QUIZALOFOP-P-ETHYL

Collaborative Study

Full Scale Collaborative Study
for the
Determination of Quizalofop-p-ethyl
in Technical Material and Emulsifiable Concentrate
by High Performance Liquid Chromatography

Report to CIPAC
by
Anhui Fengle Agrochemical Co., Ltd.
Huang Liang
Hefei Circular Economy Demonstration Park, Feidong County,
Hefei, Anhui, China

May 2020

Content page

1. Participants

Quanzhi Deng	Shanghai pesticide research institute Co., Ltd. No. 333, Shuangbang Road, Xujing Town, Qingpu District, Shanghai, China
Peng Wu	National Center for Pesticide Quality Supervision and Inspection (Beijing), Institute for the Control of Agrochemicals, Ministry of Agriculture and Rural Affairs , P. R. China Maizidian road No.22, Chaoyang district, Beijing, P. R. China.
Liang Wu	ZHEJIANG TIANFENG BIOSCIENCE CO., LTD. 666 Dayan Road, Wucheng District, Jinhua City, Zhejiang Province, China
Liang Huang	Anhui Fengle Agrochemical Co., Ltd. Product Testing Center Hefei Circular Economy Demonstration Park, Feidong County, Hefei, Anhui, China
Xiu'e Yin	Pesticides Test Laboratory Shenyang Research Institute of Chemical Industry Co., Ltd No. 8 Shen Liao East Road, Tie Xi District Shenyang City 110021, P.R. China
Angela Santilio	Italian National Institute of Health - Istituto Superiore di Sanità (ISS) Viale Regina Elena 299, 00161 Rome (Italy)
Ivan Orgei	FRANDESA Co. LTD 8-F Skoriny st., Minsk, 220114, Republic of Belarus.
Xiaoying Liu	Laprode (ZheJiang) Analysis Co., Ltd. 4/F, Building 6, No. 503 Xingguo Road, Yuhang District, Hangzhou, Zhejiang P.R. China.
Hiroka Harada	Agricultural Chemicals Inspection Station Food and Agricultural Materials Inspection Center 2-772, Suzuki, Kodaira City, Tokyo 187-0011 JAPAN
Juntao Zhang	Helm China Co., Ltd. Room 905, Tower 1, Kerry Center Building 1515 Nanjing Road West Shanghai, 200040, P.R. China
Wagener Peter	Bayer CropScience Division Industriepark Höchst G813 65926 Frankfurt-Höchst

	Germany
Aysel Takkabulan	Ankara Plant Protection Central Research Institute Pesticide Control Laboratuary Ankara Directorate of Plant Protection Central Research Institute Gayret Mah. Fatih Sultan Mehmet Bul. No:66 Yenimahalle, Ankara/TURKEY
Maria Chiara Neri	ChemService S.r.l. Controlli e Ricerche Via Fratelli Beltrami, 15 20026 Novate Milanese (MI) Italy
Robin Xiao	Jiangsu BioGuide Laboratory Co., Ltd. 5F, Building D2. No.9, Changyang Road, Wujin Economic Development Zone, Changzhou, Jiangsu, China
Madhuri	BIONEEDS INDIA PRIVATE LIMITED DEVARAHOSAHALLY, SOMPURA HOBLI, NELAMANGALA TALUK, BANGALORE RURAL DISTRICT, PIN - 562 111, KARNATAKA, INDIA.
Agus Salim	Laboratorium PT Agricon Jl. Melati Desa Wanaherang Kec. Gn Putri Cibinong 16965 West Java Indonesia
Yusuf Vohra	Jai Research Foundation Next to Daman Ganga Bridge, Off N.H. No: 48, Valvada, 396105, Dist – Valsad, Gujarat, India

Participants are listed in random sequence, lab numbers in the result tables were assigned insequence of result receipt.

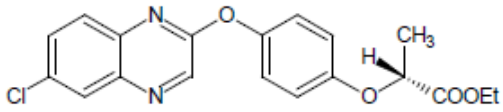
2. Quizalofop-p-ethyl, General Information

Chemical name: ethyl (R)-2-[4-(6-chloroquinoxalin-2-yloxy)phenoxy]propionate

ISO common name: Quizalofop-p-ethyl

CAS-Nr.: 100646-51-3

Structure:



Molecular mass: 372.8

Empirical formula: $C_{19}H_{17}ClN_2O_4$

m.p.: 76.1~77.1 °C

Solubility (g/L, 20°C): In water, 6.1×10^{-4} g/l at 20 °C, pH 5.0-7.0; Xylene, ethyl acetate and acetone > 250g/l, 1,2-dichloroethane > 1000g/l at 22-23 °C; methanol 34.87 g/l, n-heptane 7.168 g/l at 20 °C

Description: Off-white powder

Stability: Stable at neutral and acidity condition.

3. Samples

The participants who completed the study are listed in section 1.
Five test samples, the analytical standard were sent to the participants:

1. TC (Sample A)
2. TC (Sample B)
3. EC formulation (Sample C)
4. EC formulation (Sample D)
5. EC formulation (Sample E)

Quizalofop-p-ethyl analytical standard, 99.3 % purity.

17 participants sent back their results in time.

4. Method

4.1 Scope

The content of Quizalofop-p-ethyl is determined in technical material and emulsifiable concentrate products.

4.2 Principle

The Quizalofop-p-ethyl content of the samples is determined by normal phase HPLC on chiral column using UV detector at 237nm and external standardization.

4.3 Procedure

The samples were analyzed on two different days, each day involving duplicate injections of duplicate weights. Both test and reference solutions were freshly prepared on each day.

5. Remarks of the Participants

Several participants made comments about the performance of the method and noted deviations from the method:

Laboratory 1	Column: Diacel, Dimensions: 4.6mm x 250mm, Chiralcel AD-H, 5µm, Serial No: ADH0CE-XI076 Remarks: Injection volume changed from 1.5µL to 3µL.
Laboratory 2	Column: Chiralcel AD-H, 250mm x 4.6mm (id), 5µm, serial No.: ADOHCE-XH017 Remarks: None
Laboratory 3	Column: Diacel, Chiralcel OD-H, 250mm x 4.6mm (id), 5µm, serial No.: ODH0CE-LJ097 Remarks: Column: Chiralcel AD-H was replaced by Chiralcel OD-H. Mobile phase: n-heptane+isopropanol =99:1 was used in the revised method. Injection volume: 5µL was injected in the revised method.
Laboratory 4	Column: CHIRALPAK AD-H, DAICEL, 4.6mm x 250mm, Lot No.ADH0CE-QD122 Remarks: None
Laboratory 5	Column: OD-H chiralcel DAICEL/4.6mm/ ODH0ce-SB018 Remarks: Column: OD-H chiralcel, Mobile phase: n-heptane: isopropanol =94:6(v/v), Retention time: approximately 15.6 min.
Laboratory 6 *	Column: DAICEL ODH 250mm x 4.6mm Remarks: None
Laboratory 7	Column: CHIRALPAK® AY-H 250mm x 4.6mm x 5µm--- Amylose tris(5-chloro-2-methylphenylcarbamate) Remarks: None
Laboratory 8	Column: DAICEL, CHIRALCEL OD-H, Dimensions: 4.6mm x 250mm, Particle Size: 5µm, Serial No. : ODH0CE-RJ034 Remarks: None
Laboratory 9	Column: CHIRALPAK AD-H (Daicel, 4.6mm x 250mm, 5 µm) Remarks: Injection volume can't be set 1.5 µL due to apparatus specifications. Column temperature 30°C.
Laboratory 10	Column: CHIRALPAK AD-H 250mm x 4.6mm, 5µm, Part No. 19325 Remarks: Injection volume 1.5 µL is changed to 5 µL
Laboratory 11	Column: Chiralcel AD-H 5µm, Daicel, 250mm x 4.6mm, Part No. 19325 Remarks: Increased the flow from 0.6 to 0.8 mL/min
Laboratory 12	Column: Dimensions: 250mm x 4.6mm, CHIRALPAK AD-H, Part No: 19325 Particle Size: 5µm Remarks: Run-time for each injection was determined as 20 minutes.
Laboratory 13	Column: Daicel Corporation, Chiralpak AD-H, 4.6mm x 250mm, 5µm. Lot number ADH0CE-XH094 Remarks: None
Laboratory 14	Column: CHIRALPAK, AD-H, 250mm x 4.6mm x 5µm, Part No.: 20325 Remarks: None
Laboratory 15	Column: Diacel, Dimensions: 250mm x 4.6mm, 5 µm, Serial Number:19325

Remarks: Injection volume changed to 5 µL Instead of 1.5 µL

Laboratory 16 Column: Phenomenex Lux® 5 µm Amylose-2, Dimension: 250mm x 4.6mm (i.d), S/No: H16-374037, Part No: OOG-4472-EO
Remarks: Column HPLC used not similar column in reference method. Isopropanol change with ethanol, to get better peak chromatogram; diluting the solution, both standard and sample, 10 times, and the volume of the injection became 50µL. Flow rate was changed from 0.6 to 0.8 mL/min.

Laboratory 17 Column: Chiralpak AD-H, 250mm x 4.6mm (i.d), 5.0 µ particle size
Remarks: Injection volume was changed from 1.5 µL to 2.0 µL.

*: The data of Lab 6 is not usable. Because the chromatographic column was changed to DAICEL ODH 250mm x 4.6mm, the mobile phase was not adjusted accordingly, the enantiomers were not separated completely.

6. Evaluation and Discussion

6.1 Evaluation of the Quality of Data and Chromatograms

The data obtained from each of the laboratories were reviewed to determine if there were any significant deviations regarding the chromatography which might affect the analysis results.
All other changes and observations noted by the participants were not expected to affect the analysis results significantly.

6.2 Determination of Quizalofop-p-ethyl

Results reported by the laboratories and the statistical evaluation are listed in tables 1-5 and displayed in figures 1-5.

The statistical evaluation of the data was done following the “Guidelines for CIPAC Collaborative Study Procedures for Assessment of Performance of Analytical Methods”, according to DIN ISO 5725. The testing for outliers/stragglers of the laboratory means values were performed according to Grubbs test on a 1%/5% significance level, respectively. The Grubbs test identified stragglers and outliers for the EC formulations as well as for the technical material (marked with $^{+}/^{++}$ in Table 2).

All results reported by the 16 laboratories are reported and the statistical evaluation of these are listed in Tables 1-3 and displayed in Figures 1-5(The data of Lab 6 is not usable). These results are reported without any exclusion of outliers and/or stragglers.
In addition, a separate evaluation, listed in Table 4-5, display the results with the exclusion of stragglers and outliers.

A comparison of the RSD_R of this collaborative study with the unmodified Horwitz equation showed that the relative reproducibility standard deviation (RSD_R) is below the Horwitz value in all five samples even without elimination of stragglers and outliers (see Table 3). The RSD_R is further improved if stragglers and outliers are removed (see Table 4 and 5). No more than one value has been removed per sample (Table 5). The validity of the results and the suitability of the analytical method are shown. This collaborative trial is acceptable.

Table1: Quizalofop-p-ethyl assay in TC and EC (g/kg); results for each laboratory on day 1 and day 2

	Quizalofop-p-ethyl Sample A		Quizalofop-p-ethyl Sample B		Quizalofop-p-ethyl Sample C		Quizalofop-p-ethyl Sample D		Quizalofop-p-ethyl Sample E	
	Day1	Day2	Day1	Day2	Day1	Day2	Day1	Day2	Day1	Day2
Laboratory 1	993.1	994.3	992.0	988.6	102.8	102.2	105.1	104.4	104.3	104.8
Laboratory 2	983.4	984.5	987.3	986.5	98.4	98.7	99.6	100.3	98.6	98.5
Laboratory 3	994.4	992.2	988.2	988.8	99.6	98.8	99.5	99.9	98.5	98.5
Laboratory 4	990.0	990.1	991.3	990.3	99.0	98.8	100.3	100.1	99.6	99.6
Laboratory 5	990.9	989.8	988.8	988.6	101.4	101.1	102.2	102.2	102.1	101.8
Laboratory 6	n.u.*	n.u.*	n.u.*	n.u.*	n.u.*	n.u.*	n.u.*	n.u.*	n.u.*	n.u.*
Laboratory 7	1004.8	985.8	980.5	978.9	100.2	101.3	105.4	103.0	103.7	102.2
Laboratory 8	995.6	993.6	997.9	992.1	100.5	99.8	101.5	101.5	102.8	101.8
Laboratory 9	1010.0	1011.0	1006.0	1001.0	99.0	100.0	101.0	101.0	100.0	100.0
Laboratory 10	983.3	987.7	992.6	993.2	97.0	98.5	99.0	99.8	96.9	98.4
Laboratory 11	992.4	992.3	995.1	997.8	99.0	99.3	100.5	100.9	99.7	100.0
Laboratory 12	978.9	985.4	1002.7	1002.7	99.1	99.6	100.7	101.3	99.3	101.1
Laboratory 13	986.2	981.6	987.1	983.4	99.0	98.4	99.9	99.1	100.5	99.7
Laboratory 14	980.6	982.7	992.0	991.0	98.7	98.9	102.1	101.1	100.3	100.5
Laboratory 15	986.9	987.8	991.2	990.9	100.3	100.1	100.1	100.1	101.5	102.0
Laboratory 16	987.8	993.8	990.7	988.7	99.1	100.5	100.2	101.3	100.3	102.0
Laboratory 17	988.2	985.4	986.9	986.4	101.4	102.8	102.7	103.2	102.3	103.3

*** Result is not usable**

Table 2: Mean values

	Quizalofop-p-ethyl SAMPLE A	Quizalofop-p-ethyl SAMPLE B	Quizalofop-p-ethyl SAMPLE C	Quizalofop-p-ethyl SAMPLE D	Quizalofop-p-ethyl SAMPLE E
Laboratory 1	993.700	990.300	102.500	104.750	104.550
Laboratory 2	983.950	986.900	98.550	99.950	98.550
Laboratory 3	993.300	988.500	99.200	99.700	98.500
Laboratory 4	990.050	990.800	98.900	100.200	99.600
Laboratory 5	990.350	988.700	101.250	102.200	101.950
Laboratory 6	n.u.*	n.u.*	n.u.*	n.u.*	n.u.*
Laboratory 7	995.300	979.700	100.750	104.200	102.950
Laboratory 8	994.600	995.000	100.150	101.500	102.300
Laboratory 9	1010.500$^{+/++}$	1003.500	99.500	101.000	100.000
Laboratory 10	985.500	992.900	97.750	99.400	97.650
Laboratory 11	992.350	996.450	99.150	100.700	99.850
Laboratory 12	982.150	1002.700	99.350	101.000	100.200
Laboratory 13	983.900	985.250	98.700	99.500	100.100
Laboratory 14	981.650	991.500	98.800	101.600	100.400
Laboratory 15	987.350	991.050	100.200	100.100	101.750
Laboratory 16	990.800	989.700	99.800	100.750	101.150
Laboratory 17	986.800	986.650	102.100	102.950	102.800

*** Result is not usable**

$^{+}$ Grubbs Test straggler

$^{++}$Grubbs Test outlier

Table 3: Summary of the statistical evaluationwithoutliers /stragglers

	sample A	sample B	sample C	sample D	sample E
X_m	990.14	991.23	99.79	101.22	100.77
L	16	16	16	16	16
S_r	3.979	1.781	0.583	0.592	0.661
S_R	7.578	6.196	1.373	1.658	1.912
r	11.141	4.987	1.632	1.658	1.851
R	21.218	17.349	3.844	4.642	5.354
RSD_r	0.402	0.180	0.584	0.584	0.656
RSD_R	0.765	0.625	1.376	1.638	1.897
RSD_R(Hor)	2.003	2.003	2.829	2.823	2.825
HorRat	0.382	0.312	0.486	0.580	0.671

Table 4: Summary of the statistical evaluation without outliers

	sample A	sample B	sample C	sample D	sample E
X_m	990.45	991.23	99.79	101.22	100.77
L	15	16	16	16	16
S_r	4.030	1.781	0.583	0.592	0.661
S_R	7.716	6.196	1.373	1.658	1.912
r	11.284	4.987	1.632	1.658	1.851
R	21.605	17.349	3.844	4.642	5.354
RSD_r	0.407	0.180	0.584	0.584	0.656
RSD_R	0.779	0.625	1.376	1.638	1.897
RSD_R(Hor)	2.003	2.003	2.829	2.823	2.825
HorRat	0.389	0.312	0.486	0.580	0.671

Sample A: Results of Lab 9 eliminated.

Table 5: Summary of the statistical evaluation without stragglers

	sample A	sample B	sample C	sample D	sample E
X_m	990.45	991.23	99.79	101.22	100.77
L	15	16	16	16	16
S_r	4.030	1.781	0.583	0.592	0.661
S_R	7.716	6.196	1.373	1.658	1.912
r	13.0256	27.2328	8.1928	4.8776	8.3748
R	15.0864	27.4876	8.8116	9.4724	14.1988
RSD_r	0.407	0.180	0.584	0.584	0.656
RSD_R	0.779	0.625	1.376	1.638	1.897
RSD_R(Hor)	2.003	2.003	2.829	2.823	2.825
HorRat	0.389	0.312	0.486	0.580	0.671

Sample A: Results of Lab 9 eliminated.

x_m=overall sample mean
L = number of laboratories
s_r = repeatability standard deviation
RSD_r = relative repeatability standard deviation
R = repeatability limit
s_R = reproducibility standard deviation
RSD_R = relative reproducibility standard deviation
R = reproducibility limit
RSD_R(Hor) = relative reproducibility standard deviation (Horwitz equation)
HorRat (Horwitz Ratio) = RSD_R/RSD_R (Hor)

Figures 1 – 5(all results except lab 6)

Fig. 1:

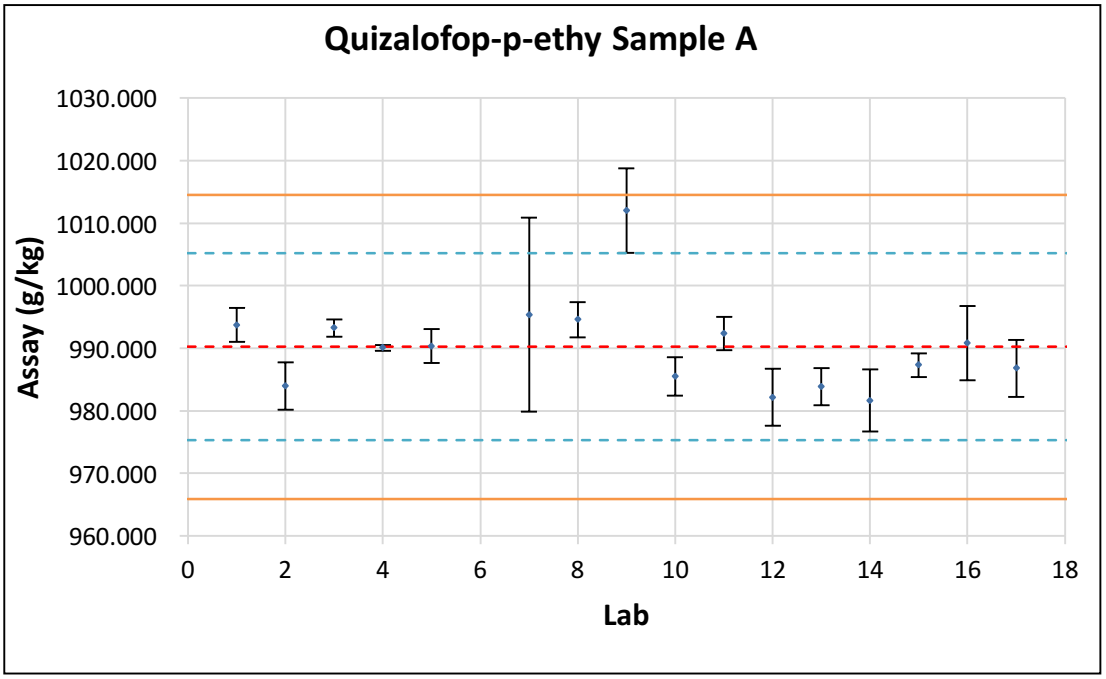


Fig. 2:

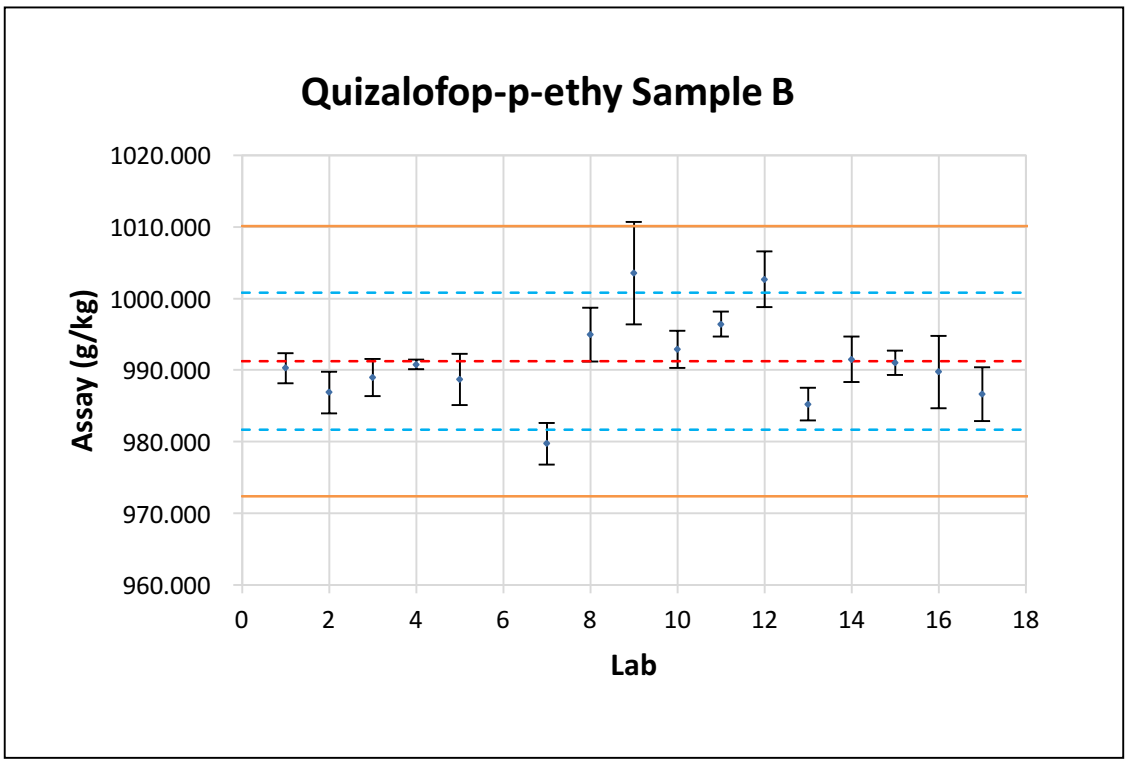


Fig. 3:

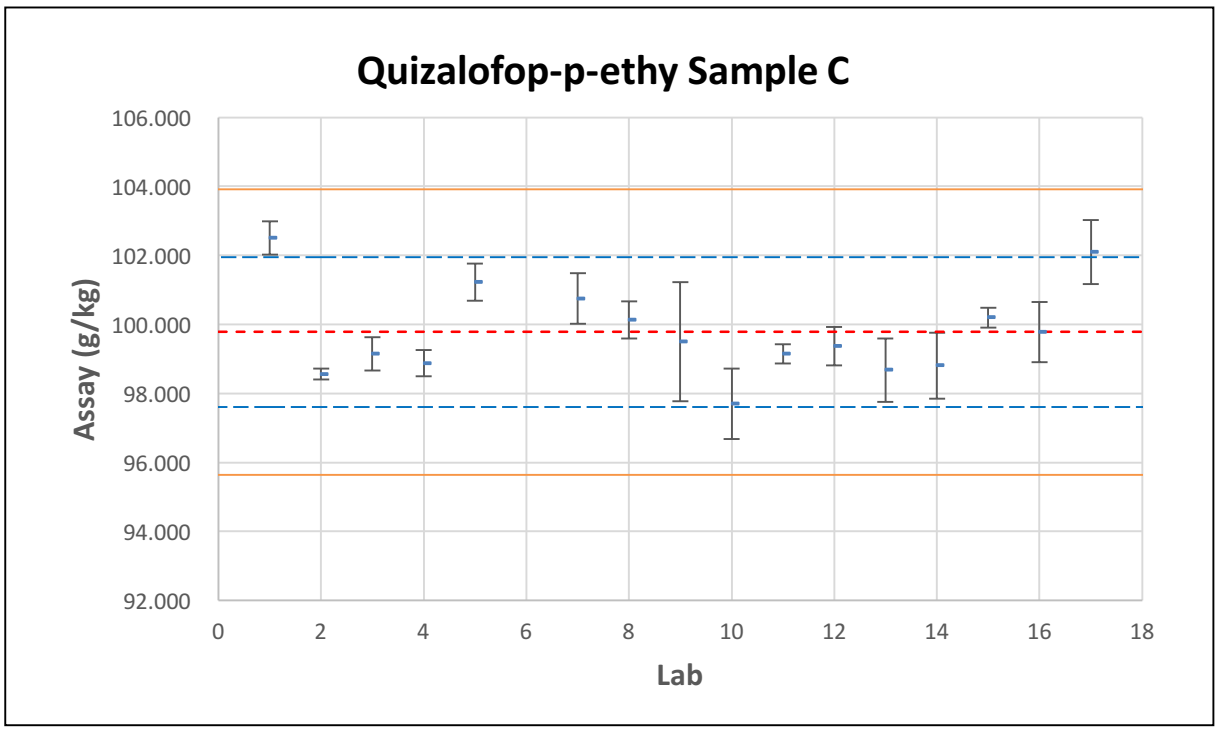

Quizalofop-p-ethy Sample C
Assay (g/kg)
106.000
104.000
102.000
100.000
98.000
96.000
94.000
92.000
0
2
4
6
8
10
12
14
16
18
Lab

Fig. 4:

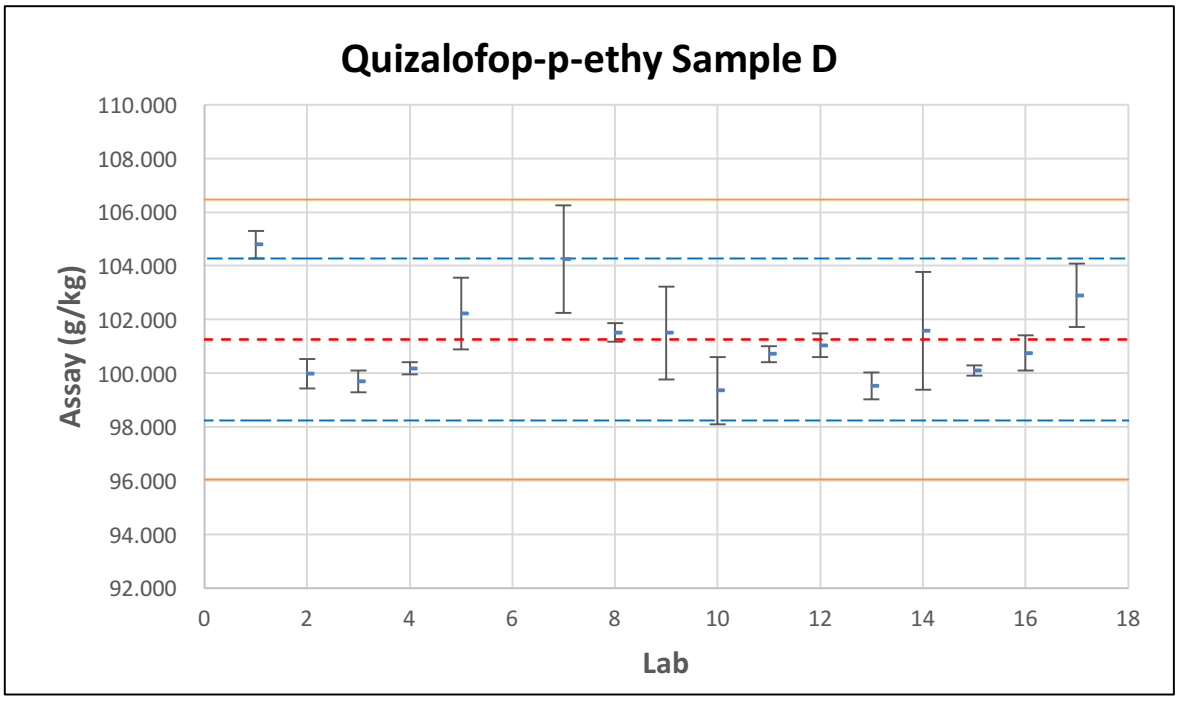
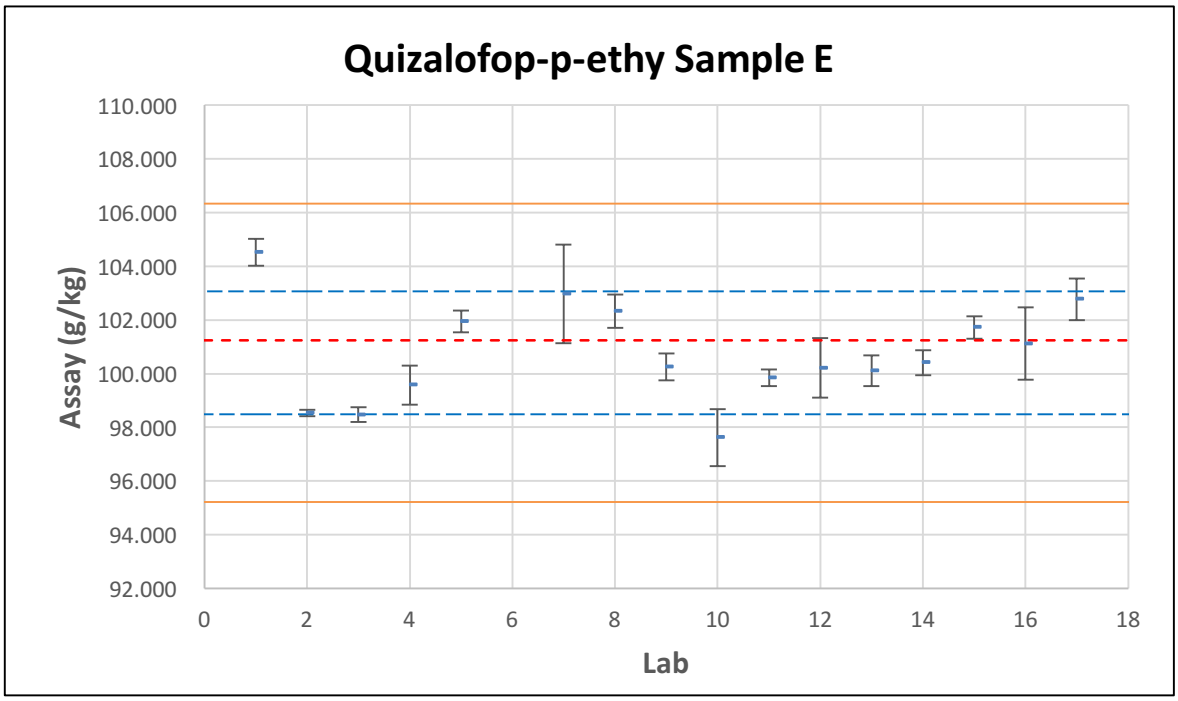

Quizalofop-p-ethy Sample D
Assay (g/kg)
110.000
108.000
106.000
104.000
102.000
100.000
98.000
96.000
94.000
92.000
0
2
4
6
8
10
12
14
16
18
Lab

Fig. 5:


Quizalofop-p-ethy Sample E
Assay (g/kg)
110.000
108.000
106.000
104.000
102.000
100.000
98.000
96.000
94.000
92.000
0
2
4
6
8
10
12
14
16
18
Lab

7. Conclusions

17 different laboratories participated in this collaborative study. The results of the labs are given in Table 1-2, the statistical summary given in Table 3-5. The results are illustrated in figures 1 – 5.

Without elimination of any outliers or stragglers the Relative Reproducibility Standard Deviation (% RSD_R) is below the calculated acceptable value based on the Horwitz curve calculation (% $RSD_{R\ (Hor)}$) in all samples.
The number of considered results after elimination of stragglers and outliers was 15.

Taking into account the relatively high number of participating laboratories a broad basis was given even after elimination of the outliers. Therefore, we consider this method to be suitable without further changes and recommend accepting it as a provisional CIPAC MT-method for the determination of Quizalofop-p-ethyl in technical material and EC formulation.