ISTITUTO SUPERIORE DI SANITÀ

RAPPORTI ISTISAN 24|2

ISSN: 1123-3117 (cartaceo) • 2384-8936 (online)

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AMBIENTE E SALUTE

ISTITUTO SUPERIORE DI SANITÀ

Results of the proficiency test on plant protection products in 2023

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Rapporti ISTISAN
24/2

Istituto Superiore di Sanità
Results of the proficiency test on plant protection products in 2023.
Angela Santilio, Roberto Cammarata, Silvana Girolimetti
2024, iii, 38 p. Rapporti ISTISAN 24/2

In 2023, the sixth Proficiency Test (PT) on plant protection products available on the Italian market was organized. The aim was to find out the quantity of active ingredients in different formulations of plant protection products. Eight Italian laboratories and seventeen worldwide laboratories, which routinely deal with pesticides, were invited to participate. Participation is voluntary and five Italian and fourteen European laboratories have joined. All laboratories obtained data with acceptable z-score values within the limits $-3.5 \leq Z \leq +3.5$.

Key words: Proficiency test; Plant protection products; Ciprodynil; Deltametrin; Trifloxystrobin

Istituto Superiore di Sanità
Risultati dell'esercizio interlaboratorio sui prodotti fitosanitari nel 2023.
Angela Santilio, Roberto Cammarata, Silvana Girolimetti
2024, iii, 38 p. Rapporti ISTISAN 24/2 (in inglese)

Nel 2023 è stato organizzato il sesto esercizio interlaboratorio su prodotti fitosanitari disponibili sul mercato nazionale. L'esercizio riguardava la determinazione del contenuto di principio attivo presente in prodotti fitosanitari di diversa formulazione. Sono stati invitati a partecipare 8 laboratori italiani preposti al controllo dei prodotti fitosanitari e 17 laboratori mondiali interessati ai controlli sui prodotti fitosanitari. La partecipazione è su base volontaria e hanno aderito cinque laboratori italiani e quattordici europei. Tutti i laboratori hanno ottenuto risultati con valori di *z-score* entro i limiti definiti $-3{,}5 \leq Z \leq +3{,}5$.

Parole chiave: Esercizio interlaboratorio; Prodotti fitosanitari; Ciprodynil; Deltametrin; Trifloxystrobin

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Citare questo documento come segue:
De Santi A, Longo E, Risi PM, Aguzzoli C, Rimondini M (Ed.). *Cura dei curanti.* Roma: Istituto Superiore di Sanità; 2024. (Rapporti ISTISAN 24/2).

Legale rappresentante dell'Istituto Superiore di Sanità: *Rocco Bellantone*
Registro della Stampa - Tribunale di Roma n. 114 (cartaceo) e n. 115 (online) del 16 maggio 2014

Direttore responsabile della serie: *Paola De Castro*
Redazione*: Sandra Salinetti*
La responsabilità dei dati scientifici e tecnici è dei singoli autori, che dichiarano di non avere conflitti di interesse.

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ABBREVIATIONS

AAPCO	Association of American Pesticide Control Officials
AFSCA	*Agence fédérale pour la sécurité de la chaîne alimentaire* (Federal Agency for the Safety of the Food Chain)
CAS	Chemical Abstract Service
CIPAC	Collaborative International Pesticide Analytical Council
CS	Capsule Suspension
CV	Coefficient of Variation
DAD	Diode Array Detector
FID	Flame Ionisation Detector
GC	Gas Chromatography
HRMS	High Resolution Mass Spectrometry
HPLC	High Performance Liquid Chromatography
ISO	International Organization for Standardization
ITPT	Italian Proficiency Test
LC	Liquid Chromatography
MAD	Median absolute deviation
MS	Mass Spectrometry
N/A	Not Available
PDA	PhotoDiode Array
PTFE	Polytetrafluoroethylene
PPP	Plant Protection Product
PPP01	Plant Protection Product number 1
PPP02	Plant Protection Product number 2
PPP03	Plant Protection Product number 3
PRSD	Predicted Relative Standard Deviation
PT	Proficiency Test
RSD	Relative Standard Deviation
SC	Suspension Concentrate
SD	Standard Deviation
SL	Soluble Concentrate
UV	UltraViolet
VIS	Visible
VWD	Variable Wavelength Detector
z-score	Standard Score

Symbols

σ_{PT}	standard deviation for proficiency test
T-test	statistic test of Student's t distribution

PREFACE

The European legislation on Plant Protection Products (PPPs) – Regulation (EC) 1107/2009) – regulates the authorisation, placing on the market, use and control of PPPs and of any active substances, safeners, synergists, co-formulants and adjuvants, which they might contain or which they might consist of.

The objective of those rules is to ensure a high level of protection of both human and animal health and of the environment through evaluation of the risks posed by PPPs, while improving the functioning of the Union market through harmonisation of the rules for their placing on the market and improving agricultural production.

In addition, the Regulation (EU) 2017/625 establishes a harmonised European Union framework for the organisation of official controls and official activities taking into account the rules on official controls laid down in Regulation (EC) 882/2004 and in relevant sectoral legislation, and the experience gained from the application of those rules.

The laboratories designated by the competent authorities to perform analyses on PPP samples taken in the context of official controls should possess the expertise, equipment, infrastructure and staff to carry out such tasks to the highest standards. To ensure sound and reliable results, those laboratories should be accredited for the use of these methods according to standard EN ISO/IEC 17025.

One of the instruments to reach a high-quality standard and performance is the participation in the interlaboratory test (Proficiency Test, PT) to demonstrate that the analytical data obtained from laboratories are reliable. For this reason, it is important to organize PTs for the active ingredient content for the official laboratories.

As the national monitoring programs are in comply with the European monitoring programs, it is useful to enlarge the invitation to European Member State laboratories that work on this issue.

This activity was planned in the framework of the collaboration (CUP I83C22000730005) with the Ministry of Health and the Istituto Superiore di Sanità (ISS, the National Institute of Health in Italy).

As defined in the collaboration agreement, the Department of Environment and Health of the ISS organised a PT for the year 2023 for the detection of active ingredient in PPPs available on the Italian market.

The laboratory provider is accredited according to the ISO/IEC 17025 but is not accredited according to the ISO/IEC 17043.

INTRODUCTION

The 6th Italian PT on PPPs (later indicated as ITPT2023) was organized between November 2022 and April 2023.

The announcement letter (Appendix A) sent to the laboratories on 7th November 2022, according to the calendar. The laboratories sent confirmation of participation by email. Eight Italian laboratories and 17 European laboratories received the invitation.

All relevant Italian laboratories and European Member State laboratories participated in the ITPT2023.

In January, three different commercial products containing three active ingredients (Cyprodinil 300 g/kg; Deltamethrin 2 g/kg; Trifloxystrobin 500 g/kg) were shipped to the laboratories.

Each participant received the sample bottles.

The relevant documents, such as Safety Disposable Sheets (SDS), technical instructions and the result report form were sent by e-mail. It was requested to determine the content of active ingredient using a routine analytical method applied in each participant's laboratory.

The participants were asked to report the measurement results in three significant figures in the provided result form. Also, the laboratories gave technical information on their methods, such as extractant, sample preparation, injection volume, the column used, column temperature and detector used.

The deadline of the test results submission was in April 2023.

1. PROFICIENCY TEST ON PLANT PROTECTION PRODUCTS

1.1. Test materials

The test materials of the ITPT2023 consisted of three PPPs obtained from manufacturer and available from Italian market. The product types are: Water Dispersible Granule (WDG), Dustable Powder (DP) and Emulsifiable Concentrate (EC) at a declared concentration reported in Table 1.

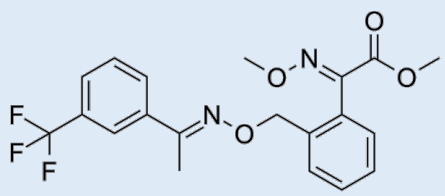
Table 1. Test materials of ITPT2023

Check Sample N.	Product description	Active ingredient	Declared level g/kg
PPP01	Water Dispersible Granule	Trifloxystrobin	500
PPP02	Dustable Powder	Deltamethrin	2
PPP03	Emulsiafiable Concentrate	Cyprodinil	300

For the preparation of the subsamples to send each laboratory, the PPPs were mixed mechanically and divided in 19 samples, for a total of 57 plastic containers sealed and stored at ambient temperature before the shipment to the participants. Each laboratory received three samples. Nothing, added to our samples.

1.2. Description of the active substances in the PPPs

1.2.1. Trifloxystrobin



Common name Trifloxystrobin

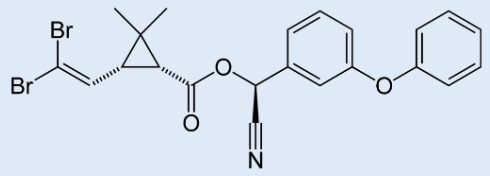
IUPAC name
methyl(E)-methoxyimino-{(E)-α-[1-(α,α,α-trifluoro-*m*-tolyl)ethylideneaminooxy]-*o*-tolyl}acetate

Structure Formula $C_{20}H_{19}F_3N_2O_4$

CAS number 141517-21-7

Trifloxystrobin is a foliar applied fungicide for cereals which is particularly active against Ascomycetes, Deuteromycetes and Oomycetes It has a role as a mitochondrial cytochrome-bc1 complex inhibitor and an antifungal agrochemical. It is an oxime O-ether, an organofluorine compound, a methyl ester and a methoxyiminoacetate strobilurin antifungal agent.

1.2.2. Deltamethrin



Common name Deltamethrin

IUPAC name
(S)-a-cyano-3-phenoxybenzyl (1R,3R)-3-(2,2-dibromovinyl)-2,2-dimethylcyclopropanecarboxylate

Structure formula $C_{22}H_{19}Br_2NO_3$

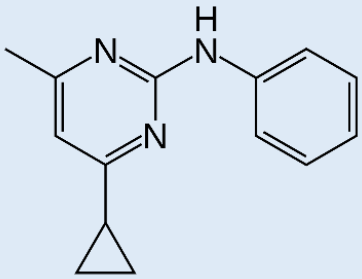
CAS number 52918-63-5

Deltamethrin is a pyrethroid ester insecticide. It plays a key role in controlling malaria vectors, and is used in the manufacture of long-lasting insecticidal mosquito nets; however, resistance of mosquitos and bed bugs to deltamethrin has seen a widespread increase.

Deltamethrin is toxic to aquatic life, particularly fish. Although generally considered safe to use around humans, it is still neurotoxic. It is an allergen and causes asthma in some people.

Deltamethrin is a highly effective insecticide. It is used, among other applications, for the production of Long-Lasting Insecticidal Nets (LLINs), which, along with Indoor Residual Spraying (IRS), are the main vector control strategies recommended by the World Health Organization for the management of malaria.

1.2.3. Cyprodinil



Common name Cyprodinil

IUPAC name
4-cyclopropyl-6-methyl-N-phenylpyrimidin-2-amine

Structure formula $C_{14}H_{15}N_3$

CAS number 121552-61-2

Cyprodinil is a member of the class of aminopyrimidine. A broad spectrum fungicide used to control a range of pathogens including *Tapesia yallundae*, *Botrytis* spp., *Alternaria* spp. and *Rhynchospium secalis*. Whilst it is a recognised irritant no serious human health concerns have been identified.

Cyprodinil is moderately toxic to birds as well as most aquatic organisms and earthworms, but it is not considered toxic to honeybees. It has a role as an aryl hydrocarbon receptor agonist, an environmental contaminant, a xenobiotic and an antifungal agrochemical. It is an aminopyrimidine, a secondary amino compound, a member of cyclopropanes and an anilinopyrimidine fungicide.

Cyprodinil is a fungicide that acts by inhibition of germ tube elongation and hyphal mycelia. Cyprodinil is applied to the foliage of almonds, grapes, stone fruit crops, and pome fruit crops to control plant diseases.

1.3. Homogeneity and stability test

Homogeneity and stability tests were performed according to the ISO 13528:2015(E) - Annex B and the International Harmonized Protocol.

For the determination of the homogeneity and stability test, the organiser used the CIPAC n. 617 method for Trifloxystrobin, In-house method for Deltamethrin and CIPAC n. 511 method for Cyprodinil.

1.3.1. Trifloxystrobin analytical method

For determination of Trifloxystrobin, weight a quantity of sample corresponding to 50 mg of Trifloxystrobin. Dilute with 90 mL acetonitrile/water (90/10, v/v), sonicate for 15 minutes and mix allow to cool to room temperature and fill up to the mark with (acetonitrile/water (90/10, v/v) 100 mL. Filter on 0.45 mm PTFE (polytetrafluoroethylene) filter before injection.

The determination was performed using High Performance Liquid Chromatography Coupled Diode Array detector (HPLC/DAD) at 280 nm. A Zorbax Eclipse plus C18 column 100 x 4.6mm; 3.5 µm was used; flow rate was 1 mL/min; column temperature: 25°C; mobile phase: acetonitrile/H_2O acidify with H_3PO_4 10 mM in gradient mode.

1.3.2. Deltamethrin analytical method

For determination of Deltamethrin, weight a quantity of sample corresponding to 20 mg of Deltamethrin into a 25-mL volumetric flask and a volume of 20 mL of acetonitrile was added. The solution was treated with ultrasounds for 15 minutes. After cooling, H_3PO_4 50 µL added and fill up to volume with acetonitrile. Filter on 0.2 mm PTFE filter before injection.

The determination was performed using HPLC/DAD at 240 nm. A Roc C18 column 250 x 4.6 mm; 5 µm was used; flow rate was 1 mL/min; column temperature: 25°C; mobile phase: Acetonitrile/H_2O acidify with H_3PO_4 0.1% in gradient way.

1.3.3. Cyprodinil analytical method

For determination of Cyprodinil, weight a quantity of sample corresponding to 100 mg of Cyprodinil into a 100-mL volumetric flask and add 5 mL of H_2O and 40 mL of acetonitrile. Sonicate for 5 minutes and allow to cool to ambient temperature. Fill up to volume 100 mL with acetonitrile. After, 10 mL of this solution was diluted to 100 mL with acetonitrile/H_2O acidify with trifluoroacetic acid 1%. Mix well and filter on 0.45 um PTFE filter before injection.

The determination was performed using HPLC/DAD at 254 nm. A Nucleosil C18 column 250 x 4.6mm; 5 µm was used; flow rate was 1.2 mL/min; column temperature: 35°C; mobile phase: acetonitrile/water acidify with 1% trifluoroacetic acid (40:60, v/v).

1.3.4. Homogeneity

Regarding the homogeneity test, ten bottles were randomly chosen and analysed in duplicate, in two different days.

Considering that the σ_{PT} is unknown, the statistically significant differences between PT items were evaluated with the analysis of variance T-test at α=0.05, if the data series are more than two

will need the Fisher Test. The T-test shows a significativity level (P) higher than 0.05 for each active substance. The samples are homogeneous.

The results are shown in Table 2 for all compounds and the concentrations are in g/kg.

Table 2. Homogeneity results of the PT samples (ITPT2023)

Sample ID	Trifloxystrobin		Deltamethrin		Cyprodinil	
	a	b	a	b	a	b
#1	484.3	483.3	1.95	1.90	307.6	309.7
#2	483.3	483.7	1.90	1.80	306.7	307.2
#3	470.8	469.0	1.90	1.85	307.8	312.3
#4	473.5	494.5	1.85	1.83	306.5	295.8
#5	484.4	483.1	1.90	1.85	308.4	292.5
#6	480.2	480.3	1.90	1.90	304.1	304.4
#7	488.7	518.5	1.90	2.00	305.4	321.8
#8	477.4	473.9	1.90	1.90	306.7	303.9
#9	487.2	488.8	1.90	1.88	310.1	306.6
#10	480.7	479.6	1.80	1.90	306.3	308.9
Mean	481.0	485.5	1.89	1.88	307.0	306.3
SD	5.8	13.6	0.04	0.06	1.6	8.2
t**	0.9520		0.4671		0.2436	
P***	0.3537		0.6460		0.8103	
Homogeneity	YES		YES		YES	

a, b: replicates of the same sample
t**: T of Student Test
P***: significativity level;
SD: Standard Deviation

1.3.5. Stability

The stability test was performed using two bottles, randomly chosen, which were analysed in duplicate in two occasions and each occasion twice:

- *Day 1*: before the shipment of the samples in January 2023;
- *Day 2*: at the deadline for reporting results in April 2023.

Stability test was judged acceptable as the percentage difference of concentration, for each active substance was found less than 10%.

Table 3 shows the stability data of the ITPT2023.

Table 3. Summary of stability data in g/kg (ITPT2023)

Active ingredient	January	April	Concentration
Trifloxystrobin	492	482	500
Deltamethrin	1.9	1.9	2.0
Cyprodinil	306	307	300

Tables 4, 5, and 6 show the individual results for each substance. The deviation calculated with reference to the 1st analysis and to the declared label show a deviation less than 10% for all substances. The products are stable.

Table 4. TRIFLOXYTROBIN: results of stability test (ITPT2023)

Parameter	January				April			
	Replicate 1		Replicate 2		Replicate 1		Replicate 2	
	inj 1	inj 2	inj 1	inj 2	inj 1	inj 2	inj 1	inj 2
Sample 1	514.7	506.5	491.6	497.6	478.0	483.5	489.9	487.3
Sample 2	474.9	479.6	482.3	485.2	479.6	484.8	478.1	474.8
Mean	493.9		489.2		481.5		482.5	
SD	19.6		6.8		3.2		7.2	
Mean of 2 days	491.6				482			
Standard Deviation of 2 days	3.4				0.74			
Deviation (ref 1st Analysis)/ [(M2-M1)/M1]*100	-1.9							
Deviation (ref to declared label g/kg)/ [(SM-500)/500]*100	-2.6							
Stability Mean	486.8		Declared Label g/kg		500			
Stability Standard Deviation	6.8		CV %		1.4			

Table 5. DELTAMETHRIN: results of stability test (ITPT2023)

Parameter	January				April			
	Replicate 1		Replicate 2		Replicate 1		Replicate 2	
	inj 1	inj 2	inj 1	inj 2	inj 1	inj 2	inj 1	inj 2
Sample 1	1.95	1.95	1.86	1.85	1.86	1.87	1.85	1.88
Sample 2	1.87	1.88	1.86	1.85	1.87	1.88	1.85	1.87
Mean	1.91		1.86		1.87		1.86	
SD	0.04		0.006		0.008		0.015	
Mean of 2 days	1.88				1.87			
Standard Deviation of 2 days	0.04				0.007			
Deviation (ref 1st Analysis)/ [(M2-M1)/M1]*100	-0.79							
Deviation (ref to declared label g/kg)/ [(SM-2)/2]*100	-6.5							
Stability Mean	1.87		Declared Label g/kg		2			
Stability Standard Deviation	0.01		CV %		0.6			

Table 6. CYPRODINIL: results of stability test (ITPT2023)

Parameter	January				April			
	Replicate 1		Replicate 2		Replicate 1		Replicate 2	
	inj 1	inj 2	inj 1	inj 2	inj 1	inj 2	inj 1	inj 2
Sample 1	308.7	308.4	305.2	304.6	307.5	307.1	306.4	307.6
Sample 2	302.2	302.4	307.5	305	306.3	306.3	306.5	305.9
Mean	305.4		305.6		306.8		306.6	
SD	3.6		1.3		0.6		0.7	
Mean of 2 days	305.5				306.7			
Standard Deviation of 2 days	0.1				0.1			
Deviation (ref 1st Analysis)/ [(M2-M1)/M1]*100	0.39							
Deviation (ref to declared label g/kg)/ [(SM-300)/300]*100	2							
Stability Mean	306.1		Declared Label g/kg		300			
Stability Standard Deviation	0.8		CV %		0.3			

1.4. Distribution of the samples and instructions for the participants

Three plastic transparent containers were filled. Each sample was shipped to the participating laboratories at ambient temperature. An information message was sent out by e-mail during shipment so that laboratories made their own arrangements for the reception of the package, and a protocol was sent by e-mail.

The participants (Appendix B) were asked:

– to inform on the safe recipient of the samples in their laboratories;
– to report results in the appropriate form and send them to the organizer by e-mail along with the details of methodology used.

The samples were sent to the participants on 15th January 2023.

The deadline for results was 30th of April 2023.

The final report was dispatched to all participants at the end of July 2023.

1.5. Statistical evaluation of results

This PT has been evaluated using the modified z-score parameter to rate the laboratory performance for each active substance according to AAPCO protocol.

The outliers were calculated using the modified z-score.

A Horwitz ratio (HorRat) has been calculated. The HorRat is a normalized performance parameter indicating the acceptability of analytical methods respect to among-laboratory precision (reproducibility). It illustrates the deviation or agreement of an observed interlaboratory

reproducibility with typical values. In this PT, the HorRat for the laboratories was calculated for each substance.

1.5.1. Robust mean

The purpose of using a robust estimator for the mean was to cope with the possibility of outlying data points without having to remove them from the sample.

The robust mean estimator used was the median.

1.5.2. Robust estimate of standard deviation

The robust estimate of the standard deviation used was the MAD_E value.

To obtain the MAD_E, calculate Median Absolute Deviation (MAD) from the sample median:

$$MAD = median\ (|X_i - median\ (Xi)|_{i=1,2\ldots n})$$

Calculate MAD_E:

$$MAD_E = K \times MAD$$

For normally distributed data, K= 1.483:

$$MAD_E = 1.483 \times MAD$$

1.5.3. Calculation of modified z-scores

Modified z-scores (Zi) for each laboratory were calculated as:

$$Zi = 0.6745 \times {}^{(Xi\ -\ median)} / MAD$$

Z values falling outside the range of $-3.5 \leq Zi \leq 3.5$ were marked as outliers.

1.5.4. Calculation of Horwitz ratio

A HorRat can be calculated using RSD (Relative Standard Deviation), which is defined as follow:

$$HorRat = RSDr/PRSDr$$

where RSDr is the RSD among laboratories and PRSDr is the predicted standard deviation from Horwitz equation:

$$PRSDr(\%) = 2C^{-0.15}$$

where C is the concentration found expressed as a mass fraction.

The empirical acceptable HorRat value is ranged between 0.5-2.0.

1.5.5. Presentation of data

Data is presented graphically in two ways:

– A scatter plot showing each participating laboratory's two-day mean value for each analyte along with the associated standard deviation. These plots also show the upper and lower Horwitz (Thompson) limits for the sample, as well as median ±2 MAD_E.

– A plot of modified z-scores.

2. ANALYSIS OF THE SUBSTANCES

Description and statistical evaluation of the results are presented for each compound separately.

2.1. Trifloxystrobin

For the active substance Trifloxystrobin, 19 boxes were sent to all laboratories, in particular 5 to Italian's Laboratories and 14 to European Laboratories outside Italy. We received 19 participation results. Eighteen laboratories used for the analysis an HPLC instrument with a UV or PDA Detector and 1 used a Gas Chromatography (GC) with Flame Ionization Detector (FID).

To carry out this analysis, 12 laboratories applied an in-house method and 7 the CIPAC method, as is shown in Table 7. At the same time, all the methods gave appreciable data, as Figure 1 shows.

Table 7. TRIFLOXYSTROBIN: methods applied for analysis (ITPT2023)

Laboratories	In-house	CIPAC	Manufacturer's
Number	12	7	0

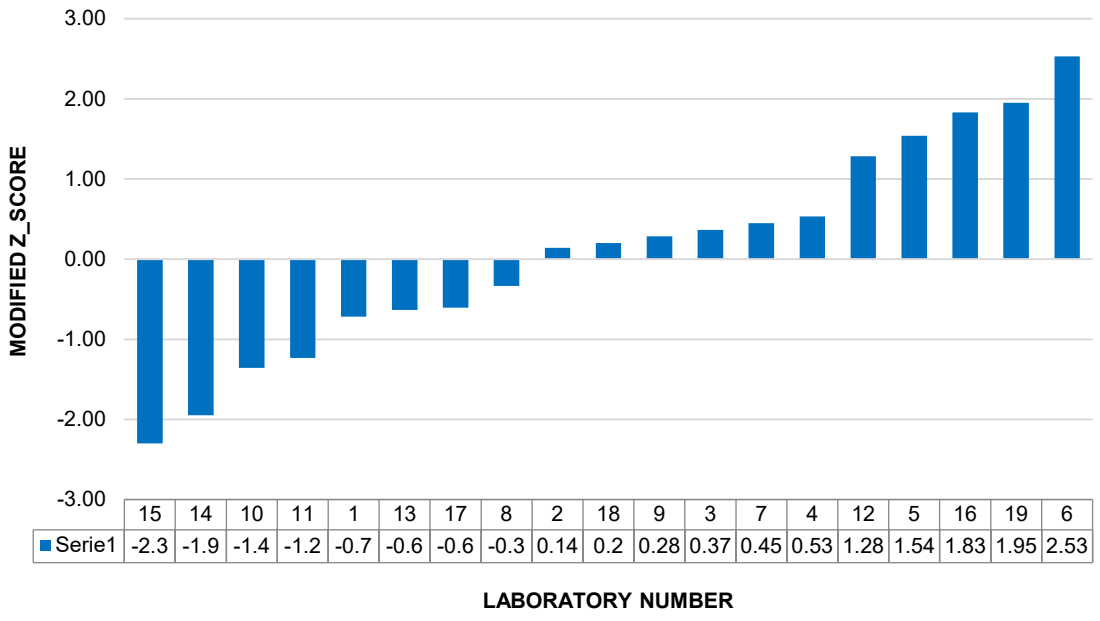


Figure 1. TRIFLOXYSTROBIN: modified z-scores (ITPT2023)

For Trifloxystrobin, a statistical evaluation based on a robust estimator instead of the mean was applied on the collected data. The purpose of this choice was to cope with the possibility of outlying data points without having to remove them, so the median and the standard deviation

were used. Figure 1 shows the lab's values of modified z-score. The results obtained are valuable data, in fact all results are inside the z-score range of $-3.5 \leq Z \leq +3.5$.

The HorRat value calculated was 0.72 that indicates good acceptability of the chemical methods used with respect to precision.

2.2. Deltamethrin

For the substance Deltamethrin 19 boxes were sent to laboratories, in particular 5 to Italian's Laboratories and 14 to European Laboratories outside Italy. We received 16 participation results. The analysis was performed using LC instrument for 14 laboratories with UV or PDA Detector and one decide to use the GC with FID. Ten laboratories chose to use an in-house method, others six CIPAC method, as is showed in Table 8. For this substance no Manufacturer's method was used. At the same time, all the methods gave appreciable data.

Table 8. DELTAMETHRIN: methods applied for analysis (ITPT2023)

Laboratories	In-house	CIPAC	Manufacturer's
Number	10	6	0

As for the Trifloxystrobin mentioned before, on the collected data a statistical evaluation based on a robust estimator (median) instead the mean was applied. The purpose of this choice was to handle possible outlier data points instead of removing them, so it was used the median and the standard deviation. Figure 2 shows the lab's values of the modified z-score.

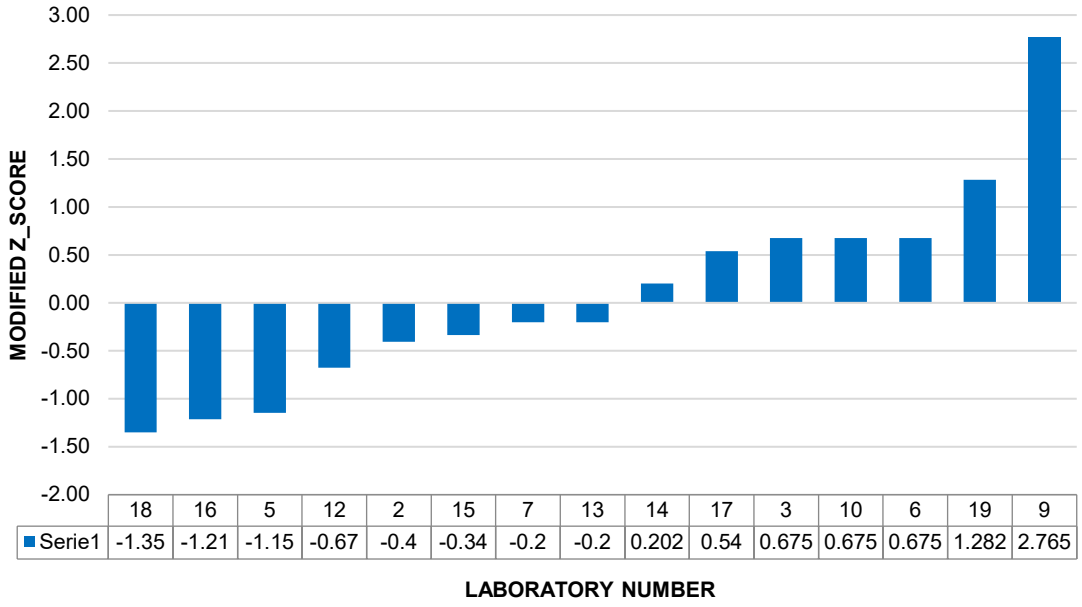


Figure 2. DELTAMETHRIN: modified z-scores (ITPT2023)

The results obtained are valuable data, in fact all of them are inside the z-score range of $-3.5 \leq Z \leq +3.5$.

The HorRat value calculated was 1.14 that indicates good acceptability of the chemical methods used with respect to precision.

2.3. Cyprodinil

Regarding the active substance Cyprodinil, 19 boxes were sent to all over the world, in particular 5 to Italian's Laboratories and 14 to European Laboratories outside Italy. We received 19 participation results. 15 laboratories used for the analysis an LC instrument with a UV or PDA Detector. It is interesting to note that 11 laboratories chose to use an in-house method, 7 laboratories choose to use CIPAC methods, one applied a manufacturer's method, as is showed in Table 9. At the same time, all the methods gave appreciable data.

Table 9. CYPRODINIL: methods applied for analysis (ITPT2023)

Laboratories	In-house	CIPAC	Manufacturer's
Number	11	7	1

On the collected data, a statistical evaluation based on a robust estimator (median) instead the mean was applied. The purpose of this choice was to cope the possibility of outlying data points without having to remove them, so it was used the median and the standard deviation.

Figure 3 shows the lab's values of modified z-score. The results obtained are laudable data, in fact all of them are inside the modified z-score range of $-3.5 \leq Z \leq +3.5$.

The HorRat value calculated was 1.06 that indicates good acceptability of the chemical methods used with respect to precision.

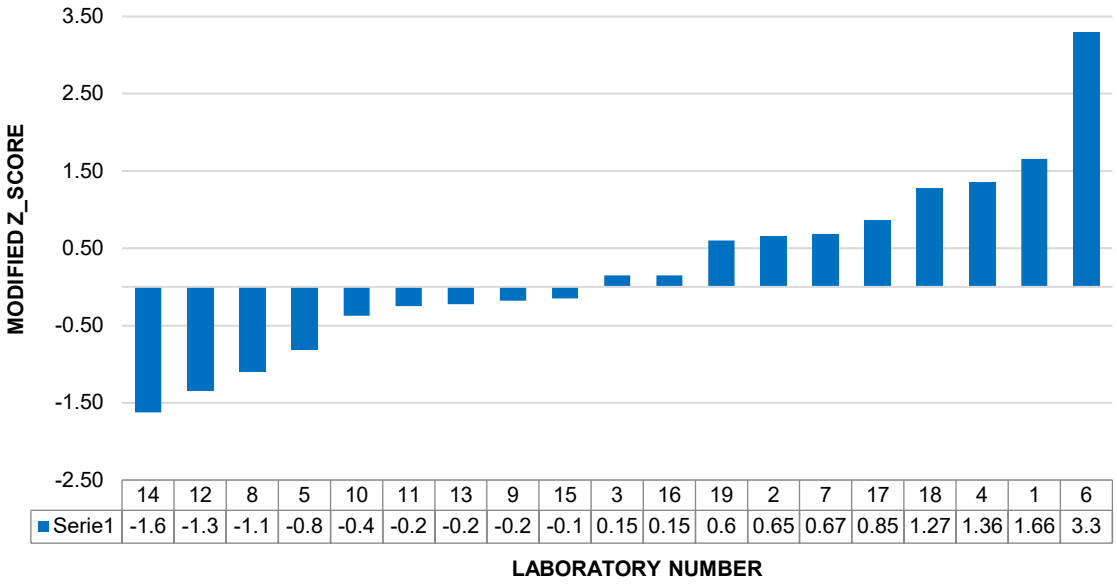


Figure 3. CYPRODINIL: modified z-scores (ITPT2023)

3. RESULTS

The result of the 6th PT (ITPT2023) can be regarded as satisfactory.

The exercise received good interest from participating laboratories.

The participation of the Italian and European laboratories was good.

For Italy, five laboratories participated so distributed: two from the North, two from the Centre and one from the South of the Country. The European laboratories were fourteen, excluding Italy, distributed throughout Europe.

For the analysis of Trifloxystrobin, 63% of the laboratories used the in-house method and 37% used CIPAC method.

As concern Deltamethrin, 63% of the laboratories used in-house methods, 37% CIPAC method and none manufacturer's method.

Finally, for Cyprodinil, 58% of the laboratories used in-house methods, 37% CIPAC method and 5.2% manufacturer's method.

Most of the laboratories used LC and only few laboratories used GC technique; for all active substances no failing results were observed (Table 10).

Table 10. Summary of participation per active ingredient (ITPT2023)

ID Sample	Product description	Active ingredient	Participants (n.)	Labs using GC (n.)	Labs using LC (n.)	Failing results[1](%)
PPP01	Water dispersible granule	Trifloxystrobin	19	1	18	0
PPP02	Dustable powder	Deltamethrin	15	2	13	0
PPP03	Emulsifiable concentrate	Cyprodinil	19	4	15	0

[1] Where failing indicates a mean assay result outside the modified z-score defined acceptable limits.

For each substance, the HorRat value calculated indicates the good acceptability of the chemical methods used with respect to the precision.

Tables 11 and 12 summarize the results per active ingredient including and excluding the outliers.

The performance of the laboratories in terms of modified z-score was satisfactory for almost all participants for all substances. For all active substance, there are not outlier values.

Based on the results, we can conclude that the PT was successful and that a satisfactory number of laboratories participated.

Table 11. Summary of lab results per active ingredient, including outliers (ITPT2023)

ID Sample	Analyte (Label claim)	Minimum result (g/kg)	Maximum result (g/kg)	Grand Average (g/kg)	Grand %CV
PPP01	Trifloxystrobin (500 g/kg)	483.5	509.0	497.9	1.9
PPP02	Deltamethrin (2 g/kg)	1.815	2.120	1.920	4.0
PPP03	Cyprodinil (300 g/kg)	293.7	326.5	306.1	0.3

Table 12. Summary of lab results per active ingredient, excluding outliers

ID Sample	Analyte (Label claim)	N. of outliers[1]	Average excluding outliers	%CV excluding outliers
PPP01	Trifloxystrobin (500 g/kg)	0	no	no
PPP02	Deltamethrin (2 g/kg)	0	no	no
PPP03	Cyprodinil (300 g/kg)	0	no	no

[1] An outlier is flagged when the modified z-score falls outside the range of $-3.5 \leq Zi \leq 3.5$; see Appendix for calculations.

Tables 13, 14 and 15 show details of the z-score values for each laboratory and the analytical technique used for each substance.

Tables 16, 17 and 18 report the information on analytical methods used for each substance and each laboratory.

Table 13. TRIFLOXYSTROBIN Sample PPP01: summary results (ITPT2023)

Lab #	Method	Two Day Average[1]	RPD[1]	Modified z score[2]	Outlier[2]
1	HPLC/UVD	493.00	-0.811	-0.716	NO
2	HPLC/UV	498.15	-0.622	0.142	NO
3	HPLC/UV	499.50	0.601	0.366	NO
4	HPLC/DAD	500.50	-0.999	0.533	NO
5	HPLC/DAD	506.55	-0.651	1.541	NO
6	HPLC/DAD	512.50	-4.488	2.531	NO
7	HPLC/DAD	500.00	0.400	0.450	NO
8	HPLC/DAD	495.30	-0.929	-0.333	NO
9	HPLC/DAD	499.00	-7.214	0.283	NO
10	HPLC/DAD	489.15	-0.675	-1.357	NO
11	HPLC/DAD	489.90	-0.204	-1.232	NO
12	HPLC/DAD	505.00	5.545	1.282	NO
13	GC/FID	493.50	0.608	-0.633	NO
14	HPLC/DAD	485.60	0.165	-1.949	NO
15	HPLC/DAD	483.50	0.745	-2.298	NO
16	HPLC/UV	508.30	-1.062	1.832	NO
17	HPLC/DAD	493.65	-0.304	-0.608	NO
18	HPLC/DAD	498.50	-0.602	0.200	NO
19	HPLC/DAD	509.00	0.786	1.949	NO
Grand Average[3]		497.93			
Total SD		9.77			
Total Median[4]		497.3			
MAD		4.050			
MAD_E		6.006			

[1] Average yield and Relative Percent Difference between the two-day determinations per laboratory.
[2] An outlier is flagged when the modified z-score falls outside the range of $-3.5 \leq Zi \leq 3.5$; see Glossary.
[3] Grand average, standard deviation and median.
[4] Median Absolute Deviation Robust estimation of standard deviation; see Appendix for calculations.

Table 14. DELTAMETHRIN Sample PPP02: summary results (ITPT2023)

Lab #	Method	Two Day Average[1]	RPD[1]	Modified z score[2]	Outlier[2]
1[5]	NA				
2	HPLC/UV	1.885	0.531	-0.405	NO
3	HPLC/UV	1.965	-0.509	0.675	NO
4[5]	NA				
5	HPLC/DAD	1.830	-2.186	-1.147	NO
6	HPLC/DAD	1.965	-13.74	0.675	NO
7	HPLC/DAD	1.900	-10.53	-0.202	NO
8[5]	NA				
9	HPLC/DAD	2.120	0	2.765	NO
10	HPLC/DAD	1.965	1.527	0.675	NO
11[5]	NA				
12	HPLC/DAD	1.8650	-1.609	-0.675	NO
13	GC/FID	1.900	0	-0.202	NO
14	HPLC/DAD	1.930	-1.036	0.202	NO
15	HPLC/DAD	1.890	-1.058	-0.337	NO
16	GC/FID	1.825	2.740	-1.21	NO
17	HPLC/PDA	1.955	-1.535	0.540	NO
18	HPLC/PDA	1.815	3.857	-1.349	NO
19	HPLC/PDA	2.010	6.965	1.282	NO
Grand Average[3]			1.92		
Total SD			0.077		
Total Median[4]			1.915		
MAD			0.05		
MAD_E			0.074		

[1] Average yield and Relative Percent Difference between the two-day determinations per laboratory.
[2] An outlier is flagged when the modified z-score falls outside the range of $-3.5 \leq Zi \leq 3.5$; see Glossary.
[3] Grand average, standard deviation and median.
[4] Median Absolute Deviation Robust estimation of standard deviation; see Appendix for calculations.
[5] Laboratory did not analyze (NA) the substances.

Table 15. CYPRODINIL Sample PPP03: summary results (ITPT2023)

Lab #	Method	Two Day Average[1]	RPD[1]	Modified Z Score[2]	Outlier[2]
1	HPLC/UV	315.55	-0.285	1.656	NO
2	HPLC/UV	308.85	0.939	0.652	NO
3	HPLC/PDA	305.50	-0.327	0.150	NO
4	HPLC/DAD	313.55	0.989	1.356	NO
5	HPLC/DAD	299.05	3.310	-0.817	NO
6	HPLC/DAD	326.50	5.207	3.298	NO
7	GC/FID	309.00	3.236	0.675	NO
8	HPLC/UV	297.15	-0.370	-1.102	NO
9	HPLC/DAD	303.30	-0.132	-0.180	NO
10	HPLC/DAD	302.00	1.987	-0.375	NO
11	HPLC/DAD	302.85	-0.561	-0.247	NO
12	HPLC/DAD	295.50	-0.338	-1.349	NO
13	GC/FID	303.00	-0.660	-0.225	NO
14	HPLC/DAD	293.65	0.102	-1.626	NO
15	HPLC/DAD	303.50	0.198	-0.150	NO
16	GC/FID	305.50	-0.327	0.150	NO
17	GC/FID	310.20	0.516	0.854	NO
18	HPLC/DAD	313.00	-3.834	1.274	NO
19	HPLC/DAD	308.50	-0.972	0.600	NO
Grand Average[3]				306.11	
Total SD				0.809	
Total Median[4]				304.50	
MAD				4.50	
MAD_E				6.67	

[1] Average yield and Relative Percent Difference between the two-day determinations per laboratory.
[2] An outlier is flagged when the modified z-score falls outside the range of $-3.5 \leq Zi \leq 3.5$; see Glossary.
[3] Grand average, standard deviation and median.
[4] Median Absolute Deviation Robust estimation of standard deviation; see Appendix for calculations.

Table 16. TRIFLOXYSTROBIN: representative method for the determination (ITPT2023)

ID Lab	Reference method	Internal standard	Extractants	Sample preparation	Injection volume µL	Column T°	Detector	Stationary phase (SP) Mobile phase (MP)
1	CIPAC MT617	No	Acetonitrile	Weight a sample portion diluted in acetonitrile, sonicate for 30 min, add 10 mL H_2O, sonicate for 5 min. Dilute 1 mL to 5 mL Acetonitrile. Filter through a 0.45 µm filter	1	45	PDA 280 nm	**SP**: Phenomenex biphenyl 100 X 2.1 mm; 2.6 µm; 0.4 mL/min **MP**: Acetonitrile/Water acidified H_3PO_4 10 mM
2	In-house method	No	Acetonitrile/ Water	Sonicate for 8 min, filter through a 0.22 µm PTFE syringe filter	0.5	25	UV 220 nm	**SP**: Phenomenex Kinetex C18; 100 X 2.1 mm; 2.6 µm; 0.4 mL/min **MP**: Acetonitrile/Water acidified 0.1% H_3PO_4
3	In-house method	No	Acetonitrile	Weight a sample portion diluted in acetonitrile, and sonicate for 15 min	2	30	UV 270 nm	**SP**: Xterra RP18 150 X 2.1 mm; 3.5 µm; 0.3 mL/min **MP**: Acetonitrile/Water 0.1% acidified H_3PO_4
4	CIPAC Multi analyte method	No	MilliQ water and Acetonitrile	Sonicate for 15 min, diluted and filtered through a 0.45 µm PTFE-filter	10	30	DAD 220 nm	**SP**: Kinetex C18 150 X 4.6 mm; 5 µm; 1.0 mL/min **MP**: Water acidified 0.1% formic acid/Acetonitrile
5	CIPAC	No	Water Acetonitrile	Dilute a sample portion in 90 mL of acetonitrile, and sonicate for 15 min. Dilute to 100mL with H_2O	5	50	DAD 280 nm	**SP**: Kinetex C18 50 X 4.6 mm; 2.6 µm; 2.0 mL/min **MP**: Water acidified H_3PO_4 10 mM/Acetonitrile
6	In-house method	No	Water acidified 0.5% H_3PO_4 / Tetrahydrofuran (50:50)	Weight a sample portion. Sonicate for 15 min. Filter through a 0.2 µm PP disk	10	35	DAD 250 nm	**SP**: Nucleodur 250 X 3 mm; 5 µm; 0.3 mL/min **MP**: Water acidified 0.5% H_3PO_4/Acetonitrile (20/80, v/v).
7	In-house method	No	Methanol	Dissolve in 50 mL methanol, sonicate for 15 min. Dilute (1:4, v/v) with methanol. Filter through a 0.45 µm cellulose filter	10	30	DAD 230 nm	**SP**: Lichrospher 100 RP18 250 X 4 mm; 5 µm; 1.8 mL/min **MP**: Acetonitrile/Water acidified H_3PO_4 0.1% (65/35)

ID Lab	Reference method	Internal standard	Extractants	Sample preparation	Injection volume µL	Column T°	Detector	Stationary phase (SP) Mobile phase (MP)
8	In-house method	No	Methanol/water (90:10)	Dissolve sample	20	25	PDA 250 nm	**SP**: Phenomenex 4-Hydro RP80A 150 X 2 mm; 5 µm; 0.2 mL/min **MP**: Methanol/Water acidified 0.3% formic acid (90/10, v/v)
9	In-house method	No	Acetone	Extract with acetone for 24 h by RT. Dilute with acetonitrile	10	40	DAD 230 nm	**SP**: Zorbax SBC18 150 X 4.6 mm; 5 µm; 1 mL/min **MP**: Acetonitrile/Water acidified H_3PO_4 0.1% (60:40, v/v)
10	CIPAC 617	No	Acetonitrile/Water	Weight a sample portion, add 25 mL water/ 20 mL acetonitrile. Dilute 10 mL to 25 mL with CH_3OH	20	NA	DAD 280 nm	**SP**: Zorbax Eclipse Plus C18 150 X 4.6 mm; 5 µm; 1 mL/min **MP**: Acetonitrile/ Water acidified H_3PO_4 (60/40 v/v)
11	CIPAC 617	No	Acetonitrile	Dissolve the sample in 90 mL of acetonitrile. Sonicate for 20 minutes. Fill up to volume with acetonitrile. Filter through a 0.20 µm filter	2	50	DAD 277 nm	**SP**: Phenomenex Kinetex C18 100 A. 50 X 4.6 mm; 2.6 µm; 2 mL/min **MP**: Acetonitrile/Water acidified 0.2% H_3PO_4 (gradient)
12	In-house method	No	Acetonitrile	Weight a sample portion. Sonicate 15 min. Filter on a 0.45 µm nylon filter	10	35	DAD 218 nm	**SP**: Zorbax Eclipse C8 150 X 4.6 mm; 5 µm; 1.0 mL/min **MP**: Acetonitrile/Water acidified H_3PO_4 0.1%
13	In-house method	Dicyclo-hexyl-phthalate 0.4 mg/mL	Acetone	Weight a sample portion. Sonicate for 3 min. Shake for 10 s	1	gradient	FID	**SP**: Rxi 1 ms 30 m x0.25 mm; 0.25 µm
14	In-house method	No	Methanol	Dissolve a sample portion in methanol. Sonicate for 10 min. Filter through a 0.45 µm PTFE disk	10	35	DAD 220 nm	**SP**: Phenomenex Gemini 150 X 4.6 mm; 5 µm; 1.0 mL/min **MP**: Acetonitrile/Water (70:30)

ID Lab	Reference method	Internal standard	Extractants	Sample preparation	Injection volume µL	Column T°	Detector	Stationary phase (SP) Mobile phase (MP)
15	CIPAC MT 617	No	Acetonitrile / Water (90/10, v/v)	Dilute with acetonitrile; sonicate for 5 min; filter through a 0.45 µm PTFE filter, before injection	10	30	PDA 280 nm	**SP**: Zorbax Eclipse plus C18 10 X 4.6 mm; 3.55 µm; 1.0 mL/min **MP**: Water acidified H_3PO_4 10mM/Acetonitrile (90:10, v/v)
16	In-house multianalyte method	No	Water / Acetonitrile (1:24)	Sonicate 10 min, filter through a Nylon 0.45 µm disk	5	30	VWD 230 nm	**SP**: Zorbax Eclipse, XDB C18; 250 X 4.6 mm; 5 µm; 1.1 mL/min **MP**: Acetonitrile/Water acidified 0.1% H_3PO_4 (gradient)
17	In-house multianalyte method	No	Acetonitrile	Weigh, add solvent and sonicate, fill up to volume 100 mL, filter on a 0.45 µm filter	5	25	PDA 260 nm	**SP**: Phenomenex Kinetex C18 100 X 4.6 mm; 2.6 µm; 5 mL/min **MP**: Water acidified formic acid 0.1%/Acetonitrile (35/65, v/v)
18	In-house	No	Acetonitrile	Weight a sample portion, dilute with acetonitrile, sonicate and filter on 0.2 um filter	2	//	PDA 254 nm	**SP**: Aquity UHPLC BEH 100 X 2.1 mm; 1.7 µm; 8.5 mL/min **MP**: Water acidified formic acid 0.1% /Acetonitrile
19	CIPAC 617	No	Acetonitrile	Weight a sample portion diluted in 100 mL acetonitrile, sonicate for 10 min; filter on a 0.2 µm filter in vial	5	50	DAD 280 nm	**SP**: Pinnacle IIC18 50 X 4.6mm; 5 µm; 1.5 mL/min **MP**: Water acidified 10mM H_3PO_4/Acetonitrile (40/40, %)

Table 17. DELTAMETRIN: representative method of the determination (ITPT2023)

ID Lab	Reference method	Internal standard	Extractants	Sample preparation	Injection volume µL	Column T°	Detector	Stationary phase (SP) Mobile phase (MP)
1	CIPAC MT 333	N/A	Dioxane/ Isooctane	Weight a sample portion dilute with 5 mL dioxane. Fill to up volume 50 mL Iso-octane. Filter on a 0.45 µm nylon disk	10	30	PDA 230 nm	**SP**: Luna CN 250 x 4.6 mm; 5 µm; 1.5 mL/min **MP**: Dioxane (Water 0.15%)/Iso-octane
2	In-house method	N/A	Acetonitrile	Sonicate for 8 min, filter through a 0.45 µm PTFE syringe filter	0.5	25	UV 210 nm	**SP**: Kinetex C18 100 x 2.1 mm; 2.6 µm; 0.4 mL/min **MP**: Water acidified H_3PO_4 0.1%/Acetonitrile
3	In-house method	N/A	Acetonitrile	Sonicate for 15 min	2	30	UV 240 nm	**SP** : Xterra RP18 150 x 2.1 mm; 3.5 µm; 0.3 mL/min **MP**: Water acidified H_3PO_4 0.1%/Acetonitrile
5	CIPAC MT 333	NA	Dioxane / Isooctane	Weight a sample portion dilute with 15 mL dioxane/iso-octane. Sonicate and fill up to 50 mL with isooctane	5	35	UV 230 nm	**SP**: Lichrospher 100 CN 250 x 4.0 mm; 5 µm; 1.5 mL/min **MP**: Iso-octane/Dioxane (0.15% Water) (94/6, v/v)
6	In-house method	NA	Water acidified 0.5% H_3PO_4 / Tetrahydrofuran (50/5, v/v)	Sonicate for 15 min. Filters through a 0.2 µm PP disk	10	35	DAD 220 nm	**SP**: Nucleodur C18 250 x 3 mm; 5 µm; 0.3 mL/min **MP**: Water acidified H_3PO_4 0.5% /Acetonitrile (20:80, v/v)
7	In-house method	NA	Acetonitrile	Dissolve with 50 mL acetonitrile. Sonicate for 15 min. Filter on a 0.45 µm cellulose filter	10	30	DAD 230 nm	**SP**: Lichrospher 100 RP18 250 x 4.0 mm; 5 µm; 2 mL/min **MP**: Water acidified H_3PO_4 0.5% /Acetonitrile (20:80, v/v)
9	In-house method	N/A	Acetone	Extract with acetone for 24 h by RT. Dilute with acetonitrile	10	40	DAD 220 nm	**SP**: Zorbax SBC18 150 X 4.6mm; 5 µm; 1 mL/min **MP**: Acetonitrile/Water acidified H_3PO_4 0.1% (90:10, v/v)

ID Lab	Reference method	Internal standard	Extractants	Sample preparation	Injection volume µL	Column T°	Detector	Stationary phase (SP) Mobile phase (MP)
10	CIPAC MT 333	N/A	Iso-Octane / dioxane with 0.15% H_2O	Weight sample / 25 mL solvents	20	NA	DAD 230 nm	**SP**: Varian CN 3 250 x 4.6 mm; 5 µm; 1.0 mL/min **MP**: Iso-Octane/Dioxane with 0.15% Water (470 mL+ 30 mL)
12	In-house method	N/A	Acetonitrile	Sonicate for 15 min, filter on a 0.45 nylon filter	10	35	DAD 218nm	**SP**: Zorbax Eclipse C8 150 x 4.6 mm; 5 µm; 1.0 mL/min **MP**: water acidified H_3PO_4 0.1%/Acetonitrile
13	In-house method	Dicyclohexy lphthalate 0.4 mg/mL	Acetone	Weight a sample portion. Sonicate 3 min. Shake for 10 s	1	gradient	FID	**SP**: Rxi 1ms 30 m x 0.25 mm; 0.25 µm
14	CIPAC MT 333	N/A	Dioxane / Iso-Octane (10:40, v/v)	Dissolve in 10 mL dioxane. Sonicate for 15 min. Fill to up volume 50 mL Iso-octane. Filter through a 0.45 µm PTFE disk	10	30	DAD 254 nm	**SP**: Hypersil silica 120A 150 x 4.0 mm; 3 µm; 0.8 mL/min **MP**: Iso-Octane/Dioxane 97:3, (v/v)
15	In-house method	N/A	Acetonitrile	Dilute with acetonitrile, and add 50 µL H_3PO_4. Fill to volume with acetonitrile. Sonicate for 15 min; filter through a 0.2 µm filter	10	35	DAD 240nm	**SP**: Roc C18 250 x 4.6 mm; 5 µm; 1.0 mL/min **MP**: Water acidified H_3PO_4 0.1%/Acetonitrile (20:80, v/v)
16	In-house multi analyte method	Dicyclohexy lphthalate 0.4 mg/mL	Acetonitrile	Sonicate for 20 min. Filter through a 0.45 µm nylon disk	1	gradient	FID	**SP**: HP5 30 m x 0.32 mm; 0.25 µm.
17	In-house multi analyte method	NA	Acetonitrile	Weigh, and dilute in acetonitrile. Sonicate and fill up to volume with acetonitrile. Filter on a 0.45 µm filter	5	25	PDA 220 nm	**SP**: Kinetix C18 100A 100 x 4.6 mm; 2.6 µm; 5 mL/min **MP**: Water acidified formic acid 0.1% / Acetonitrile (35:65 v/v)
18	CIPAC MT 333	N/A	Acetonitrile	Sonicate for 15 min	15	NA	UV 230 nm	**SP**: Spherisorb S5 Nitrile 250 mm x 4.6 mm; 5 µm; 1.5 mL/min **MP**: Iso-Octane/Dioxane (95/5, v/v)
19	CIPAC MT 333	N/A	Dioxane (0.15% water) / Iso-octane (20/80, v/v)	Sample + 2 mL of 1.4 dioxane (1.4-dioxane added with 0.15% of water) and 7 mL of isooctane. Mix on a vortex for 1-2 min. Add 10 mL of isooctane. Filter on a 0.45 µm filter	5	35	DAD 230 nm	**SP**: Supelco Ascentis ES Cyano 150 x 2.1 mm; 3.0 µm; 0.3 mL/min **MP**: Dioxane (0.15% Water) / Iso-octane (6/94, v/v)

Table 18. CIPRODYNIL: representative method of the determination (ITPT2023)

ID Lab	Reference method	Internal standard	Extractants	Sample preparation	Injection volume µL	Column T°	Detector	Stationary phase (SP) Mobile phase (MP)
1	CIPAC MT 511	N/A	Acetonitrile	Sample + 2.5mL H_2O fill up to volume 50 mL acetonitrile. 1 mL to 20 mL acetonitrile. Sonicate for 30 min, filter through a 0.45 µm filter	1	40	PDA 254 nm	**SP**: Phenomenex Biphenyl, 100 x 2.1 mm; 2.6 µm; 0.4 mL/min **MP**: Acetonitrile/Water acidified TFA 1%
2	In-house method	NA	Acetonitrile	Sonicate for 8 min, filter through a 0.22 µm PTFE syringe filter	0.5	25	UV 240 nm	**SP:** Kinetex C18, 100 x 2.1 mm; 2.6 µm; 0.4 mL/min **MP**: Acetonitrile/Water acidified H_3PO_4 0.1%
3	In-house method	NA	Acetonitrile	Sonicate for 15 min	2	30	UV 315 nm	**SP** : Xterra RP18 150 x 2.1 mm; 3.5 µm; 0.3 mL/min **MP**: Water acidified TFA 0.1%/Acetonitrile
4	CIPAC MT 511	NA	5% Milli-Q-water/ 95% Acetonitrile	Sonicate	10	25	DAD 254 nm	**SP**: Kinetex Luna C18, 250 x 4,6 mm; 5 µm; 1.2 mL/min **MP**: Acetonitrile/Water acidified TFA 1% (40:60, v/v)
5	CIPAC MT 511	NA	Water/Acetonitrile	Extract with 5 mL water and 40 mL acetonitrile; sonicate for 5 min; dilute to 100 mL with acetonitrile (solution 1) after 10 mL of solution 1 fill up to volume 100 mL with eluent.	10	30	DAD 254 nm	**SP**: Phenomenex Luna C18, 250 x 4,6 mm; 5 µm; 1.4 mL/min **MP**: Water acidified TFA1%/Acetonitrile (60:40, v/v)
6	In-house method	N/A	Acidified water (0,5% H_3PO_4) / Tetrahydrofuran (50/50 (v/v))	Sonicate for 15 min, filter through a 0.2µm PP disk.	10	35	DAD 270 nm	**SP:** Nucleodur 250 x 3 mm; 5µm; 0.3 mL/min **MP**: Acetonitrile/Water acidified H_3PO_4 0.5% (90:10, v/v)
7	In-house method	NA	Acetone	Dilute in 50 mL acetone. Sonicate for 15 min. Dilute with acetone (1:5, v:v)	1		FID	**SP**: Zebron/HM-G-006 7B17-01; 30 m x 0.32 mm; 0.25 µm.
8	In-house method	NA	Methanol	Dilute in 50mL of methanol. Fill up to volume with methanol. Dilute with methanol and filter through a 0.45 µm filter	20	25	PDA 266 nm	**SP:** Phenomenex Synergi 4-Hydro RP-C18, 150 x 2 mm; 4 µm; 0.2 mL/min **MP**: Methanol/Water acidified formic acid 0.3%

ID Lab	Reference method	Internal standard	Extractants	Sample preparation	Injection volume µL	Column T°	Detector	Stationary phase (SP) Mobile phase (MP)
9	In-house method	N/A	Acetone	24 h RT in acetone, shake manually, dilute in acetonitrile	10	40	DAD 254 nm	**SP**: Zorbax SBC18, 150 x 4,6 mm; 5 µm 1.0 mL/min **MP**: Acetonitrile/Water acidified H_3PO_4 0.1% (60:40, v/v)
10	Manufacturer's method	N/A	Acetonitrile	Weight of sample dilute in 25 acetonitrile	10	NA	DAD 254 nm	**SP**: Zorbax Rx C18, 250 mm x 4,6 mm; 5 µm 1 mL/min **MP**: Water acidified TFA1%/Acetonitrile (60:40, v/v)
11	CIPAC MT 511	N/A	Acetonitrile	Disperse the sample in 5 mL of water. Add about 40 mL of acetonitrile. Sonicate for 5 minutes. Fill up to the mark with acetonitrile at 20°C. Take 10mL of this solution and dilute up to 100 mL with solvent (acetonitrile/water + 1% trifluoroacetic acid) (40/60 v/v). Filter through a 0,45µm filter	10	25	DAD 254 nm	**SP**: Nucleosil 120 -5 C18 250 x 4.0 mm; 5 µm; 1.2 mL/min **MP**: Water acidified 1%TFA /Acetonitrile/ (60:40, v/v)
12	in-house method	N/A	Acetonitrile	Sonicate 15 min, filter 0,45 nylon filter	10	35	DAD 218 nm	**SP**: Zorbax Eclipse C8, 150 x 4,6 mm; 5 µm; 1.5 mL/min **MP**: Acetonitrile/Water acidified TFA 1%
13	in-house method	Dicyclohexy lphthalate 0.4 mg/mL	Acetone	Shake 10 s	1	/	FID	**SP**: Rxi 1 ms 30 m x 0.25 mm; 0.25 µm.
14	CIPAC MT 511	NA	Acetonitrile	Suspend the sample with 5 mL of water, add 40 mL of acetonitrile and sonicate for 5 mins. Then make up to 50 mL with acetonitrile and make dilution 1/10 with acetonitrile. Filter through 0.45 µm PTFE disk	10	Ambient	DAD 340 nm	**SP:** Phenomenex Luna C18(2) 100A, 250 x 4.6 mm; 5 µm; 1.2 mL/min **MP**: Acetonitrile/Water acidified TFA 1% (60:40, v/v)

ID Lab	Reference method	Internal standard	Extractants	Sample preparation	Injection volume µL	Column T°	Detector	Stationary phase (SP) Mobile phase (MP)
15	CIPAC MT 511	NA	Acetonitrile	Weight a quantity of a sample containing about 100 mg of Ciprodinil, add 5 mL H_2O and 40 mL acetonitrile. Sonicate for 5 min. Allow to cool to ambient temperature and fill up to mark (100 mL) with acetonitrile. Take 10 mL and dilute with 100 mL of acetonitrile/water with Trifluoroacetic acid (TFA) 1%. Filter on Anotop 0.45 µm filter, before injection	10	35	DAD 254nm	**SP**: Nucleosil C18, 250 x 4.6 mm; 5 µm 1.2 mL/min **MP**: Acetonitrile/Water acidified TFA 1% (60:40, v/v)
16	In-house multi analyte method	Dicyclohexy lphthalate 0.4 mg/mL	Ethyl acetate	Sonicate for 20 min, filter through a Nylon 0.45 µm disk	1	30	FID	**SP**: HP5 30 m x 0.32 mm; 0.25 µm
17	In-house multi analyte method	NA	Ethyl acetate	Weight sample, dilute in Ethyl Acetate; sonicate and allow to cool. Fill up to volume 100 mL	0.2	//	FID	**SP**: HP5 MS 30 m x 0.25 mm; 0.25 µm
18	In-house method	NA	Acetonitrile	Dilute the sample in water, add acetonitrile, sonicate, and filter on 0.2 µm filter	2	//	PDA 254 nm	**SP**: Aquity UHPLC BEH 100 mm x 2.1 mm; 1.7 µm. 8.5 mL/min **MP**: Acetonitrile/Water acidified TFA 1% (60:40, v/v)
19	CIPAC MT 511	NA	Acetonitrile	Weigh the sample, and dilute to 10 mL with acetonitrile. Dilute 600 µL of the prepared solution to 20 mL with acetonitrile	0.5	25	DAD 254 nm	**SP**: Restek Pinnacle II C18 150 mm x 4.6 mm; 5 µm; 1.2 mL/min **MP**: Acetonitrile/Water acidified TFA 1% (60:40, v/v)

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APPENDIX A
The announcement letter

DIPARTIMENTO
AMBIENTE E SALUTE

ANNOUNCEMENT/INVITATION
ITPT2024

Dear Colleagues,

We herewith cordially invite you to participate in the Italian Proficiency Test on the analysis of PPPs in EC, SG and WG. The Italian Laboratory of National Institute of Health – Department of Environment and Health organize this exercise, in the framework of the collaboration with the Health Ministry.
We scheduled to run the ITPT2024 from 15th of January until 30th of April 2024.

AIMS
Participation in proficiency tests is part of the QA/QC system of laboratories and provides them with an assessment of their analytical performance as well as a comparison with the performance of other laboratories. The general aim is to help laboratories demonstrate adequate analytical performance and, in case of underperformance, to help them identify sources of errors so that they take the necessary measures for quality improvement.

TEST ITEM
Ca. 10g of PPP test Item will be shipped to each participating laboratory.
To participant it ask to analyze three products containing three active substances in two different days.

TARGET ANALYTES
The analytes are:

Active Substance	Conc (g/100g)	Formulation
Fluroxypyr	29.2	EC
Boscalid	50	WG
Bentazone	87	SG

SHIPMENT AND RECEIPT OF THE TEST ITEM
We planned the shipment of the Test Item around 15th of January 2024. If any laboratory will be on holiday in the week of the shipment, please inform the organizer to rearrange shipment.
The sample will be shipped at room temperature.
Participants must check the integrity and condition of the materials upon receipt and to report within 48h if they accept the materials or not.

IMPORTANT DATES
- Shipment of the Test Items around 15th of January 2024.
- Submission of results and method information by 30th of April 2024.

Istituto Superiore di Sanità
Dipartimento /
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DIPARTIMENTO
AMBIENTE E SALUTE

PARTICIPATION FEE
The participation is free of charge.

RELEVANT DOCUMENTS
Copies of SDS will be send via e-mail separately.
Participants are encouraged to employ the method typically run in their lab for these compounds.
Copies of the methods will be send to participants that asked them, separately.

OTHER INFORMATION
Only the information of the laboratory and name of participant will be publish on the report.
The correlation between laboratory (name of participant, name of laboratory) and number of laboratory will be consider confidential and not publish on the report.

CALENDAR for the ITPT2024

Activity	Dates
Opening of the ITPT2024	7 November 2023
Confirm the participation	5 December 2023
Shipment of the ITPT2024 Test Item	15 January 2024
Confirmation of Sample Receipt and Acceptance	Within 48 h of receipt
Result Submission	30 January – 30 April 2024
Preliminary Report	May 2024
Final Report	June 2024

SUPPORT AND CONTACT INFORMATION

For any questions about the ITPT2024, please mail to angela.santilio@iss.it; silvana.girolimetti@iss.it

Best regards,

The ITPT2023 Organizing Team

Angela Santilio

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APPENDIX B
Calendar and list of participants

CALENDAR for the ITPT2023

Activity	Dates
Opening of the ITPT2023	7th November 2022
Confirm the participation	5th December 2022
Shipment of the ITPT-PPP03 Test Item	15th January 2023
Confirmation of Sample Receipt and Acceptance	Within 48 h of receipt
Result Submission	30th January – 30th April 2023
Preliminary Report	May 2023
Final Report	June 2023

LIST OF PARTICIPANTS

Italian participants

Arianna Palchetti	*Laboratorio analisi alimenti e sicurezza dei prodotti – APPA BZ*
Luigi Bazzani Diego Tamoni	*ARPA Emilia Romagna* *Sede secondaria laboratorio Multisito, sezione di Ferrara*
Leonardo Sabatino	*Ministero delle Politiche Agricole Alimentari e Forestali, Ispettorato centrale della tutela della qualità e repressione frodi dei prodotti agroalimentari - Laboratorio di Catania*
Tiziana Generali	*Istituto Superiore di Sanità, Roma*
Alessandra Giuliani	*ARPA Lazio - Servizio Ambiente e Salute -Dipartimento di Prevenzione e Laboratorio Integrato -Sede territoriale di Roma*

European participants

Christoph Czerwenka	*AGES Group for contaminant and special analysis, Austrian Agency for Health and Food Safety - Austria*
Florentina Ciotea	*National Phytosanitary Authority - Romania*
Frantisek Csicsay	*Central Control and testing Institute in agriculture, ÚKSÚP – Slovak Republic*
Veronique Nedellec Sabine Castelle	*Service Commun des laboratories- DGCCRF – DGDDI*
Claudia Vinke Kristina Pape	*Federal Office of Consumer Protection and Food Safety, Laboratory for formulation chemistry - Germany*
Cristina Ø Pedersen Sara Kobbelgard	*Laboratory for chemistry and microbiology, Danish Technological Institute - Denmark*

Isabelle Monisse	*AFSCA- Belgium*
Eva Jacobsen	*Danish Technological Institute - Aarhus, Denmark*
Kati Hakala	*Finnish Food Authority - Finland*
Helen Karasali Petros Tbiantas	*Laboratory of chemical Control of Pesticide, Benaki Phytopathological Institute –Greece*
Elaine Devaney	*Pesticide formulation laboratory - Ireland*
Olga Nováková	*UKZUZ Central Institute for Supervising and Testing in Agriculture, National Reference laboratory, Department of testing Plant Protection Products – Czech Republic*
Benoit Saclier	*Service Commun des Laboratoires - France*
Petar Ilchev	*CLCT, Bulgary*
Bernard de Rychel	*Walloon Agricultural Research Centre (CRA-W), Belgium*
Javier Garcìa-Hierro Navas	*Laboratorio Arbitral Agroalimentario, Spain*

GLOSSARY

Active Ingredient. An Active Ingredient (AI) is the ingredient in a pharmaceutical drug or plant-health drug that is biologically active. Some products may contain more than one active ingredient.

Analyte. An analyte, component, or chemical species is a substance or chemical constituent that is of interest in an analytical procedure.

CAS number. A CAS Registry Number, also referred to as CASRN or CAS Number, is a unique numerical identifier assigned by the Chemical Abstracts Service (CAS) to every chemical substance described in the open scientific literature (currently including all substances described from 1957 through the present, plus some substances from the early or mid-1900s) including organic and inorganic compounds, minerals, isotopes, alloys and no structural materials (UVCBs, of unknown, variable composition, or biological origin). The registry maintained by CAS is an authoritative collection of disclosed chemical substance information. It currently identifies more than 141 million unique organic and inorganic substances and 67 million protein and DNA sequences, plus additional information about each substance. It is updated with around 15,000 additional new substances daily.

Chemical formula. A chemical formula is a way that chemists describe a molecule. The formula says what atoms, and how many of each type, are in the molecule. Sometimes the formula shows how the atoms are linked, and sometimes the formula shows how the atoms are arranged in space. The letter shows what chemical element each atom is.[1] The subscript shows the number of each type of atom.

% CV. The coefficient of variation (CV) is defined as the ratio of the standard deviation σ to the mean μ multiplied 100: $CV = (\sigma / \mu) \times 100$.

E isomer. It is the IUPAC convention of a molecular configuration, if the two groups of higher priority are on opposite sides of the double bond, the bond is assigned the configuration E (from the German word for "opposite" *entgegen*).

Grand Average. The grand mean or average is the mean of the means of several subsamples, as long as the subsamples have the same number of data points. For example, consider several lots, each containing several items. The items from each lot are sampled for a measure of some variable and the means of the measurements from each lot are computed. The mean of the measures from each lot constitutes the subsample mean. The mean of these subsample means is then the grand mean.

Homogeneity. Homogeneity and heterogeneity are concepts often used in the sciences and statistics relating to the uniformity in a substance or organism. A material or image that is homogeneous is uniform in composition or character (i.e., colour, shape, size, weight, height, distribution, texture, language, income, disease, temperature, radioactivity, architectural design, etc.); one that is heterogeneous is distinctly non uniform in one of these qualities.

Horwits Ratio. The Horwits ratio is a normalized performance parameter indicating the acceptability of methods of analysis with respect to among-laboratory precision (reproducibility).

Internal Standard. An internal standard in analytical chemistry is a chemical substance that is added in a constant amount to samples, the blank and calibration standards in a chemical analysis. This substance can then be used for calibration by plotting the ratio of the analyte signal to the internal standard signal as a function of the analyte concentration of the standards. This is done to correct for the loss of analyte during sample preparation or sample inlet. The internal standard is a compound that is very similar, but not identical to the chemical species of interest in the samples, as the effects

of sample preparation should, relative to the amount of each species, be the same for the signal from the internal standard as for the signal(s) from the species of interest in the ideal case.

MAD. In statistics, the Median Absolute Deviation (MAD) is a robust measure of the variability of a univariate sample of quantitative data. MAD = median of ($|X_i$ – median (Xi) $|_{i=1,2...n}$).

Median. The median is the value separating the higher half of a data sample, a population, or a probability distribution, from the lower half. For a data set, it may be thought of as the "middle" value. For a continuous probability distribution, the median is the value such that a number is equally likely to fall above or below it. The median is a commonly used measure of the properties of a data set in statistics and probability theory. The basic advantage of the median in describing data compared to the mean (often simply described as the "average") is that it is not skewed so much by extremely large or small values, and so it may give a better idea of a "typical" value. Because of this, the median is of central importance in robust statistics.

Modified z-score. The z-score of an observation is defined as $Zi = (X - \mu) / \sigma$, where X is a sample, μ the sample mean and σ the standard deviation. In other words, data is given in units of how many standard deviations it is from the mean. Although it is common practice to use z-scores to identify possible outliers, this can be misleading in particularly for small sample sizes, so is better to use the modified z-score:

$$Zi = 0.6745 \text{ x } ^{(Xi - median)} / MAD$$

The modified z-scores with an absolute value of greater or lower than 3.5 be labelled as an outlier.

Outlier. An outlier is an observation that appears to deviate markedly from other observations in the sample. Identify potential outliers is important because it may indicate a bad data. For example, the data may have been coded incorrectly or an experiment may not have been run correctly. If it can be determined that an outlying point is in fact erroneous, then the outlying value should be deleted from the analysis (or corrected if possible). If it is not possible to simply delete the outlying observation, the use of robust statistical techniques may be considered.

Reference method. A reference method is an analytic procedure sufficiently free of random or systemic errors to make it useful for validating proposed new analytic procedures for the same analyte. This method has to be accuracy of a definitive method already certified demonstrated through direct comparison and must use primary reference material (standards, glasses, instruments). An in-house method it means that the method is not certified and made with the laboratory's instruments and techniques. The CIPAC methods is an analytical method make following CIPAC's instructions as the Manufacturer's method is make with the Manufacturer's instructions.

SD. The standard deviation (SD, also represented by the Greek letter sigma σ or the Latin letter s) is a measure that is used to quantify the amount of variation or dispersion of a set of data values. A low standard deviation indicates that the data points tend to be close to the mean of the set, while a high standard deviation indicates that the data points are spread out over a wider range of values.

Stability. The stability is a molecular characteristic of a chemical or compound; is the tendency of a material to resist change or decomposition in its natural environment or when exposed to air, heat, light, pressure or other natural conditions or due to internal reaction.

Z isomer. is the IUPAC convention of a molecular configuration, if the two groups of higher priority are on the same side of the double bond, the bond is assigned the configuration Z (from the German word for "together" *zusammen*).

Serie Rapporti ISTISAN
numero di gennaio 2024, 1° Suppl.

Stampato in proprio
Servizio Comunicazione Scientifica – Istituto Superiore di Sanità

Roma, marzo 2024