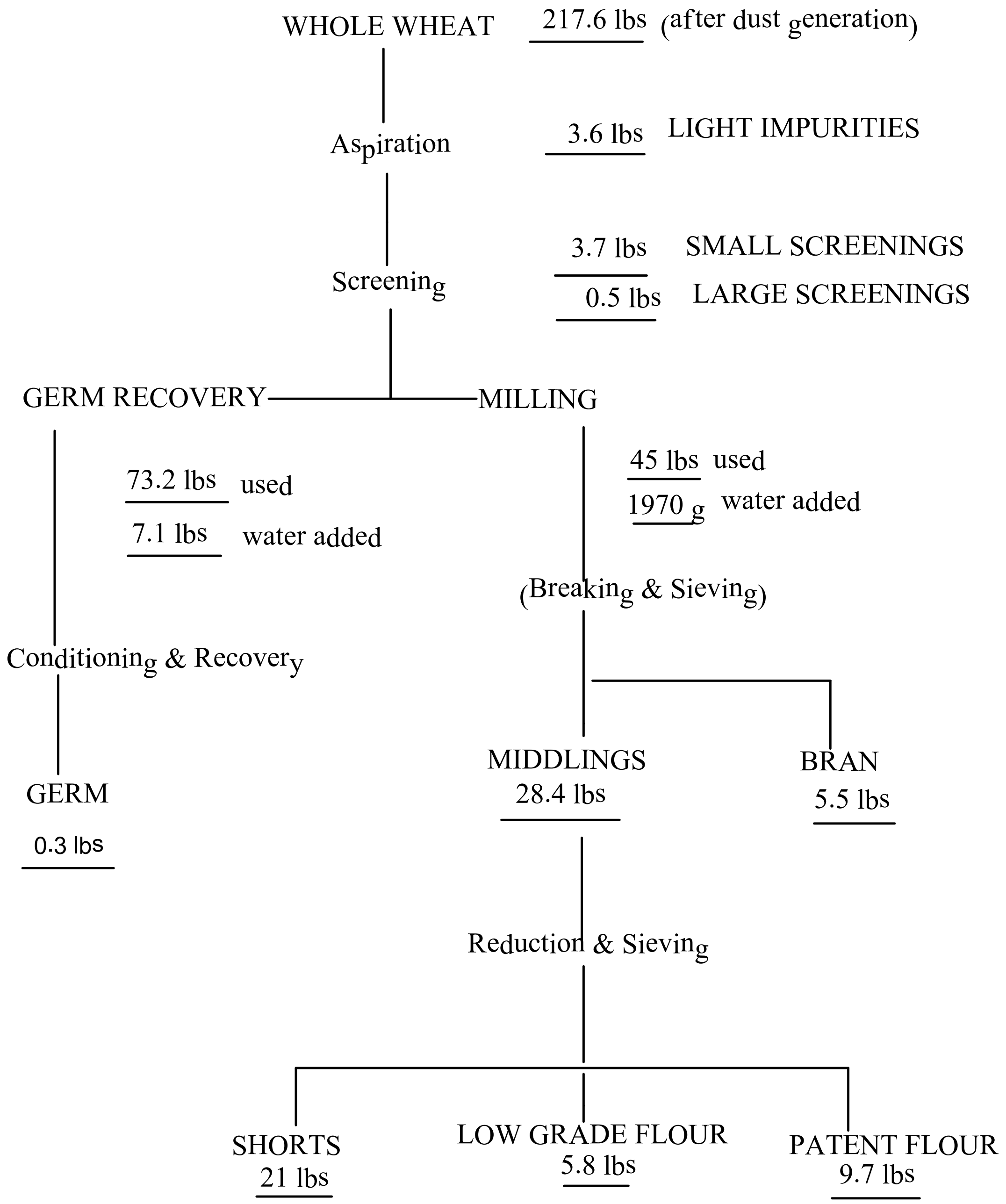


Figure 2 Wheat Processing Flow Chart

Samples were stored frozen (approximately -20 ºC) after processing. The maximum storage interval of processing study samples from harvest/processing to analysis was 338 days for wheat grain; 390 to 404 days for flour, germs, middlings, and shorts; and 496 days for bran. Storage stability studies on wheat grain and flour demonstrated that MCPA and HMCPA are stable in wheat grain up to 545 days and in flour up to 541 days under frozen storage conditions. Information on hydrolysis could be found in analytical methods part.

The results (Table 60) indicate that combined residues of MCPA and HMCPA, expressed as acid equivalents, do not concentrate in germ, shorts, middlings and flour but concentrate slightly in bran.

Table 60 Residues of MCPA and HMCPA in wheat processed fractions (Kludas, RS, 2000, MCPA-R133 and MCPA-R134)

Processed Fractions	Residues (Average) Mg/kg			Process Factor	Reference
	MCPA	HMCPA	Total		
DMA salt trial					
Wheat (RAC, field)	0.012, 0.018 (0.015)	< 0.01, 0.01 (0.01)	0.025	–	Kludas, RS, 2000, MCPA-R133
Wheat (RAC, pre-process)	0.011, 0.026 (0.019)	< 0.01, < 0.01 (< 0.01)	0.029	–	
Germ	< 0.01, < 0.01	< 0.01, < 0.01	< 0.02	< 0.67	
Bran	< 0.01, < 0.01 (< 0.01)	0.02, 0.03 (0.025)	0.035	< 0.67	
Middlings	< 0.01, < 0.01 (< 0.01)	0.01, 0.02 (0.015)	0.025	< 0.67	
Shorts	< 0.01, < 0.01 (< 0.01)	0.01, 0.02 (0.015)	0.025	< 0.67	
Flour	< 0.01, < 0.01	< 0.01, < 0.01	< 0.02	< 0.67	
2-EHE trial					
Wheat (RAC, field)	0.030, 0.038 (0.034)	0.02, 0.03 (0.025)	0.059	–	Kludas, RS, 2000, MCPA-R134
Wheat (RAC, pre-process)	0.024, 0.034 (0.029)	< 0.01, 0.02 (0.015)	0.044	–	
Germ	< 0.01, < 0.01 (< 0.01)	< 0.01, < 0.01 (< 0.01)	< 0.02	< 0.29	
Bran	0.01, < 0.01 (0.01)	0.02, 0.02 (0..02)	0.03	< 0.29	
Middlings	< 0.01, < 0.01 (< 0.01)	< 0.01, 0.01 (0.01)	0.02	< 0.29	
Shorts	< 0.01, < 0.01 (< 0.01)	0.01, 0.01 (0.01)	0.02	< 0.29	
Flour	< 0.01, < 0.01	< 0.01, < 0.01	< 0.02	< 0.29	

Processed Fractions	Residues (Average) Mg/kg			Process Factor	Reference
	(< 0.01)	(< 0.01)			
Average Processing Factors					
Wheat (RAC, field)				-	
Wheat (RAC, pre-process)				-	
Germ				< 0.48	
Bran				< 0.48	
Middlings				< 0.48	
Shorts				< 0.48	
Flour				< 0.48	

RESIDUES IN ANIMAL COMMODITIES

Farm animal feeding studies

Dairy cows

The Meeting received a lactating dairy cow feeding study, which provided information on likely residues resulting in animal tissues and milk from residues in the animal diet.

A cattle feeding study was conducted to determine the magnitude of residues of MCPA and its metabolites in milk and animal tissues (Koch, DA, 2007, MCPA-R137). Twelve lactating Holstein cows were orally dosed for 28 consecutive days with encapsulated MCPA via a balling gun at three different levels, following a 7-day acclimation period to the test facility. In addition three cows were maintained as controls and received placebo doses. Nominal dose levels were based upon the average body weight of the three cows in each treatment group and a test substance concentration of 50, 150, and 500 mg/kg in feed on a dry weight basis. This corresponds to 1×, 3× and 10× of the anticipated dietary burden of MCPA residues expected in feedstuff produced from MCPA-treated feeds.

Milk sampling was initiated prior to treatment on Day 0. Milk samples were collected on Days 0, 1, 3, 7, 11, 14, 18, 21, 24 and 27. For the 10× depuration group (and two of the controls), milk samples were also collected on Days 29 and 30. The evening samples were stored refrigerated overnight and then composited for each individual cow with the morning samples according to the ratio of PM and AM production. Aliquots of milk samples from day 27 for 3 of the 500 mg/kg treated cows were separated into cream and skim milk samples for the purpose of determining whether MCPA residues would preferentially concentrate into the cream fraction.

With the exception of two control and the three animals in the 10× depuration group, all cows were necropsied and tissues (liver, kidney, muscle and fat) were collected at the end of the 28-day dosing period, within 24 hours after the last dose. The composite fat sample was prepared for each individual cow with equal amounts of perirenal, omental and subcutaneous fat. The composite muscle sample was prepared for each individual cow with equal amounts of round, loin and flank muscle. The two control cows and the depuration group animals were necropsied and sampled on Day 35.

All samples were stored frozen at -20 ºC until extraction (approximate period of storage was 73 days). The storage stability studies conducted concurrently with this study confirmed that residues of MCPA are stable when stored frozen up to at least 4 months in liver and in milk, 5 months in kidney and fat, and 3 months in muscle samples. Samples from the metabolism study showed that MCPA, MCPA-glycine (milk only) and triglycerides (remaining tissues) were stable in frozen storage up to about 46 weeks. Residues in muscle, liver, kidney and fat after 28 days of dosing and after the depuration period are summarized in Table 61. MCPA-equivalent residues in milk are summarized in Table 62.

Table 61 MCPA-equivalent residues (mg/kg) in edible tissues of cows following dosing for 28 consecutive days and depuration period of 7 days (Koch, DA, 2007, MCPA-R137)

Treatment level mg/kg	Liver		Kidney		Composite muscle		Composite fat	
	28 days	35 days	28 days	35 days	28 days	35 days	28 days	35 days
0 (Control)	< 0.05 – –	– < 0.05 < 0.05	< 0.05 – –	– < 0.05 < 0.05	< 0.05 – –	– < 0.05 < 0.05	< 0.05 – –	– < 0.05 < 0.05
Average	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
50 (1×)	< 0.05 < 0.05 < 0.05	– – –	0.40 0.28 0.41	– – –	< 0.05 < 0.05 < 0.05	– – –	< 0.05 < 0.05 < 0.05	– – –
Average	< 0.05	–	0.36	–	< 0.05	–	< 0.05	–
150 (3×)	0.06 0.09 < 0.05	– – –	0.60 1.20 0.63	– – –	< 0.05 < 0.05 0.08	– – –	< 0.05 0.17 0.12	– – –
Average	0.07	–	0.81	–	0.06	–	0.11	–
500 (10×)	0.28 0.25 0.16	< 0.05 < 0.05 < 0.05	1.66 2.44 1.69	< 0.05 0.05 –	0.08 0.05 < 0.05	– – –	0.13 0.12 < 0.05	– – –
Average	0.23	< 0.05	1.93	< 0.05	0.06	–	0.10	–

Table 62 MCPA-equivalent residues in milk and cream from dairy cows dosed for 28 days (Koch, DA, 2007, MCPA-R137)

DAY	Treatment, mg/kg						
	50 (1× dose group)			150 (3× dose group)			500 (10× dose group) Average from 6–7 cows
	Milk						
1	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.018, 0.019, 0.019, 0.020, 0.021, 0.024 (Average = 0.020)
3							< 0.01, 0.012, 0.014, 0.016, 0.018, 0.019 (Average = 0.015)
7	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.012, 0.015, 0.019, 0.019, 0.022, 0.022, 0.039 (Average = 0.021)
11							0.013, 0.013, 0.013, 0.014, 0.016, 0.019 (Average = 0.015)
14	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.018, 0.018, 0.018, 0.020, 0.021, 0.028 (Average = 0.020)
18							0.013, 0.015, 0.016, 0.017, 0.017, 0.019

DAY	Treatment, mg/kg						
	50 (1× dose group)			150 (3× dose group)			500 (10× dose group) Average from 6–7 cows
							(Average = 0.016)
21							0.011, 0.014, 0.016, 0.017, 0.018, 0.020 (Average = 0.016)
24							0.014, 0.017, 0.018, 0.020, 0.022, 0.043 (Average = 0.022)
27	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.013, 0.021, 0.022, 0.023, 0. 26, 0.031 (Average = 0.023)
	Depuration period						
29							< 0.01, < 0.01, < 0.01 (Average = < 0.01)
30							< 0.01, < 0.01, < 0.01 (Average = < 0.01)
Cream							
27							0.015, 0.020, 0.017 (Average = 0.017)

RESIDUES IN FOOD IN COMMERCE OR AT CONSUMPTION

There are no data on market-basket monitoring studies available for MCPA.

NATIONAL RESIDUE DEFINITIONS

Information was provided on national residue definitions for MCPA.

Australia

Commodities of plant and animal origin: MCPA.

Canada

Commodities of plant origin: MCPA + HMCPA.

Commodities of animal origin: MCPA.

APPRAISAL

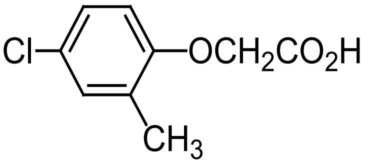
Residue and analytical aspects of MCPA were considered for the first by the present Meeting. It was scheduled for evaluation by the 2012 JMPR by the Forty-third Session of the CCPR.

MCPA is a herbicide in the phenoxyacetic acid class and works by concentrating in the actively growing regions of a plant (meristematic tissue), where it interferes with protein synthesis, cell division and the growth of the plant. It is used for the selective control of broadleaf weeds. MCPA is an acid, but it is usually formulated and applied as a salt, an amine salt or an ester.

The Meeting received information on physical and chemical properties, metabolism, environmental fate, analytical methods and freezer storage stability, national registered use patterns, as well as supervised trials, processing studies and livestock feeding studies.

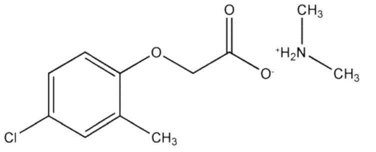
The 2012 JMPR established an ADI for MCPA of 0–0.1 mg/kg bw/day and an ARfD of 0.6 mg/kg bw.

MCPA is 4-chloro-o-tolyloxyaceic acid.

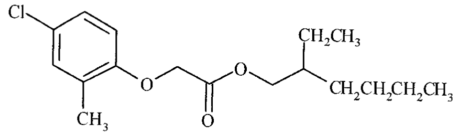


The following compounds are used for the metabolites discussed below:

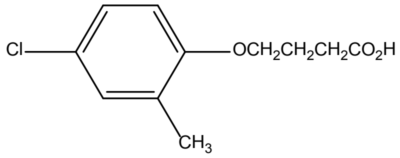
MCPA DMA
(4-chloro-2-methylphenoxyacetic acid) dimethylamine salt



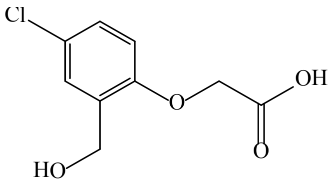
MCPA 2-EHE
2-ethylhexyl (4-chloro-2-methylphenoxy)acetate



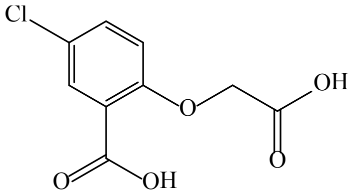
MCPB
4-(4-chloro-2-methylphenoxy) butanoic acid



HMCPA or CHTA
2-hydroxy-4-chlorophenoxyacetic acid



CCPA
2-carboxy-4-chlorophenoxyacetic acid



Animal metabolism

Information was available on metabolism of MCPA in rats, lactating goats and laying hens.

In rats, following oral dose of uniformly ring-labelled [^{14}C]-MCPA, approximately 90% of the administered dose was excreted in urine, with low levels detected in faeces (~5% of the administered dose). MCPA ion was the major compound detected in rat excreta followed by HMCPA and glycine-conjugated MCPA. The proportions of MCPA and HMCPA in rat urine ranged from 51–80% and 6–16% of the administered dose, respectively. In rat faeces, MCPA and HMCPA accounted for approximately 1–2% and 1–7% of the administered dose, respectively. Following oral dosing of rats, there was no evidence of accumulation of radioactivity in any tissues, with the concentration in the majority of tissues lower than in blood.

In a lactating goat study, uniformly ring-labelled [^{14}C]-MCPA was fed to goats for 3 consecutive days at 694 and 832 ppm in feed. Following oral administration, the goats excreted the majority of the dose (99.3%) within 24 hours of dosing, primarily in the urine as unmetabolized MCPA. The primary [^{14}C] component excreted in faeces was also MCPA. Milk and tissues each contained < 0.1% of the total radioactive residues. The small amount of MCPA that is not excreted is metabolized to the glycine conjugate of MCPA in milk and to an unknown metabolite mainly in liver, kidney, and bile, later identified as composed of three compounds of similar polarity, characterized as triglyceride-like compounds with a dechlorinated MCPA-like structure incorporated by ester or ether linkage.

Unchanged parent MCPA was a significant residue in goat fat (30.2% TRR, 0.042 mg/kg), in milk (28.5% TRR, 0.046 mg/kg), in muscle (22.3% TRR, 0.022 mg/kg) and only a small proportion of the residue in goat kidney (6.7% TRR, 0.060 mg/kg) and liver (4.9% TRR, 0.024 mg/kg).

The conjugate MCPA-glycine was a major residue in milk at 53.9% TRR (0.086 mg eq./kg) but wasn't found in fat, muscle, kidney and liver. Triglyceride-like compounds with a dechlorinated MCPA-like structure were identified as a major residue in fat (30.3% TRR, 0.042 mg eq./kg), kidney (57.4% TRR, 0.509 mg eq./kg) and liver (50.5% TRR, 0.242 mg eq./kg) and as a minor residue in muscle (0.2% TRR, < 0.001 mg eq./kg).

Fifteen laying hens had uniformly ring-labelled [^{14}C]-MCPA administered via feed at 100 ppm for 7 consecutive days, 99.5% of the radioactivity was recovered, primarily as MCPA and acid labile MCPA conjugates in the excreta. The tissues and eggs combined accounted for only 0.04% of the dose administered over 7 days. MCPA was the major component identified in egg white (90.3% TRR, 0.029 mg/kg), egg yolk (57.4% TRR, 0.127 mg/kg), fat (12.0% TRR, 0.004 mg/kg), thigh muscle (35.5% TRR, 0.006 mg/kg) and liver (78.2% TRR, 0.0663 mg/kg). The parent compound was a major component in animal muscle, fat, milk and egg. The metabolism of MCPA in rats, lactating goats and laying hens is qualitatively similar.

Plant metabolism

The Meeting received plant metabolism studies with MCPA on wheat and MCPB on peas.

Metabolism studies of MCPA in two different crops (wheat and peas) demonstrated that metabolism of MCPA was similar, and that the compound undergoes oxidation of the phenyl methyl, and the resulting hydroxymethyl compound forms conjugates, including a glucose conjugate. Further metabolism to the carboxyl compound (CCPA) is also seen.

A wheat metabolism study was conducted with [^{14}C]-MCPA 2-EHE and [^{14}C]-MCPA DMA, labelled with ^{14}C in the ring position. The residue in forage and straw of wheat treated with either form of MCPA was qualitatively similar. A higher proportion of parent MCPA was found in the forage (54.4% TRR, 28.3 mg/kg) and straw (26.6% TRR, 35.9 mg/kg) of wheat for [^{14}C]-MCPA DMA salt. A lower proportion of parent MCPA was found in forage (10.0% TRR, 3.30 mg/kg) and straw (13.7% TRR, 11.3 mg/kg) of wheat for [^{14}C]-MCPA 2-EHE. The residue profiles in grain were similar for either form of MCPA. The main residue in grain was CCPA with a concentration of 25.3% TRR (0.103 mg/kg) for [^{14}C]-MCPA 2-EHE, and 16.5% TRR (0.091 mg/kg) for [^{14}C]-MCPA DMA. Analysis of the hydrolysates of the unextracted residue in forage and straw demonstrated the presence of conjugated forms of MCPA, HMCPA and CCPA. Unextractable residue in grain was subjected to chemical and enzymatic hydrolysis. Analysis of the hydrolysates of bound residue from grain demonstrated the presence of HMCPA and CCPA conjugates. A majority of the resident residue in grain was incorporated into cellular endogenous compounds, primarily glucose, which could be further incorporated into starch or cellulose.

MCPB breaks down into MCPA by the process of β-oxidation. MCPB metabolism study in peas could provide relevant information about the residue pattern of MCPA metabolized in plant. The metabolism of MCPB in peas was investigated using [^{14}C]-MCPB uniformly labelled in the ring position, applied at the rate of 2.26 kg ai/ha. Although the majority of the residues were found in the mature and immature vine, adequate total radioactivity was found in mature pods (0.025 mg eq./kg), seeds (0.024 mg eq./kg) and foliage (4.97 mg eq./kg) to permit extraction and identification of major metabolites. A combination of acetone and acetone/water extracted the majority of the radiolabelled residue from mature vine (92% TRR, 4.57 mg eq./kg) and pod (86% TRR, 0.022 mg eq./kg). Solvents extracted only 38% TRR (0.0092 mg eq./kg) from mature seed. Another 40% TRR (0.0095 mg/kg) was recovered by sequential base and acid hydrolysis. Some of the radiolabelled residue was identified in mature forage, pod and seed. Mature vine contained mainly the parent, 72% MCPB (3.59 mg/kg), 5.8% MCPA (0.29 mg/kg), and 13% polar unknowns (0.63 mg/kg). Mature pod contained 40% MCPB (0.01 mg/kg), 0.8% MCPA (0.0002 mg/kg) and 48% polar unknowns (0.012 mg/kg). Mature seed contained 1.2% MCPB (0.0003 mg/kg), 11.3% MCPA/MCPA ester (0.0027 mg/kg), 12.5% glucose conjugate of HMCPA (0.003 mg/kg) and about 27% polar unknowns (0.0065 mg/kg). About 29% TRR was unaccounted, including 15% TRR in the residual solid. Based on the study, MCPA and MCPB are the major residues in mature pea vines and pods after treatment of with [^{14}C]-MCPB. The minor residues of MCPB and MCPA were found in grain about 1.2%-4.2% TRR (0.0003-0.001 mg/kg).

Environmental fate in soil

The Meeting received information on the environmental fate of MCPA in soil, including studies on aerobic soil metabolism, soil photolysis and crop rotational studies.

Aerobic soil metabolism

The primary hydrolysis rate of ring-labelled [^{14}C]-MCPA 2-EHE was studied in two US soils, a clay loam and a sandy loam. MCPA 2-EHE hydrolysed quickly to MCPA in both soils. Half-life values ranged between 4.5 and 16.6 hours. A further study on aerobic metabolism and degradation of [^{14}C]-MCPA 2-EHE was conducted in a sandy loam soil for 209 days. The calculated half-life was 24 days. A total of 65.6% of applied radioactivity was evolved as volatile radioactivity identified as $^{14}CO_2$ over the 209-day incubation period.

Soil photolysis

[^{14}C]-MCPA degraded moderately under sunlight. PCOC which is the major degradate did not exceed 5.1% of applied radioactivity. Calculated first order half-lives were 4,718 hours for artificially irradiated soil and 220 hours for naturally irradiated soil.

Confined rotational crop

In a confined rotational crop study in the USA, soil was treated directly with [^{14}C]-MCPA in phenol ring. Crops of lettuce, turnips, and barley were sown into the treated soil at intervals of 30, 120 and 365 days after treatment and were grown to maturity and harvested except for lettuce, which was harvested at intermediate intervals whenever sufficient leaf material could be obtained. [^{14}C]-residues in the top 0–15 cm of soil were 0.276 mg eq./kg on the day of application and declined to 0.045 mg eq./kg by the final barley grain and straw harvest at 582 days after treatment. The decline in soil [^{14}C] residues appeared biphasic with a rapid initial phase (0 to 120 days) having a half-life of 63 days, and a slow secondary phase (120 to 582 days) with a half-life of 511 days. Following application of [^{14}C]-MCPA at 0.84 kg ai/ha, radioactive residues were generally highest in lettuce (0.044 mg eq./kg) at the first harvest from the 120-day plant back interval and lowest in barley grain, turnip roots and tops (< 0.013 mg eq./kg, LOD) at all plant back intervals. For lettuce at the 30-day and 120 day plant-back intervals, residues were greatest at initial sampling (0.029 or 0.044 mg eq./kg), declining to < 0.013 mg eq./kg by the final harvest. For turnip tops and roots and barley grain, residues were non-detectable at all plant-back intervals. Residues in barley forage were detectable at the 30 day plant-back interval (0.017 mg eq./kg), while in barley straw, they were detectable at the 30-day and 120 day plant-back intervals (0.021 and 0.029 mg eq./kg). Residues were all at non-detectable levels at the 365 day plant-back interval. Total MCPA-equivalent residues obtained from rotational crops were below the LOQ at all plant-back intervals. The results of this study indicated that potential for uptake of MCPA residues from the soil by the succeeding crops is low.

Methods of analysis

The Meeting received descriptions and validation data for analytical methods for residues of MCPA in raw agricultural commodities, feed commodities and animal commodities.

The crop and animal methods typically use an initial extraction and hydrolysis step, either with acid, base or enzymatic treatment to hydrolyse any esters. After solvent partition and SPE or GPC clean-up, the MCPA, HMCPA and CCPA are methylated ready for GC-MSD analysis or further clean-up before the GC-MSD analysis. After solvent partition and SPE clean-up, reaction with acidic methanol yields the methyl ester and methyl ether derivatives which are analysed by GC/MSD or hydrolysed to MCPA free acid and HMCPA mono-methyl ether for analysis by LC/MS. MCPA residues can be measured in most matrices to an LOQ of 0.01 to 0.05 mg/kg. All methods are considered sufficiently validated for the determination of MCPA, CCPA and HMCPA including conjugates, esters and salts thereof.

The multi-residue method included in the Pesticide Analytical Manual was suitable for enforcement of MCPA residues in a variety of commodities.

Stability of residues in stored analytical samples

The Meeting received information on the freezer storage stability of residues of MCPA in plant and animal commodities.

Storage stability studies conducted on cereal and grass commodities demonstrated that MCPA DMA, HMCPA, CCPA and MCPA 2-EHE are stable for up to 12 months in wheat forage, straw and grain, and grass forage and hay samples. MCPA DMA, HMCPA and MCPA 2-EHE are stable up to 17.5 months in wheat flour samples except CCPA stable up to about 14 months. Storage stability studies on cereal green plants, grain and straw showed that MCPA and HMCPA are stable in samples for up to 18 months.

In animal commodities the storage stability studies on MCPA, conducted concurrently with a cattle feeding study, confirmed that residues of MCPA are stable when stored frozen up to at least 4 months in liver and milk, 5 months in kidney and fat, and 3 months in muscle samples. Samples from the metabolism study showed that MCPA and MCPA-glycine (milk only) were stable in frozen storage up to about 46 weeks.

Definition of the residue

The composition of the residue in the metabolism studies, the available residue data in the supervised trials, the toxicological significance of metabolites, the capabilities of enforcement analytical methods and the national residue definitions already operating all influence the decision on residue definition.

A metabolism study showed unchanged parent MCPA comprised the main residue in animal tissues. The major component of residue in milk was MCPA-glycine and wasn't found in any other animal tissues. The Meeting decided that for animal commodities, parent MCPA is the appropriate residue of concern for MRL enforcement, and parent MCPA and its conjugates is the appropriate residue of concern for dietary risk assessment.

The metabolism of MCPA was investigated in wheat and peas. Unchanged parent compound formed the major part of the residue in these studies except wheat grain. CCPA was the major part of residue in wheat grain, but is 5 times less toxic than parent. A certain percentage of the parent residue was present in conjugated form, as uncleaved MCPA 2-EHE (in forage only) or was only released after hydrolysis (forage 15–60%, straw 40–73%, grain 76–85%). Since unconjugated parent MCPA was found in all plant commodities investigated, the Meeting concluded the parent substance is a suitable marker for enforcement purposes in plant commodities and could easily be implemented in multi-residue methods. For dietary intake assessment MCPA-conjugates and esters are easily cleaved and bioavailable. Therefore the Meeting decided to also include conjugates and esters into the residue definition for intake assessment for plant commodities.

The maximum octanol-water partition coefficient of MCPA (log K_{OW} = -0.81–0.71 at pH 7) implied that MCPA may be not fat-soluble. In the goat metabolism study, TRRs in fat and muscle were at similar levels. Based on the above information, the Meeting agreed that MCPA is not fat-soluble.

Definition of the residue (for compliance with the MRL for plant and animal commodities): *MCPA.*

Definition of the residue (for estimation of dietary intake for plant commodities): *Sum of MCPA, its conjugates and esters, expressed as MCPA.*

Definition of the residue (for estimation of dietary intake animal commodities): *Sum of MCPA and its conjugates, expressed as MCPA.*

The residue is considered as not fat-soluble.

Results of supervised residue trials on crops

The Meeting received supervised trials data for MCPA using 2-EHE, DMA salt, sodium salt and potassium salt formulations for barley, wheat, corn, peas (legume vegetable and pulses), flax and grasses. Although the residue definition for compliance with MRLs is MCPA only, the analytical methods used in the supervised trials include hydrolysis steps that release the conjugates and the esters.

The OECD calculator was used as a tool in the estimation of the maximum residue level from the selected residue data set obtained from the supervised trials. As a first step, the Meeting reviewed all relevant factors related to each data set in arriving at a best estimate of the maximum residue level using expert judgement. Then the OECD calculator was employed. If the statistical calculation spreadsheet suggested a different value from that recommended by the Meeting, a brief explanation of the deviation was supplied.

Peas (legume vegetables)

The GAP of the USA for the DMA salt and MCPA Sodium salt, SL formulation, is one spray application at 0.13–0.42 kg ae/ha at 3 node stage up to before flowering. Three trials were carried out in USA in 1996. Residues in green peas without pods were: < 0.01 (3) mg/kg. Three trials were carried out in the USA in 1996 and 2005 in which residues in green peas with pods were: < 0.03 (3) mg/kg.

The Meeting considered the residue data for peas with pods and residue data for peas without pods were insufficient upon which to base a recommendation.

Peas (dry)

The GAP for dry peas in the USA (DMA salt and MCPA Sodium salt, SL formulation) is one spray application at 0.13–0.42 kg ae/ha at the 3 node stage up to before flowering.

In eight trials on peas from Canada matching the US GAP residues in dry peas were: < 0.01(8) mg/kg.

The Meeting estimated a maximum residue level and STMR value for MCPA in dry peas of 0.01* and 0 mg/kg, respectively.

Barley and wheat

The GAP for the UK is for one spray application at 1.7 kg ae/ha at BBCH 30(DMA salt SL formulation). Four barley trials were conducted in France and the UK matching the GAP of the UK. In the trials residues in barley grain were < 0.05 (4) mg/kg.

The GAP in Spain (DMA salt SL formulation), is for one spray application at 1.2 kg ae/ha at BBCH 30. Four barley trials were conducted in France and Spain in line with Spanish GAP. The residues in barley were: < 0.05 (3) and 0.12 mg/kg.

The GAP for the UK is for one spray application at 1.7 kg ae/ha at BBCH 31 (DMA salt SL formulation). Five wheat trials were conducted in France and the UK in line with the UK GAP. The residues in wheat were: < 0.05 (4) and 0.16 mg/kg.

The GAP in Spain consists of one spray application at 1.2 kg ae/ha at BBCH 31 (Sodium or potassium salt SL formulation). Four wheat trials were conducted in France and Spain in line with Spanish GAP. Residues found in wheat grain were: < 0.05 (4) mg/kg.

The Meeting noted that MCPA applied to barley and wheat before flowering results in comparable residues and agreed to combine all data from France and the UK against the UK GAP to support a maximum residue level for grain of barley, oats, rye, triticale and wheat. The residues found, median underlined, were: < 0.05(11) and 0.16 mg/kg.

The Meeting estimated a maximum residue level and an STMR in the cereals grains barley, oats, rye, triticale and wheat of 0.2 and 0.05 mg/kg, respectively.

Maize

The GAP of Canada consists of one spray application at 0.55 kg ae/ha (DMA salt SL formulation); one spray application at 0.6 kg ae/ha, at 15 cm height stage (MCPA sodium salt SL formulation). All eight trials in Canada were treated at 1.5× the maximum rate and resulted in non-detectable residues in maize grain: < 0.01(8) mg/kg.

The Meeting estimated a maximum residue level and an STMR for MCPA in maize grain of 0.01* and 0 mg/kg, respectively.

Flax seeds

The GAP of Canada consists of one spray application at 0.41–0.875 kg ae/ha, before bud stage (MCPA 2-EHE EC formulation, DMA salt SL formulation, and MCPA sodium salt SL formulation). In six trials on flax against the Canadian GAP residues in linseeds were: < 0.01(6) mg/kg for MCPA.

The Meeting estimated a maximum residue level and an STMR value for MCPA in flax seeds of 0.01* and 0 mg/kg, respectively.

Animal feedstuffs

Pea forage

The GAP of the USA (DMA salt and MCPA sodium salt, SL formulation), consists of one spray application at 0.13–0.42 kg ae/ha at the 3 node stage up to before flowering. Two trials on pea were carried out in Canada against the US GAP. The ranked order of residues on pea forage was: < 0.25 and 0.42 mg/kg.

The Meeting considered the residue data for peas forage to be insufficient upon which to base recommendations.

Pea hay

The GAP of the USA (DMA salt and MCPA Sodium salt, SL formulation), consists of one spray application at 0.13–0.42 kg ae/ha at 3 node stage up to before flowering. Two trials on pea were carried out in Canada against the US GAP. The residues in pea hay were: 0.74 and 1.97 mg/kg (fresh weight).

The Meeting considered the residue data for pea hay to be insufficient upon which to base a maximum residue level recommendation.

Barley, oats, rye, triticale and wheat forage

The GAP of the UK (DMA salt SL formulation), is one spray application at 1.7 kg ae/ha at BBCH 30. Two trials on barley and wheat each were carried out in France and the UK matching UK GAP. The ranked order of concentrations on barley forage (fresh weight) was: 4.2, 4.3, 7.5 and 23 mg/kg.

The GAP of Spain (DMA salt SL formulation), consists of one spray application at 1.2 kg ae/ha; (MCPA sodium or potassium salt SL formulation), one spray application at 1.2 kg ae/ha, at

BBCH 30 stage. Four trials on barley and wheat were carried out in Spain against Spanish GAP. The residues found on barley forage were: 0.6, 1.1, 1.4 and 5.1 mg/kg.

The GAP of Canada (MCPA 2-EHE EC formulation), is one spray application at 0.35–0.88 kg ae/ha; or one spray application at 0.63–0.88 kg ae/ha (DMA salt SL formulation); or one spray application at 0.45–0.83 kg ae/ha (MCPA sodium salt SL formulation), at 15 cm height stage. The GAP of the USA (MCPA 2-EHE EC formulation and DMA salt SL formulation) consists of one spray application at 0.88 kg ae/ha at early boot stage.

In 25 trials on wheat forage from Canada (15 trials) and the USA (10 trials) at about double the maximum rate of the Canadian or US GAP, residues were: 3.08, 3.18, 3.46, 4.13, 5.38, 5.48, 5.55, 5.82, 6.37, 7.14, 7.15, 7.36, 7.73, 7.94, 8.30, 8.74, 9.02, 9.12, 9.75, 9.79, 11.0, 12.6, 12.8, 13.6 and 21.2 mg/kg

The residues were scaled to the application rates authorised by Canada and the USA were calculated by dividing by 2 (1.85 kg ae/ha / 0.88 kg ae/ha) and were (n = 25): 1.56, 1.57, 1.70, 2.09, 2.45, 2.66, 2.76, 2.89, 3.01, 3.38, 3.81, 3.87, <u>3.93</u>, 4.09(2), 4.43, 4.51, 4.69, 4.72, 4.91, 5.19, 6.03, 6.59, 7.00 and 9.52 mg/kg.

The Meeting considered the residue data for barley and wheat forage from European trials matching the UK GAP to be insufficient, and agreed to base the estimations on the Canadian dataset and to extrapolate the estimated values to oats, rye and triticale.

The Meeting estimated an STMR and a highest residue values for MCPA in barley, oats, rye, triticale and wheat forage of 3.93 and 9.52 mg/kg.

Maize forage

The GAP of Canada consists of one spray application at 0.55 kg ae/ha (DMA salt SL formulation), or one spray application at 0.6 kg ae/ha at 15 cm height stage (MCPA sodium salt SL formulation). No trials in Canada complied with the Canadian GAP.

The Meeting considered the residue data for maize forage to be insufficient upon which to base an estimate.

Grass forage

The GAP of the USA, consists of either one spray application at 1.6–2.1 kg ae/ha at early bud to full bloom stage (MCPA 2-EHE EC formulation) or, one spray application at 1.7 kg ae/ha when grasses begin to tiller or before heads come to boot stage (MCPA DMA salt, SL formulation). All eight trials on grasses were carried out in the US matched GAP. The residues on grass forage, median underlined, in ranked order were: 16.4, 21.0, 31.0, <u>40.5</u>, <u>53.5</u>, 70.2, 94.3 and 108 mg/kg.

The GAP in Spain consists of one spray application at 1.2–1.6 kg ae/ha targeting weeds in active growth stage (DMA salt SL formulation). Four trials on grasses were carried out in France and Spain matching Spanish GAP. The residues in forage were: 3.70, 6.60, 11.0 and 19.0 mg/kg.

The Meeting noted that the US trials resulted in higher residues in grass forage and decided to use the US data to estimate a STMR and a highest residue values for MCPA in grass forage of 47 and 108 mg/kg, respectively.

Grass hay

The GAP of the USA consists of one spray application at 1.6–2.1 kg ae/ha at early bud to full bloom stage (MCPA 2-EHE EC formulation), or one spray application at 1.7 kg ae/ha when grasses begin to tiller or before heads come to boot stage (MCPA DMA salt, SL formulation). Eight trials on grasses were carried out in US matching GAP. The residues on grass hay, median underlined, in ranked order were: 37.4, 40.3, 42.5, <u>68.0</u>, <u>80.7</u>, 94.8, 196 and 217 mg/kg (air dry).

Based on an average dry-mass of 88% residues in grass hay (dry weight) were: 42.5, 45.8, 48.3, 77.3, 91.7, 107.7, 222.7 and 246.6 mg/kg.

The Meeting estimated a maximum residue level, an STMR and a highest residue for MCPA in grass hay of 500 mg/kg (DM based), 74.35 mg/kg and 217 mg/kg (air dry), respectively.

Straw and fodder of cereal grain (dry)

Barley, oat, rye, triticale and wheat hay

The GAP of Canada for barley consists of one spray application at 0.35–0.88 kg ae/ha (MCPA 2-EHE EC formulation), or one spray application at 0.63–0.88 kg ae/ha (DMA salt SL formulation), or one spray application at 0.45–0.83 kg ae/ha, at early flag leaf stage (MCPA Sodium salt SL formulation). In two trials in Canada matching the GAP the residues on barley hay were: 5.18 and 6.61 mg/kg.

The GAP in Canada on wheat consists of one spray application at 0.35–0.88 kg ae/ha (MCPA 2-EHE EC formulation); or, one spray application at 0.63–0.88 kg ae/ha (DMA salt SL formulation); or, one spray application at 0.45–0.83 kg ae/ha, at 15 cm height stage (MCPA sodium salt SL formulation). The US GAP on wheat consists of, one spray application at 0.88 kg ae/ha at early boot stage (MCPA 2-EHE EC formulation and DMA salt SL formulation). In 25 wheat trials from Canada (15 trials) and US (10 trials) treated at about 2× the maximum GAP rate of Canadian and the US residues were: 4.25, 6.68, 7.34, 8.09, 10.9, 11.3(2), 13.5, 14.6, 15.7(2), 16.7, 19.8, 20.9, 21.6, 23.3, 26.5, 30.6, 30.7, 30.9, 32.7, 35.5, 49.3, 50.5 and 66.0 mg/kg (air dry).

The residues scaled to the application rates authorised by Canada and the USA were calculated by dividing by 2 (1.85 kg ae/ha / 0.88 kg ae/ha) and were (n = 25): 2.15, 3.03, 3.91, 4.07, 5.00, 5.39, 5.56, 7.12, 7.20, 7.30, 7.85, 8.35, 10.5, 10.8, 11.2(2), 12.5, 14.4, 14.7, 15.8, 16.1, 16.5, 24.3, 26.3 and 28.9 mg/kg.

Barley, oat, rye, triticale and wheat straw

The GAP of the UK is one spray application at 1.7 kg ae/ha at BBCH 30 stage (DMA salt SL formulation). In 12 trials on barley and wheat carried out in Austria, France and the UK matching UK GAP. The residues on barley straw were: < 0.05(3), 0.07, 0.22, 0.28 and 1.04 mg/kg. The residues on wheat straw were: < 0.05(2), 0.05, 0.09 and 0.22 mg/kg.

The GAP of Spain consists of one spray application at 1.2 kg ae/ha (DMA salt SL formulation), or one spray application at 1.2 kg ae/ha, at BBCH 30 stage (MCPA sodium or potassium salt SL formulation). Nine trials on barley were carried out in France and Spain matching Spanish GAP. The residues on barley straw were: < 0.05(4) and 0.24 mg/kg. The residues on wheat straw were: < 0.05(4) mg/kg.

The GAP of Canada on barley consists of one spray application at 0.35–0.88 kg ae/ha (MCPA 2-EHE EC formulation); or, one spray application at 0.63–0.88 kg ae/ha (DMA salt SL formulation); or one spray application at 0.45–0.83 kg ae/ha (MCPA sodium salt SL formulation), at early flag leaf stage In 36 trials matching Canadian GAP the residues on barley straw, median underlined, were: < 0.25(34), 0.25 and 0.29 mg/kg.

The GAP of Canada on wheat consists of one spray application at 0.35–0.88 kg ae/ha (MCPA 2-EHE EC formulation); or one spray application at 0.63–0.88 kg ae/ha (DMA salt SL formulation); or one spray application at 0.45–0.83 kg ae/ha (MCPA sodium salt SL formulation), at 15 cm height growth stage. The GAP of the USA consists of, one spray application at 0.88 kg ae/ha at early boot stage (MCPA 2-EHE EC formulation and DMA salt SL formulations). In wheat trials from Canada (15) and US (10) treatment rates were 2× the maximum rate of Canadian and US GAP. Residues found, in ranked order were: < 0.25(6), 0.31, 0.34, 0.37, 0.42, 0.65, 0.82, 1.16, 1.30, 1.62, 1.72, 1.73, 2.51, 2.99, 3.65, 3.98, 4.93, 5.54, 7.19 and 11.3 mg/kg.

Based on an average dry-mass of 88% residues in wheat hay (dry weight) were: 2.44, 3.44, 4.44, 4.63, 5.68, 6.13, 6.32, 8.09, 8.18, 8.30, 8.92, 9.49, 11.9, 12.3, 12.7(2), 14.2, 16.4, 16.7, 18.0, 18.3, 18.8, 27.6, 29.9 and 32.8 mg/kg.

The Meeting noted that higher residues data came from the scaled datasets at 2× US and Canadian GAPs on wheat hay. Based on wheat hay, the Meeting agreed to estimate a maximum residue level, a highest residue and an STMR for MCPA on wheat hay of 50 (DW), 28.9 and 10.5 mg/kg, and extrapolate them to straw of barley, oat, rye and triticale.

Maize fodder, dry

The GAP of Canada consists of, one spray application at 0.55 kg ae/ha (MCPA DMA salt SL formulation); or one spray application at 0.60 kg ae/ha (MCPA sodium salt SL formulation), at the 15 cm height stage. Eight trials were carried out in Canada at 1.5× the maximum rate and resulted in residues in maize stover of < 0.25(8) mg/kg.

Based on an average dry-mass of 83%, residues in maize fodder (dry weight) were: < 0.30(8) mg/kg.

The Meeting estimated an STMR and a highest residue for MCPA in maize stover of 0 mg/kg (fresh weight) and recommended a maximum residue level of 0.3 mg/kg for maize fodder, dry.

Fate of residues during processing

The Meeting received information on the fate of MCPA residues during the food processing of wheat grain.

Calculated processing factors are summarized in the following table. Factors are indicated with a "<" (less than) sign when the residue in the processed commodity is below the LOQ of the analytical method. The calculation is then made on the LOQ of the analytical method and the residue concentration of the RAC (raw agricultural commodity).

Processed Fractions	MCPA DMA salt	MCPA 2-EHE	Average process factor	Wheat grain STMR (mg/kg)	STMR-P (mg/kg)
Germ	0.67	0.29	0.48		0.024
Bran	0.67	0.29	0.48	0.05	0.024
Flour	0.67	0.29	0.48		0.024

Residues in animal commodities

Farm animal feeding

The Meeting received lactating dairy cow feeding studies, which provided information on likely residues resulting in animal tissues and milk from residues in the animal diet. Animals were orally administered the equivalent to 50(1×), 150(3×), and 500(10×) ppm in feed on a dry weight basis.

Residues of MCPA in whole milk in the 50, 150 and 500 ppm groups were < 0.01 mg/kg, < 0.01 mg/kg and 0.015–0.023 mg/kg (average values) respectively. In muscle, for the same groups, residues were < 0.05 mg/kg, < 0.05 mg/kg, and < 0.05–0.08 mg/kg respectively. Residues of MCPA in fat were < 0.05 mg/kg, < 0.05–0.17 mg/kg and < 0.05–0.13 mg/kg respectively. Residues of MCPA in liver were < 0.05 mg/kg, < 0.05–0.09 mg/kg and 0.16–0.28 mg/kg respectively. Residues in kidney were 0.28–0.41 mg/kg, 0.60–1.23 mg/kg and 1.66–2.44 mg/kg respectively.

In a hen metabolism study [^{14}C]-MCPA was fed at 100 ppm in the diet for 7 consecutive days. Residue levels in edible tissues and eggs were 0.004 mg/kg in fat, 0.006 mg/kg in muscle, 0.0663 mg/kg in liver, and 0.156 mg/kg in eggs.

Estimated maximum and mean dietary burdens of farm animals

Dietary burden calculations for beef cattle, dairy cattle, broilers and layer are provided in Annex 6. The calculations were made according to the animal diets from US-Canada, EU, Australia and Japan in the OECD Feed Table 2009.

The calculations are then summarized and the highest dietary burdens are selected for MRL and STMR estimates on animal commodities.

	Animal dietary burden, MCPA, ppm of dry matter diet							
	US-Canada		EU		Australia		Japan	
	max	mean	max	mean	max	mean	max	mean
Beef cattle	37.0	12.7	216	94.0	432 [a]	188 [b]	107.9	39.0
Dairy cattle	194.4	84.6	259.2	112.8	432 [c]	188 [d]	191.2	69.5
Poultry-broiler	0.043	0.043	0.04	0.043	0.009	0.009	0.006	0.006
Poultry-layer	0.043	0.043	43.3 [e]	18.9 [f]	0.009	0.009	-	-

[a] Highest maximum beef or dairy cattle dietary burden suitable for MRL estimates for mammalian meat.

[b] Highest mean beef or dairy cattle dietary burden suitable for STMR estimates for mammalian meat.

[c] Highest maximum dairy cattle dietary burden suitable for MRL estimates for mammalian milk.

[d] Highest mean dairy cattle dietary burden suitable for STMR estimates for mammalian milk.

[e] Highest maximum poultry dietary burden suitable for MRL estimates for poultry meat and eggs.

[f] Highest mean poultry dietary burden suitable for STMR estimates for meat and eggs.

Both the highest maximum dietary burden (432 ppm) and the mean dietary burden for cattle (188 ppm) is greater than the actual 3× dose in the feeding study (150 ppm) and lower than the actual 10× dose in the feeding study (500 ppm). The MRL and STMR values were estimated by interpolation of data between dose levels.

Tabulated below are the calculations of maximum residue levels and STMRs for milk and animal tissues.

	Feed level (ppm) for milk residues	Residues (mg/kg) in milk	Feed level (ppm) for tissue residues	Residues (mg/kg) in			
				Muscle	Liver	Kidney	Fat
Maximum residue level beef or dairy cattle							
Feeding study[a]	500/150	0.043/< 0.01	500/150	0.08/0.08	0.28/0.09	2.44/1.20	0.17/0.13
Dietary burden and residue estimate	432	0.035	432	0.08	0.25	2.20	0.16
STMR beef or dairy cattle							
Feeding study[b]	500/150	0.043/< 0.01	500/150	0.08/< 0.08	0.28/0.09	2.44/1.20	0.17/0.13
Dietary burden and residue estimate	188	0.013	188	0.08	0.10	1.33	0.13

[a] Highest residue for tissues and mean residue for milk

[b] Mean residues for tissue and milk

The Meeting estimated maximum residue levels of 0.1 mg/kg for meat from mammals other than marine mammals, 0.2 mg/kg for mammalian fat, 3 mg/kg for mammalian edible offal, and 0.04 mg/kg for milks. The Meeting estimated STMRs of 0.08 mg/kg for meat from mammals other than marine mammals, 0.13 mg/kg for mammalian fat, 1.33 mg/kg for mammalian edible offal, 0.013 mg/kg for milks. The Meeting estimated HRs of 0.08 mg/kg for meat from mammals other than marine mammals, 0.16 mg/kg for mammalian fat and2.20 mg/kg for mammalian edible offal.

Residues in poultry tissues and eggs are estimated using the data from the poultry metabolism study in which the dose rate was 100 ppm and the highest and mean residues in tissues and eggs were determined.

Estimation of residues in poultry tissues and eggs.

	Feed level (ppm) for egg residues	Residues (mg/kg) in egg	Feed level (ppm) for tissue residues	Residues (mg/kg) in		
				Muscle	Liver	Fat
Maximum residue level broiler or layer poultry						
Feeding study[a]	100	0.156	100	0.006	0.0663	0.004
Dietary burden and residue estimate	43.3	0.068	43.3	0.003	0.029	0.002
STMR broiler or layer poultry						
Feeding study[b]	100	0.156	100	0.006	0.0663	0.004
Dietary burden and residue estimate	18.9	0.029	18.9	0.001	0.0125	0.0008

[a] Highest residue for tissues and mean residue for egg

[b] Mean residues for tissue and egg

The Meeting noted that the LOQ of analytical method is 0.05 mg/kg, and agreed to estimate maximum residue levels of 0.05* mg/kg for poultry meat (fat), poultry edible offal and for eggs. The Meeting estimated STMRs of 0.05 mg/kg for poultry meat, poultry fat, edible offal and for eggs. The Meeting estimated HRs of 0.05 mg/kg for poultry meat, poultry fat, edible offal and for eggs.

RECOMMENDATIONS

On the basis of the data from supervised trials, the Meeting concluded that the residue concentrations listed below are suitable for establishing MRLs and for assessing IEDIs and/or IESTIs.

Definition of the residue (for compliance with the MRL for plant and animal commodities): *MCPA*.

Definition of the residue (for estimation of dietary intake for plant commodities): *Sum of MCPA, its conjugates and esters, expressed as MCPA.*

Definition of the residue (for estimation of dietary intake animal commodities): *Sum of MCPA and its conjugates, expressed as MCPA.*

The residue is considered not fat-soluble.

CCN	Commodity	MRL (mg/kg)	STMR (mg/kg)	HR (mg/kg)
GC 0640	Barley grain	0.2	0.05	
AS 0641	Barley straw and fodder, dry	50	10.5[a]	28.9[a]
PE 0112	Eggs	0.05 *	0.05	0.05
SO 4711	Flax-seed	0.01 *	0	

CCN	Commodity	MRL (mg/kg)	STMR (mg/kg)	HR (mg/kg)
AS 0162	Hay of grasses, dry	500	74.35[a]	217[a]
MO 0105	Edible offal (mammalian)	3	1.33	2.20
GC 0645	Maize grain	0.01 *	0	
AS 0645	Maize straw and fodder, dry,	0.3	0.25[a]	0.25[a]
MF 0100	Mammalian fats	0.2	0.13	0.16
MM 0095	Meat from mammals other than marine mammals	0.1	0.08	0.08
ML 0106	Milks	0.04	0.013	0.035
GC 0647	Oat grain	0.2	0.05	
AF 0647	Oat straw and fodder, dry	50	10.5 [a]	28.9[a]
VD 0072	Peas, dry	0.01 *	0	
PM 0110	Poultry meat	0.05 *	0.05	0.05
PF 0110	Poultry fats	0.05 *	0.05	0.05
PO 0111	Poultry, Edible offal of	0.05 *	0.05	0.05
GC 0650	Rye grain	0.2	0.05	
AF 0650	Rye straw and fodder, dry	50	10.5 [a]	28.9 [a]
GC 0653	Triticale grain	0.2	0.05	
AS 0653	Triticale straw and fodder, dry	50	10.5 [a]	28.9 [a]
GC 0654	Wheat grain	0.2	0.05	
AF 0654	Wheat straw and fodder, dry	50	10.5 [a]	28.9 [a]

* At or about the limit of quantification.

[a] fresh weight basis.

Animal commodities and processed foods for which no maximum residue levels were recommended.

CCN	Commodity	STMR or STMR-P (mg/kg)	HR or HR-P (mg/kg)
AF 0649	Barley forage	3.93	9.52
AF 0162	Grass, forage	47	108
AF 0647	Oat forage	3.93	9.52
AF 0650	Rye forage	3.93	9.52
AF 0653	Triticale forage	3.93	9.52
AF 0654	Wheat forage	3.93	9.52
CM 0654	Wheat bran	0.024	
CF 1211	Wheat flour	0.024	
CF 1210	Wheat germ	0.024	

DIETARY RISK ASSESSMENT

Long term intake

The evaluation of MCPA resulted in recommendations for MRLs and STMR values for raw and processed commodities. Data on consumption were available for 19 food commodities and were used to calculate dietary intake. The results are shown in Annex 3 of the 2012 JMPR Report.

The International Estimated Daily Intakes (IEDIs) of MCPA, based on the STMRs estimated, were 0–1% of the maximum ADI of 0.1 mg/kg bw for the thirteen GEMS/Food cluster diets. The Meeting concluded that the long-term intake of residues of MCPA resulting from its uses that have been considered by JMPR is unlikely present a public health concern.

Short-term intake

The IESTI of MCPA calculated on the basis of the recommendations made by the JMPR ranged from 0–5% of the ARfD (0.6 mg/kg bw). The results are shown in Annex 4 of the 2012 JMPR Report.

The Meeting therefore concluded that the short-term intake of MCPA residues, when used in

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