Food and Agriculture Organization
of the United Nations

FAO SPECIFICATIONS AND EVALUATIONS FOR AGRICULTURAL PESTICIDES

ATRAZINE

6-chloro-*N*^{2}-ethyl-*N*^{4}-isopropyl-1,3,5-triazine-2,4-diamine

2025

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DISCLAIMER[1]

FAO specifications are developed with the basic objective of promoting, as far as practicable, the manufacture, distribution and use of pesticides that meet basic quality requirements.

Compliance with the specifications does not constitute an endorsement or warranty of the fitness of a particular pesticide for a particular purpose, including its suitability for the control of any given pest, or its suitability for use in a particular area. Owing to the complexity of the problems involved, the suitability of pesticides for a particular purpose and the content of the labelling instructions must be decided at the national or provincial level.

Furthermore, pesticides which are manufactured to comply with these specifications are not exempted from any safety regulation or other legal or administrative provision applicable to their manufacture, sale, transportation, storage, handling, preparation and/or use.

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FAO is not responsible, and does not accept any liability, for the testing of pesticides for compliance with the specifications, nor for any methods recommended and/or used for testing compliance. As a result, FAO does not in any way warrant or represent that any pesticide claimed to comply with a FAO specification actually does so.

[1] This disclaimer applies to all specifications published by FAO.

INTRODUCTION

FAO establishes and publishes specifications* for technical material and related formulations of agricultural pesticides, with the objective that these specifications may be used to provide an international point of reference against which products can be judged either for regulatory purposes or in commercial dealings.

From 1999 onward, the development of FAO specifications follows the New Procedure, described first in the fifth edition of the "Manual on the development and use of FAO specifications for plant protection products" and later in the first edition of the “Manual on Development and Use of FAO and WHO Specifications for Pesticides” (2002) – currently available as „Manual on the development and use of FAO and WHO specifications for chemical pesticides” second edition (2022) – which is available only on the internet through the FAO and WHO web sites.

This New Procedure follows a formal and transparent evaluation process. It describes the minimum data package, the procedure and evaluation applied by FAO and the experts of the FAO/WHO Joint Meeting on Pesticide Specifications (JMPS). [Note: prior to 2002, the experts were of the FAO Panel of Experts on Pesticide Specifications, Registration Requirements, Application Standards and Prior Informed Consent, which now forms part of the JMPM, rather than the JMPS.]

FAO Specifications now only apply to products for which the technical materials have been evaluated. Consequently from the year 2000 onwards the publication of FAO specifications under the New Procedure has changed. Every specification consists now of two parts namely the specifications and the evaluation report(s):

Part One: The Specification of the technical material and the related formulations of the pesticide in accordance with chapters 4 to 9 of the “Manual on the development and use of FAO and WHO specifications for chemical pesticides”.

Part Two: The Evaluation Report(s) of the pesticide, reflecting the evaluation of the data package carried out by FAO and the JMPS. The data are provided by the manufacturer(s) according to the requirements of chapter 3 of the “ Manual on the development and use of FAO and WHO specifications for chemical pesticides” and supported by other information sources. The Evaluation Report includes the name(s) of the manufacturer(s) whose technical material has been evaluated. Evaluation reports on specifications developed subsequently to the original set of specifications are added in a chronological order to this report.

FAO specifications developed under the New Procedure do not necessarily apply to nominally similar products of other manufacturer(s), nor to those where the active ingredient is produced by other routes of manufacture. FAO has the possibility to extend the scope of the specifications to similar products but only when the JMPS has been satisfied that the additional products are equivalent to that which formed the basis of the reference specification.

Specifications bear the date (month and year) of publication of the current version. Evaluations bear the date (year) of the meeting at which the recommendations were made by the JMPS.

* Note: Publications are available on the internet at (https://www.fao.org/pest-and-pesticide-management/guidelines-standards/faowho-joint-meeting-on-pesticide-specifications-jmps/pesticide-specifications/pesticide-specifications-list/en/) or in hardcopy from the plant protection information officer.

PART ONE

SPECIFICATIONS

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ATRAZINE

INFORMATION

ISO common name

atrazine

Chemical name(s)

IUPAC:

6-chloro-N^2-ethyl-N^4-isopropyl-1,3,5-triazine-2,4-diamine

or

6-chloro-N^2-ethyl-N^4-(propan-2-yl)-1,3,5-triazine-2,4-diamine

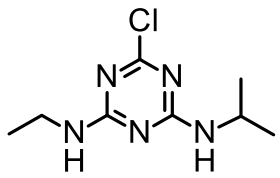
CA:

6-chloro-N^2-ethyl-N^4-(1-methylethyl)-1,3,5-triazine-2,4-diamine

Synonyms

G30027

Structural formula



Molecular formula

$C_8H_{14}ClN_5$

Relative molecular mass

215.7

CAS Registry number

1912-24-9

CIPAC number

91

Identity tests

GC retention time or IR

FAO Specification 91/TC (December 2024*)

This specification, which is PART ONE of this publication, is based on an evaluation of data submitted by the manufacturer whose name is listed in the evaluation report (91/2019). It should be applicable to relevant products of this manufactuer, but it is not an endorsement of those products, nor a guarantee that they comply with the specification. The specification may not be appropriate for TC produced by other manufacturers. The evaluation report (91/2019), as PART TWO, forms an integral part of this publication.

1 Description

The material shall consist of atrazine, together with related manufacturing impurities and shall be a white to light beige or light grey powder, free from visible extraneous matter and added modifying agents.

2 Active ingredient

2.1 Identity tests (91/TC/M2, CIPAC Handbook P, p. 13, 2021)

The active ingredient shall comply with an identity test and, where the identity remains in doubt, shall comply with at least one additional test.

2.2 A*trazine content* (91/TC/M3, CIPAC Handbook P, p. 13, 2021)

The atrazine content shall be declared (not less than 960 g/kg) and, when determined, the average measured content shall not be lower than the declared minimum content.

* Specifications may be revised and/or additional evaluations may be undertaken. Ensure the use of current versions by checking at: https://www.fao.org/pest-and-pesticide-management/guidelines-standards/faowhojoint-meeting-on-pesticide-specifications-jmps/pesticide-specifications/en/

ATRAZINE SUSPENSION CONCENTRATE

FAO Specification 91/SC (December 2024*)

This specification, which is PART ONE of this publication, is based on an evaluation of data submitted by the manufacturer whose name is listed in the evaluation report (91/2019). It should be applicable to relevant products of this manufactuer, but it is not an endorsement of those products, nor a guarantee that they comply with the specification. The specification may not be appropriate for the products of other manufacturers. The evaluation report (91/2019), as PART TWO, forms an integral part of this publication.

1 Description

The material shall consist of a suspension of fine particles of technical atrazine, complying with the requirements of FAO specification 91/TC (September 2024), in an aqueous phase together with suitable formulants. After gentle agitation, the material shall be homogeneous (Note 1) and suitable for further dilution in water.

2 Active ingredient

2.1 Identity tests (91/SC/M, CIPAC Handbook P, p. 18, 2021)

The active ingredient shall comply with an identity test and, where the identity remains in doubt, shall comply with at least one additional test.

2.2 Atrazine content (91/SC/M, CIPAC Handbook P, p. 18, 2021)

The atrazine content shall be declared (g/kg or g/l at 20 ± 2°C, Note 2) and, when determined, the average content measured shall not differ from that declared by more than the appropriate tolerance, given in the following table of tolerances:

Declared content in g/kg or g/l at 20 ± 2°C	Tolerance
above 100 up to 250	± 6 % of the declared content
above 250 up to 500	± 5 % of the declared content
above 500	± 25 g/kg or g/l
Note: In each range the upper limit is included	

3 Physical properties

3.1 pH range (MT 75.3, CIPAC Handbook J, p.131, 2000)

pH range: 4 to 8

3.2 Pourability (MT 148.2, Note 3)

Maximum "residue": 5 %

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* Specifications may be revised and/or additional evaluations may be undertaken. Ensure the use of current versions by checking at: https://www.fao.org/pest-and-pesticide-management/guidelines-standards/faowhojoint-meeting-on-pesticide-specifications-jmps/pesticide-specifications/en/

3.3 Spontaneity of dispersion (MT 160.1, Notes 4 & 5)

Minimum 60% after 5 min in CIPAC standard water D at 25 ± 5°C.

3.4 Suspensibility (MT 184.1, CIPAC Handbook P, p.245, 2021) (Note 5)

Minimum 80 % after 30 min in CIPAC standard water D at 25 ± 5°C.

3.5 Wet sieve test (MT 185.1, Note 6)

Maximum: 2 % retained on a 75 µm test sieve.

3.6 Persistent foam (MT 47.3, CIPAC Handbook O, p.177, 2017) (Note 7)

Maximum: 60 ml after 1 min.

4 Storage stability

4.1 Stability at 0°C (MT 39.3, CIPAC Handbook J, p. 126, 2000)

After storage at 0 ± 2°C for 7 days, the formulation shall continue to comply with the clauses for:
- suspensibility (3.4),
- wet sieve test (3.5).

4.2 Stability at elevated temperature (MT 46.4, CIPAC Handbook P, p.232, 2021)

After storage at 54 ± 2°C for 14 days, the determined average active ingredient content must not be lower than 95 % relative to the determined average content found before storage (Note 8) and the formulation shall continue to comply with the clauses for:
- pH range (3.1)
- pourability (3.2),
- spontaneity of dispersion (3.3),
- suspensibility (3.4),
- wet sieve test (3.5).

Note 1 Before sampling to verify the formulation quality, inspect the commercial container carefully. On standing, suspension concentrates usually develop a concentration gradient from the top to the bottom of the container. This may even result in the appearance of a clear liquid on the top and/or of sediment on the bottom. Therefore, before sampling, homogenize the formulation according to the instructions given by the manufacturer or, in the absence of such instructions, by gentle shaking of the commercial container (for example by inverting the closed container several times). Large containers must be opened and stirred adequately. After this procedure, the container should not contain a sticky layer of non-dispersed matter at the bottom. A suitable and simple method of checking for a non-dispersed sticky layer "cake" is by probing with a glass rod or similar device adapted to the size and shape of the container. All the physical and chemical tests must be carried out on a laboratory sample taken after the recommended homogenization procedure.

Note 2 Unless homogenization is carried out carefully, it is possible for the sample to become aerated. This can lead to errors in the determination of the mass per millilitre and in calculation of the active ingredient content (in g/l) if methods other than MT 3.3 or OECD 109 are used. If the buyer requires both g/kg and g/l at 20°C, then in case of dispute the analytical results shall be calculated as g/kg.

Note 3 The revision of methods MT 148 and MT 148.1 (CIPAC/5355) to combine into a single method MT 148.2 for the determination of pourability of formulations was accepted as provisional CIPAC method with the remark that MT 148.2 supersedes MT 148 and MT 148.1. Before publication in a handbook it is available as a pre-published method. (https://www.cipac.org/index.php/m-p/pre-published-methods).

Note 4 The revision of methods MT 160 (CIPAC/5323) to determine the spontaneity of dispersion of liquid formulations forming suspensions on dilution with water was accepted as full CIPAC method with the remark that MT 160.1 supersedes MT 160 (ISBN 978-1-911009-72-6). Before publication in a handbook it is available as a pre-published method. (https://www.cipac.org/index.php/m-p/pre-published-methods)

Note 5 Chemical assay is the only fully reliable method to measure the mass of active ingredient still in suspension. However, simpler methods such as gravimetric and solvent-extraction determination may be used on a routine basis provided that these methods have been shown to give equal results to those of the chemical assay method. In case of dispute, the chemical method shall be the "Referee method".

Note 6 The revision of methods MT 182 and MT 185 (CIPAC/5353) to combine into a single method for wet sieve test was accepted as provisional CIPAC method under the prerequisite that it supersedes both MT 182 and MT 185 (ISBN 978-1-911009-78-8). Before publication in a handbook it is available as a pre-published method. (https://www.cipac.org/index.php/m-p/pre-published-methods

Note 7 The mass of sample to be used in the test should correspond to the highest rate of use recommended by the supplier. The test is to be conducted in CIPAC standard water D.

Note 8 Samples of the formulation taken before and after the storage stability test may be analysed concurrently after the test in order to reduce the analytical error.

ATRAZINE WATER DISPERSIBLE GRANULES

FAO Specification 91/WG (December 2024*)

This specification, which is PART ONE of this publication, is based on an evaluation of data submitted by the manufacturer whose name is listed in the evaluation report (91/2019). It should be applicable to relevant products of this manufactuer, but it is not an endorsement of those products, nor a guarantee that they comply with the specification. The specification may not be appropriate for the products of other manufacturers. The evaluation report (91/2019), as PART TWO, forms an integral part of this publication.

1 Description

The material shall consist of a homogeneous mixture of technical atrazine, complying with the requirements of the FAO specification 91/TC (September 2024), in the form of spherical granules, with majority of them within a size-range to be specified, together with carriers and any other necessary formulants. It shall be in the form of granules for application after disintegration and dispersion in water. The formulation shall be dry, free-flowing, nearly dust free or essentially non-dusty, and free from visible extraneous matter and hard lumps.

2 Active ingredient

2.1 Identity tests (91/WG/M2, CIPAC Handbook P, p. 17, 2021)

The active ingredient shall comply with an identity test and, where the identity remains in doubt, shall comply with at least one additional test.

2.2 Atrazine content (91/WG/M3, CIPAC Handbook P, p. 17, 2021)

The atrazine content shall be declared (g/kg) and, when determined, the average content measured shall not differ from that declared by more than the appropriate tolerance, given in the following table of tolerances.

Declared content in g/kg	Tolerance
above 250 up to 500	± 5% of the declared content

3 Physical properties

3.1 Wettability (MT 53.3.1, CIPAC Handbook F, p. 165, 1995)

The formulation shall be completely wetted in 1 min without swirling.

3.2 Wet sieve test (MT 185.1, Note 1)

Maximum: 2 % retained on a 75 µm test sieve.

3.3 Dispersibility (MT 174, CIPAC Handbook F, p. 435, 1995)

Dispersibility: minimum 60 % after 1 minute of stirring.

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* Specifications may be revised and/or additional evaluations may be undertaken. Ensure the use of current versions by checking at: https://www.fao.org/pest-and-pesticide-management/guidelines-standards/faowhojoint-meeting-on-pesticide-specifications-jmps/pesticide-specifications/en/

3.4 Suspensibility (MT 184.1, CIPAC Handbook P, p.245, 2021) (Notes 2 & 3)

Suspensibility: minimum 70 % after 30 min in CIPAC standard water D at 25 ± 5°C.

3.5 Persistent foam (MT 47.3, CIPAC Handbook O, p.177, 2017) (Note 4)

Maximum: 90 ml after 1 minute.

3.6 Dustiness (MT 171.1, CIPAC Handbook P, p.235, 2021) (Note 5)

The formulation shall have a maximum collected dust of 30 mg by the gravimetric method or a maximum dust factor of 25 by the optical method of MT 171.1.

3.7 Flowability (MT 172.2, CIPAC Handbook P, p.235, 2021) (Note 6)

At least 99 % of the formulation shall pass through a 5 mm test sieve after 20 drops of the sieve.

3.8 Attrition resistance (MT 178.3, Note 7)

Minimum: 98 % attrition resistance.

4 Storage stability

4.1 Stability at elevated temperature (MT 46.4, CIPAC Handbook P, p.232, 2021)

After storage at 54 ± 2°C for 14 days, the determined average active ingredient content must not be lower than 95 % relative to the determined average content found before storage (Note 8) and the formulation shall continue to comply with the clauses for:

- wet sieve test (3.2),
- dispersibility (3.3),
- suspensibility (3.4),
- dustiness (3.6),
- attrition resistance (3.8),

Note 1 The revision of methods MT 182 and MT 185 (CIPAC/5353) to combine into a single method for wet sieve test was accepted as provisional CIPAC method under the prerequisite that it supersedes both MT 182 and MT 185 (ISBN 978-1-911009-78-8). Before publication in a handbook it is available as a pre-published method. (https://www.cipac.org/index.php/m-p/pre-published-methods

Note 2 The formulation should be tested at the highest and lowest rates of use recommended by the supplier, provided this does not exceed the conditions given in method MT 184.1.

Note 3 Chemical assay is the only fully reliable method to measure the mass of active ingredient still in suspension. However, the simpler gravimetric method may be used on a routine basis provided that it has been shown to give equal results to those of chemical assay. In case of dispute, chemical assay shall be the referee method.

Note 4 The mass on sample to be used in the test should be specified at the highest rate recommended by the supplier. The test is to be conducted in CIPAC standard water D at 25 ± 5°C.

Note 5 Measurement of dustiness must be carried out on the sample “as received” and, where practicable, the sample should be taken from a newly opened container, because changes in the water content of samples may influence dustiness significantly. The optical method of MT 171.1, usually shows

good correlation with the gravimetric method, and can, therefore, be used as an alternative where the equipment is available. Where the correlation is in doubt, it must be checked with the formulation to be tested. In case of dispute the gravimetric method shall be used.

Note 6 The flowability test (MT 172.2) includes the accelerated storage conditions to be used.

Note 7 The revision of methods MT 178 and MT 178.2 (CIPAC/5321) to combine into a single method for granular products and to include loosely packed tablets was accepted as full CIPAC method with the editorial changes and with the remark that MT 178.3 supersedes MT 178 and MT 178.2 (ISBN 978-1-911009-69-6).

Note 8 Samples of the formulation taken before and after the accelerated storage stability test may be analysed concurrently after the test in order to reduce the analytical error.

PART TWO

EVALUATION REPORTS

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ATRAZINE

FAO/WHO EVALUATION REPORT 91/2019

Recommendations

The Meeting recommended that:

(i) the specifications for atrazine TC, SC and WG formulations, proposed by Syngenta Crop Protection AG, as amended, should be adapted by FAO.

(ii) the FAO specifications for atrazine technical and dispersible powder developed under the "Old Procedure" should be withdrawn.

Appraisal

The Meeting considered the data package submitted by Syngenta Crop Protection AG (Syngenta) in November 2018 in support of conversion of "old procedure" FAO specification for atrazine TC and development of new specifications for SC and WG formulations.

Accordingly, the data were evaluated for consideration of the proposal for acceptance as a new reference specification for technical atrazine.

Atrazine is not under patent.

Atrazine was evaluated by the FAO/WHO JMPR in 2007 and by WHO/IPCS in 1990 and 2011. It was evaluated by the Australian APVMA in 2008, and it is currently under re-evaluation by the US EPA. The draft specification and the supporting data were provided by Syngenta in 2018.

Atrazine is slightly volatile, slightly soluble in water and moderately lipophilic. Atrazine is a weak base. It is stable in neutral, weak acidic or alkaline medium, however it hydrolyses rapidly in strong acidic or strong alkaline medium. On hydrolysis it forms hydroxy derivative. Atrazine technical is a white to light beige or light grey powder.

The confidential data submitted on atrazine were different from those submitted for registration in the US and other countries to the extent that a new 5-batch report was generated for the FAO. The justification for this difference is that the previous 5-batch report was from 1994, which was too old for FAO purposes. On request, the proposer provided 5-batch report also from 1994. A request for confirmation of similarity of data was sent to the registration authority in the US (EPA), however, the confirmation is still awaited.

The Meeting was provided with commercially confidential information on the manufacturing process and five batch analytical data on impurities present at or above 1 g/kg in the TC and their manufacturing limits. Quality control data (January 2016 – August 2018) were also submitted.

Mass balances ranged from 990 to 994 g/kg. None of the manufacturing impurities was considered as relevant. The requirement of minimum content has been raised from minimum 920 g/kg of the old procedure specification to minimum 960 g/kg in the proposed specification. The physical properties, the methods for testing them and the limits proposed for the SC and WG formulations comply with the requirements of the FAO/WHO Manual.

The analytical method for determination of atrazine is a CIPAC method published in Handbook P. Atrazine is determined by capillary gas chromatographic method with FID, using acetone as a solvent and dipropyl phthalate as the internal standard. The methods for

determination of impurities are based on capillary GC with FID and internal standard, HPLC with UV detection and external standard, and titration.

Test methods for determination of physico-chemical properties of technical active ingredient were OECD and EPA methods, while those for WG and SC formulations were CIPAC methods as indicated in the specifications.

Data on physical-chemical properties for atrazine were provided.

Toxicology profile of the atrazine has been submitted based on acute toxicity, irritation and sensitization; subacute to chronic; mutagenicity (*in vitro* and *in vivo*); and ecotoxicology studies.

Specifications for formulations

The proposed specifications for SC and WG specifications were broadly in accordance with the 2016 revision of the Manual. The Meeting noted however that in most cases the default values were used in the specification and questioned this.

In the WG formulation, granules of round shape, with majority of the product ranging in size between 0.25 mm and 3.35 mm, have been proposed. The proposer used MT 168, CIPAC Water C for suspensibility test for WG instead of MT 184.1 and following the Meeting's request, new data were provided using MT 184.1. Test results of both the formulations for persistent foam showed high values. The test methods for testing the technical parameters of the formulations in the proposed specifications were updated according to the latest accepted CIPAC methods, where relevant.

SUPPORTING INFORMATION

FOR

EVALUATION REPORT 91/2019

Uses

Atrazine is a selective systemic herbicide. It acts as an inhibitor of photosystem II (PS II). It is used in agriculture for the control of annual broadleaf and grass weeds.

Identity of the active ingredient

ISO common name

atrazine (ISO 1750 published)

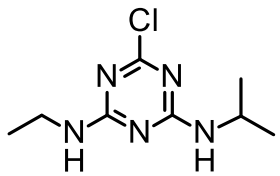
Chemical name(s)

IUPAC
6-chloro-*N*-ethyl-*N′*-isopropyl-[1,3,5]triazine-2,4-diamine
CA
6-chloro-*N*-ethyl-*N′*-(1-methylethyl)-1,3,5-triazine-2,4-diamine

Synonyms

G30027

Structural formula



Molecular formula

$C_8H_{14}ClN_5$

Relative molecular mass

215.7

CAS Registry number

1912-24-9

CIPAC number

91

Identity tests

GC retention time or IR

Table 1. Physico-chemical properties of pure atrazine

Parameter	Value(s) and conditions	Purity %	Method reference (and technique if the reference gives more than one)	Study number
Vapour pressure	3.85 x 10^{-5} Pa at 25°C (by extrapolation)	99.3	OECD 104, by extrapolation, gas saturation method	G30027/1497
Melting point.	175.8°C	99.2	OECD 102, capillary method	G30027/1756
Temperature of decomposition	No decomposition up to 150°C	97.4	Similar to OECD 113	G30027/1790
Solubility in water	0.033 g/l at 22°C at pH 7.0	99.3	OECD 105, flask method	G30027/1496
Octanol/water partition coefficient	log P_{OW} = 2.5 at 25°C at pH 7.9	99.2	OECD 117, HPLC method	G30027/1755
Hydrolysis characteristics	Half-life = 86 days at 20°C at pH 5 Tests conducted at pH 7 and pH 9 at 50°C showed that hydrolysis is slow.	Not reported	Similar to OECD 111	G30027/0090
Photolysis characteristics	10 ppm ^{14}C-atrazine in aqueous buffer solution pH 7 under natural sunlight 12 hours per day. Half-life = 335 days (12 hours sunlight per day, 40°N latitude)	>95% chemical purity; 98.3% radiopurity	EPA guideline	G30027/1416
Dissociation characteristics	pKa = 1.6	99.2	OECD 112, titration method	G30027/1812
Solubility in organic solvents	24 g/l ethyl acetate at 25°C 31 g/l acetone at 25°C 15 g/l methanol at 25°C 28 g/l dichloromethane at 25°C 8.7 g/l octanol at 25°C 4.0 g/l toluene at 25°C 0.11 g/l hexane at 25°C	99.2	Similar to OECD 105, flask method	G30027/1754

Table 2 Chemical composition and properties of atrazine technical material (TC)

Manufacturing process, maximum limits for impurities ≥ 1 g/kg, 5 batch analysis data	Confidential information supplied and held on file by FAO. Mass balances were 99.0 – 99.4 % and no unidentified impurities were reported.
Declared minimum atrazine content	960 g/kg
Relevant impurities ≥ 1 g/kg and maximum limits for them	none
Relevant impurities **<** 1 g/kg and maximum limits for them:	none
Stabilisers or other additives and maximum limits for them:	none

Parameter	Value and conditions	Purity %	Method reference	Study number
Melting temperature range of the TK	Assumed to be identical to that for pure AI, i.e. approximately 176°C			
Solubility in organic solvents	see Table 1			

Hazard Summary

Atrazine was evaluated by the WHO IPCS in 1990, and by the WHO for the drinking water guideline in 2011. Atrazine was also evaluated by the FAO/WHO JMPR in 2007.
The IPCS evaluation in 1990 resulted in a Health and Safety Guide. A WHO evaluation in 2011 concluded a drinking water guideline value of 0.1 mg/l.
The JMPR concluded that atrazine is unlikely to be genotoxic, that atrazine is not likely to pose a carcinogenic risk to humans, and that atrazine is not teratogenic.
IARC also classified atrazine (Vol. 73, 1999) and concluded that atrazine is not classifiable as to its carcinogenicity to humans (Group 3).
The IPCS hazard classification of atrazine is: Slightly hazardous, class III.
The Australian APVMA concluded that there are no major toxicological concerns relating to the use of atrazine; that atrazine is unlikely to be an endocrine disruptor in humans; and that epidemiological data provided no support for any carcinogenic potential of atrazine.
In Canada, atrazine is classified as acute oral toxicity category 4, and skin sensitization category 1.
ECHA published the EU-harmonized classification as skin sensitizer category 1, specific target organ toxicity (repeated exposure) category 2, Aquatic acute 1, and Aquatic chronic 1.

Formulations and co-formulated active ingredients

The main formulation types available are WG, SC and SE.
Atrazine may be co-formulated with mesotrione, S-metolachlor and other active ingredients. These formulations are registered and sold in many countries throughout the world.

Methods of analysis and testing

The analytical method for the active ingredient (including identity tests) is SA-70/1. The content of atrazine in TC, WG and SC is determined by capillary GC with FID and dipropyl phthalate as internal standard.

The methods for determination of impurities are based on capillary GC with FID and internal standard, HPLC with UV detection and external standard, and titration.

A CIPAC collaborative study of the active ingredient method was presented to CIPAC in June 2019. The capillary GC method for the determination of atrazine in TC, SC and WG formulations was accepted as a full CIPAC method in 2020 and is published in Handbook P.

Test methods for determination of physico-chemical properties of the technical active ingredient were OECD and EPA methods, while those for the formulations were CIPAC methods, as indicated in the specifications.

Physical properties

The physical properties, the methods for testing them and the limits proposed for the WG and SC formulations, comply with the requirements of the FAO/WHO Manual. (3rd revision).

Containers and packaging

No special requirements for containers and packaging have been identified.

Expression of the active ingredient

The active ingredient is expressed as atrazine.

ANNEX 1

HAZARD SUMMARY PROVIDED BY THE PROPOSER

Notes:
(i) The proposer confirmed that the toxicological and ecotoxicological data included in the summary below were derived from atrazine having impurity profiles similar to those referred to in the table above.

(ii) The conclusions expressed in the summary below are those of the proposer, unless otherwise specified.

Table 3 Toxicology profile of the atrazine technical material, based on acute toxicity, irritation and sensitization

Species	Test	Purity %	Guideline, duration, doses and conditions	Result	Study number
rat (m+fTif:RAI)	Acute oral	not reported	14 days	LD_{50} = 1,869 mg/kg (m&f combined)	G30027/1209
rat [m+f HSD:(SD)]	Acute oral	97.7	14 days	LD_{50} = 3,093 mg/kg (m&f combined)	G30027/1424
mouse (m+fTif:MAG)	Acute oral	not reported	14 days	LD_{50} = 3,992 mg/kg (m&f combined)	G30027/1211
mouse [m HSD:(ICR)]	Acute oral	not reported	14 days	LD_{50}> 1,332 mg/kg (m)	G30027/1352
rat (m+fTif:RAIf)	Acute dermal	not reported	14 days	LD_{50}> 3,100 mg/kg (m&f combined)	G30027/1212
rat (m+fTIF:RAIf)	Acute dermal	97.1	14 days	LD_{50}> 2,000 mg/kg (m&f combined)	G30027/1729
rat (m+fTIF:RAIf)	Acute inhalation	96.7	14 days	LC_{50}> 5,100 mg/m^3 (m&f combined)	G30027/1213
rat [m+f HSD:(SD)]	Acute inhalation	97.4	14 days	LC_{50}> 5,820 mg/m^3 (m&f combined)	G30027/1425
rat (m+fTIF:RAI)	Acute intraperitoneal	not reported	14 days	LD_{50} = 235 mg/kg (m&f combined)	G30027/1278
rabbit (m+f Himalayan)	Skin irritation	not reported	72 hours	Non-irritant	G30027/1281
rabbit (m+f Himalayan)	Eye irritation	not reported	7 days	Non-irritant	G30027/1214
Guinea-pig (m+f Pirbright White Tif:DHP)	Skin sensitization (optimization test)	98.20	53 days	Sensitizing	G30027/1216
Guinea-pig (m+f Pirbright White Tif:DHP)	Skin sensitization (Magnussen &Kligman test)	98	31 days	Sensitizing	G30027/1215
Guinea pig (m+f Hartley-Albino)	Skin sensitization (Buehler test)	97.6	29 days	Not sensitizing	G30027/5498

Human	Repeated-insult patch test	80% WP formulation	45 days	Not sensitizing	G30027/0530

Table 4. Toxicology profile of technical atrazine based on repeated administration (sub-acute to chronic)

Species	Test	Purity %	Guideline, duration, doses - and conditions	Result	Study number
mouse (m+f CD1)	Carcinogenicity	96.4	18 months 0, 10, 300, 1000 ppm	not carcinogenic	G30027/1221
mouse (m+f CD1)	Carcinogenicity	97.6	91 weeks 0, 10, 300, 1500, 3000 ppm	not carcinogenic	G30027/1222
rat (m+f Sprague-Dawley)	Carcinogenicity	98.0	2 years 0, 10, 100, 1000 ppm	≥100 ppm: decreased bw gain Carcinogenicity: Males: not carcinogenic; increased incidence of benign fibroadenomas in females at 10 and 1000 ppm. No malignant tumours. No increased incidence of malignant mammary tumors. Deficiencies in study design and data acquisition (mixing samples and errors in pathology records) prevented verification of microscopic pathology. The study was therefore not used for regulatory purposes.	G30027/1219
rat (m+f Sprague-Dawley)	Carcinogenicity	Not reported	2 years 0, 10, 70, 500, 1000 ppm	≥70 ppm increase of malignant mammary gland tumors (f), 1000 ppm: increase of mammary gland fibroadenoma (f), NOAEL 0.5 mg/kg/d (10 ppm in diet)	G30027/1217
rat (m+f Sprague-Dawley)	Carcinogenicity	97.6	105 weeks 0, 10, 50, 500 ppm	not carcinogenic	G30027/1347
rat (f Sprague-Dawley)	Carcinogenicity	97	2 years 0, 70, 400 ppm	400 ppm: decreased bw gain and food consumption, decrease of survival Carcinogenicity:	G30027/1435

				400 ppm: increase in mammary and pituitary tumors after 12 months of treatment but not at the end of the study. Decreased time-to-onset of mammary tumors. There were no effects of atrazine treatment on mammary or pituitary tumor incidence in the parallel study with Fischer-344 rats.	
rat (f Sprague-Dawley)	Carcinogenicity	97	2 years 0, 70, 400 ppm	Increase of mammary and pituitary tumors after 12 months but not after 24 months (earlier appearance of mammary tumors), NOAEL 5.0 mg/kg/d (70 ppm in diet).	G30027/1432
rat (f Sprague-Dawley)	Carcinogenicity	97.1	1 year 0, 15, 30, 50, 70, 400	NOEL: 70 ppm Carcinogenicity: Significant positive trend for onset time for combined mammary gland adenomas and fibroadenomas or combined adenomas, fibroadenomas and adenocarcinomas. No significant differences in the incidence of mammary gland adenomas, fibroadenomas or adenocarcinomas. No trend was evident when the high-dose group (400 ppm) was excluded from the analysis. Results from the 12 and 24 months studies indicated that, although the incidence of animals with tumours appeared increased at 12 months, this increase resulted from the early onset of tumors. Following lifetime (24 months) exposure, the incidence of animals with mammary tumors was	G30027/2132

				comparable between control and 400-ppm treated animals.	
rat (f intact Sprague-Dawley)	Carcinogenicity	97.1	12/24 months 0, 25, 50, 70, 400	400 ppm: decreased bw gain, decrease of survival (intact females), NOEL 70 ppm (intact rat) Carcinogenicity: Ovariectomized rats: no mammary tumours. Intact rats: increased incidence of mammary tumours at 50 ppm and 400 ppm, but not at 25 ppm or 70 ppm. Increased incidence of fibroadenomas at 50, 70, and 400 ppm. Non-monotonic increased incidences of both mammary fibroadenomas and carcinomas. Based on the absence of a dose-response relationship, and on the unusually low mammary-tumor incidence observed in the control group, the differences among the groups are not considered related to treatment with the possible exception of the incidence of adenocarcinomas in the group fed 400 ppm.	G30027/2463
rat (f ovex Sprague-Dawley	Carcinogenicity	97.1	12/24 months 0, 25, 50, 70, 400	not carcinogenic	G30027/2463
rat (m+f Fischer 344)	Carcinogenicity	98.9	126 weeks 0, 375, 750	decreased bw gain, increase of survival of males at 750 ppm. Carcinogenicity: • increased incidence of benign mammary tumours in males at 750 ppm. Appears to be due to the increased survival	G30027/2014

				in the high dose group. • increased incidence of combined leukemias/ lymphomas at 750 ppm, significant only in females. No increase in either leukemias or lymphomas in either sex when considered separately. • increased incidence of uterine carcinomas at 750 ppm. Considered likely a false positive result from age-related (not treatment related) increase in mammary tumours incidence. Overall, suggestive evidence of tumorigenic activity related to estrogen overproduction.	
rat (f Fischer 344)	Carcinogenicity	97	2 years 0, 10, 70, 200, 400	Not carcinogenic	G30027/1434
rat (m+f Fischer 344)	Carcinogenicity	97	2 years 0, 10, 70, 200, 400	Not carcinogenic	G30027/1433
rat (m+fTIF:RAIF)	Oral toxicity (short-term)	97.1	3 months 0, 10, 50, 500 ppm	Decreased bw gain and increased splemichaemosiderosis at 500 ppm	G30027/1827
dog (m+f Beagle)	Oral toxicity	97	52 weeks 0, 15, 150, 1000 ppm	NOEL at 150 ppm due to decreased bw gain and cardiac effects at 1000 ppm	G30027/1220
rabbits (m+f New Zealand White)	Dermal toxicity (short-term)	97.6	25 days 0, 10, 100, 1000 mg/kg/bw/day	NOAEL for systemic toxicity at 100 mg/kg/bw/day due to decreased bw gain in females; MTD was 1000 mg/kg/bw/day	G30027/1268
rat (m+f Sprague-Dawley)	2-gen repro	97.6	2 generations 0, 10, 50, 500 ppm	NOAEL for parental toxicity was 50 ppm due to decreased bw gains and food consumption	G30027/1266

				at 500 ppm; NOEL for repro toxicity was 50 ppm due to decreased bw of male pups at 500 ppm on PND 21	
rat [f Crl:COBS CD(SD)BR]	Prenatal dev tox	Not reported	21 days 0, 10, 70, 700 mg/kg/bw/day	NOAEL for maternal toxicity was 10 mg/kg/bw/day due to decreased bw gain and food intake at 70 mg/kg/bw/day or higher; dev tox NOAEL was 10 mg/kg/bw/day due to incomplete ossification at 70 mg/kg/bw/day or higher	G30027/1263
rat [f Crl:COBS CD(SD)BR]	Prenatal dev tox	97.6	21 days 0, 5, 25, 100 mg/kg/bw/day	NOEL for maternal toxicity was 25 mg/kg/bw/day due to decreased bw gain and food intake at 100 mg/kg/bw/day or higher; dev tox NOEL was 25 mg/kg/bw/day due to incomplete ossification at 100 mg/kg/bw/day or higher	G30027/1264
rabbit (f New Zealand White)	Prenatal dev tox	Not reported	29 days 0, 1, 5, 75 mg/kg/bw/day	NOAEL for maternal toxicity was 5 mg/kg/bw/day due to clinical signs, abortion, decreased food intake, and decreased bw gain at 75 mg/kg/bw/day; NOAEL for dev tox was 5 mg/kg/bw/day due to increased resorptions, reduced litter size, and incomplete ossification at 75 mg/kg/bw/day	G30027/1265

Table 5 Toxicology profile of the technical material based on *in vitro* and *in vivo* tests

Species	Test	Purity %	Guideline, duration, doses and conditions	Result	Study number
S. typhimurium TA98, TA100, TA1535, TA1537	Gene mutation, *in vitro*	Not reported	10-810 µg/plate	Not mutagenic	G30027/1251
S. typhimurium TA98, TA100, TA1535, TA1537	Gene mutation, *in vitro*	98.20	20-5,000 µg/plate	Not mutagenic	G30027/1260
Rat primary hepatocytes	UDS, *in vitro*	98.20	1.2-150 µg/ml	No evidence of induction of DNA damage	G30027/1259
Human fibroblasts CRL 1121	UDS, *in vitro*	98.20	1.2-150 µg/ml	No evidence of induction of DNA damage	G30027/1258
Rat primary hepatocytes	UDS, *in vitro*	97.10	15.5-1,670 µg/ml	No evidence of induction of DNA damage	G30027/1495
Chinese hamster bone marrow	Nucleus anomaly test, *in vivo*	Not reported	282, 564, 1128 mg/kg bw per day; oral, on two consecutive days	Not mutagenic	G30027/1255
Mouse bone marrow	Chromosomal aberration, *in vivo*	98.2	562.5, 1125, 2250 mg/kg bw; oral, single dose	Not mutagenic	G30027/1261
Mouse spermatogonia	Chromosomal aberration, *in vivo*	Not reported	444, 1332 mg/kg bw per day; oral, on five consecutive days	Not clastogenic	G30027/1256
Mouse spermatocytes	Chromosomal aberrations, *in vivo*	Not reported	444, 1332 mg/kg bw; oral, five doses over 10 days	Not clastogenic	G30027/1257
Mouse spermiogenesis	Dominant lethal mutation, *in vivo*	98.90	444, 1332 mg/kg bw; oral, single dose	No cytotoxic or mutagenic effect	G30027/1254
Mouse spermiogenesis	Dominant lethal mutation, *in vivo*	97.1	500, 1000, 2000, 2400 mg/ kg bw; oral, single dose	No cytotoxic or mutagenic effect	G30027/1523

Table 6 Ecotoxicology profile of technical atrazine

Species	Test	Purity %	Guideline, duration, doses and conditions	Result	Study number
Anas platyrhynchos (Mallard duck)	Acute toxicity	97.1	US EPA guideline 0, 31, 125, 500 and 2,000 mg/kg	LD_{50}> 2,000 mg/kg bw	G30027/1833
Coturnix coturnix japonica Japanese quail	Acute toxicity	97.1	US EPA guideline 0, 15, 31, 62, 125, 250, 500, 1,000 and 2,000 mg/kg	LD_{50}> 2,000 mg/kg bw	G30027/1834
Anas platyrhynchos (Mallard duck)	Dietary toxicity	97.1	OECD 205 5 d dietary exposure + 3 d observation 0, 15, 48, 153, 488, 1,563 ppm in diet	LD_{50}> 1,563 mg/kg diet	G30027/2148
Colinus virginianus (Bobwhite quail)	Reproductive toxicity	97.1	US EPA guideline 20 weeks 75, 225 and 675 ppm in diet	NOEL = 225 ppm diet	G30027/1508
Anas platyrhynchos (Mallard duck)	Reproductive toxicity	97.1	US EPA guideline 20 weeks 0, 75, 225 and 675 ppm in diet	NOEL = 225 ppm diet	G30027/1509
Oncorhynchus mykiss (Rainbow trout)	Acute toxicity	98.2	OECD 203 96 h 0, 1.8, 3.2, 5.8, 10 and 10 mg/L	LC_{50} = 11 mg/L	G30027/0065
Pimephales promelas (Fathead minnow)	Chronic toxicity	97.1	US EPA guideline 274 d, FFLC 0.13, 0.25, 0.50, 1.0 and 2.0 mg/L	NOEC = 0.25 mg/L	G30027/1510
Daphnia magna (Waterflea)	Acute toxicity	96.2	OECD 202 48 h 0 and 29 mg/L	EC_{50}> 29 mg/L	G30027/5675
Ceriodaphnia dubia (Waterflea)	Acute toxicity	97	US EPA guideline 48 h 0, 0.29, 0.60, 1.2, 2.5 and 4.9 mg/L	EC_{50}> 4.9 mg/L	G30027/1373
Daphnia magna (Waterflea)	Chronic toxicity	98.2	OECD 202 21 d, semi-static 0, 0.00045, 0.0013, 0.0038, 0.012, 0.040 and 0.12 mg/L	NOEC = 0.04 mg/L	G30027/0073
Pseudokirchneriella subcapitata (Green alga)	Acute toxicity	97.5	OECD 201 96 h 0, 0.0095, 0.031, 0.098, 0.31 and 1.0 mg/L	E_yC_{50} = 0.04 mg/L	G030027_10808
Lemnagibba (duckweed)	Subacute toxicity	97	US EPA guideline “Lemna acute	E_bC_{50} = 0.18 mg/L	G30027/1370

			toxicity test" 7 days 0.39, 0.22, 0.12, 0.057, 0.028 and 0.015 mg/L Static-renewal phytotoxicity test		
Lemnagibba (duckweed)	Subacute toxicity	98.5	US EPA guideline 14 d, static-renewal 0, 0.005, 0.010, 0.020, 0.040, 0.080 and 0.16 mg/L	E_bC_{50} = 0.05 mg/L NOEC = 0.0083 mg/L	G30027/5337
Chironomus tentans (midge)	Subacute toxicity	98.5	US EPA guideline 10 d, flow-through (water spiked, sand layer) 0, 3.2, 5.3, 8.4, 16 and 24 mg/L	EC_{50} = 8.3 mg/L	G30027/5375
Apis mellifera (honey bee)	Acute toxicity	97.1	EPPO Bulletin 22 48 hours Contact doses: 0, 0.09, 0.97, 9.71 and 97.1 µg/bee Oral doses: 0, 0.09, 0.97, 9.71 and 97.1 µg/bee	LC_{50}: >97.1 µg/bee (contact) LC_{50}: >97.1 µg/bee (oral)	G30027/1723
Cyprinodon variegatus (Sheepshead minnow)	Acute toxicity	97.1	US EPA guideline 96 h, flow-through 0, 3.2, 4.6, 7.6, 13 and 22 mg/L	LC_{50} = 13 mg/L	G30027/1838
Cyprinodon variegatus (Sheepshead minnow)	Chronic toxicity	97.1	US EPA guideline 33d, ELS 0, 0.15, 0.30, 0.57, 1.1 and 2.2 mg/L	NOEC = 1.1 mg/L	G30027/5621
Arcatiatonsa (Copepod)	Acute toxicity	97.1	US EPA guideline 96 h, flow-trough 0, 2.9, 4.7, 7.3, 11 and 20 mg/L	EC_{50} = 4.3 mg/L	G30027/1374
Americamysisbahia (Crustacean)	Chronic toxicity	97.1	US EPA guideline 28 d, life-cycle 0, 0.068, 0.14, 0.26, 0.50 and 1.1 mg/L	NOEC = 0.26 mg/L	G30027/5622
Skeletonemacostatum (Diatom)	Acute toxicity	97.1	US EPA guideline 120 h 0, 0.014, 0.026, 0.054, 0.10 and 0.20 mg/L	E_bC_{50} = 0.055 mg/L	G30027/1722
Crassostrea virginica (Oyster)	Acute toxicity	97.1	US EPA guideline 96 h, flow-through, shell deposition 0, 1.0, 2.0, 4.2, 9.2 and 17 mg/L	EC_{50}> 17 mg/L	G30027/5574

ANNEX 2

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G30027/1370	J. Hoberg	1991	Atrazine technical – Toxicity to the duckweed *Lemna gibba* G3. 91-1-3613. GLP. Springborn Laboratories, Inc., Wareham, Massachusetts, USA.
G30027/5337	D. Desjardins, H. Krueger, T. Kendall	2003	Atrazine technical: A 14-day static-renewal toxicity test with duckweed (*Lemna gibba* G3) including a recovery phase. 528A-131A. GLP. Wildlife International, Ltd., Easton, MD, USA.
G30027/5375	A. Putt	2002	Atrazine technical SF – Toxicity to midge (*Chironomus tentans* under flow-through conditions. 1781.6635. GLP. Springborn Smithers Laboratories, Inc., Wareham, Massachusetts, USA.

G30027/1723	M. Bew	1993	Test of oral and contact toxicity of G30027 to honey bees. GLP. Central Science Laboratory, Stratford Upon Avon, UK.
G30027/1838	M. Machado	1994	Atrazine technical – Acute toxicity to Sheepshead minnow under flow-through conditions. 94-7-5384. GLP. Springborn Laboratories, Inc., Wareham, Massachusetts, USA.
G30027/5621	M. Cafarella	2006	Atrazine (G-30027) – Early life-stage toxicity test with Sheepshead minnow. 1781.6642. GLP. Springborn Smithers Laboratories, Inc., Wareham, Massachusetts, USA.
G30027/1374	P. McNamara	1991	Atrazine technical – Acute toxicity to the marine copepod (*Acartia tonsa*) under flow-through conditions. 91-2-3662. GLP. Springborn Laboratories, Inc., Wareham, Massachusetts, USA.
G30027/5622	M. Cafarella	2006	Atrazine (G-30027) – Life-cycle toxicity test with mysids. 1781.6641. GLP. Springborn Smithers Laboratories, Inc., Wareham, Massachusetts, USA.
G30027/1722	J. Hoberg	1993	Atrazine technical – Toxicity to the marine diatom. 93-4-4753. GLP. Springborn Laboratories, Inc., Wareham, Massachusetts, USA.
G30027/5574	M. Cafarella	2005	Atrazine (G-30027) – Acute toxicity to eastern oysters under flow-through conditions. 1781.6640. GLP. Springborn Smithers Laboratories, Inc., Wareham, Massachusetts, USA.