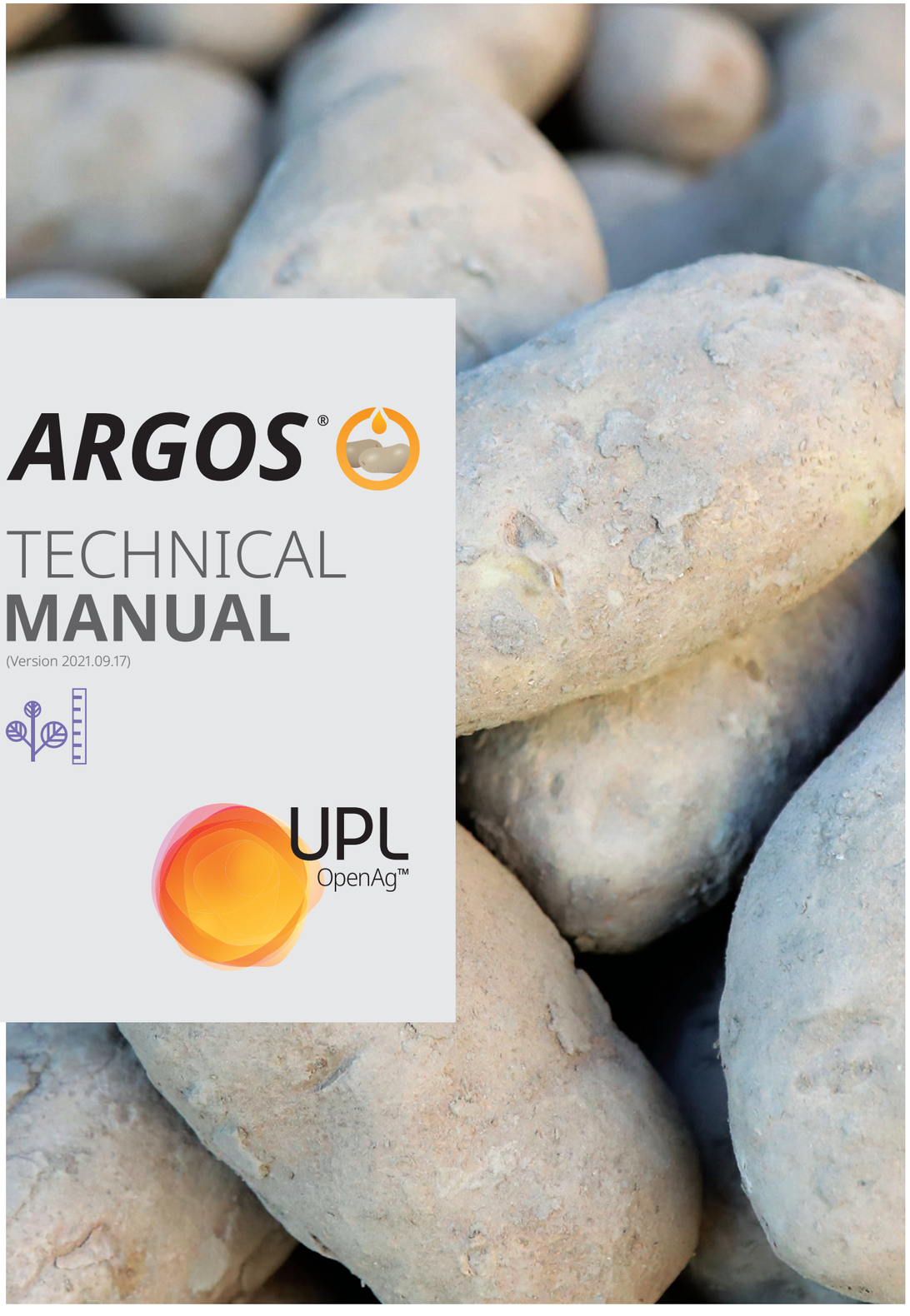
ARGOS®



ARGOS®

TECHNICAL MANUAL

(Version 2021.09.17)

UPL OpenAg™

UPL OpenAg™

Version: 2021.09.17

POTATO SPROUT SUPPRESANT

ARGOS®

TECHNICAL MANUAL

Active Ingredient: D-Limonene

Introduction

This Technical Manual provides important information on **ARGOS®**, a new natural potato sprout suppressant in Europe to prevent and control sprouting on potato tubers in storage.

ARGOS® is classified as a plant growth regulator and is based on orange essential oil. The oil is extracted from the entire orange fruit. Therefore, the active substance of the product has a natural origin. No chemical solvents or additives are used in the product.

ARGOS® can be applied as a hot or cold fog. Equipment used to produce a hot fog must be temperature controlled to allow a fog temperature of up to 175 degrees Celsius. Considering the chemical and physical properties of **ARGOS®**, the application of the product needs careful consideration, and this is explained in this document.

This Manual provides practical information to optimize the use and the efficacy of **ARGOS®**. Refer to the product application instructions described in this Technical Manual whenever you feel it necessary and do not hesitate to contact us before initiating treatment if in doubt.

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1. GENERAL

In potatoes, dormancy is the physiological state of the tuber in which autonomous sprout growth will not occur within a few weeks, even when the tuber is kept in conditions ideal for sprout growth. During this period, post-harvest environmental conditions have only limited impact on the sprouting behavior. The duration of the dormancy depends largely on the cultivar, stage of tuber development and on the conditions during tuber growth. Temperature, water supply and photoperiod and storage are important factors that regulate the sprouting behavior. Potatoes start to sprout naturally a few weeks after harvest. Perfect control of storage conditions generally saves a few weeks. This is the case in professional storage buildings, with equipment that allows darkness, temperature and humidity to be controlled very precisely, to limit germination pressure as much as possible. For longer storage periods, necessary for the availability of tubers between two potato harvests, **ARGOS®** can further delay germination, while preserving the weight and quality of the tubers as much as possible.

ARGOS® is an effective natural potato sprout suppressant used as a stand-alone product or as a perfect key element of a modern potato sprouting management program combining in-field use of **FAZOR®** and in-store **ARGOS®** treatments to ensure full season control.

FAZOR® is a sprout suppressant applied to the growing crop. It should be used 3 to 5 weeks before desiccation. Read Fazor® label before use and follow all guidance to optimize efficacy.

ARGOS® can be applied with cold and hot foggers. For hot-fogging, machinery must be temperature controlled and able to regulate flow rate and air flow. White sprouts are burned off. Even small sprouts that cannot be seen with the naked eye are removed in this way. Due to the effective and powerful burning of early sprouts, development is prevented for several weeks. **ARGOS®** does not taint the potato with odour or taste.

2. LABEL

SAFETY PRECAUTIONS

OPERATOR PROTECTION

- Engineering control of operator exposure must be used where reasonably practicable in addition to the following personal protective equipment:
- WEAR SUITABLE PROTECTIVE CLOTHING (COVERALLS) AND SUITABLE PROTECTIVE GLOVES when handling the concentrate or handling contaminated surfaces. However, engineering controls may replace personal protective equipment if a COSHH assessment shows they provide an equal or higher standard of protection.
- WASH HANDS AND EXPOSED skin before eating, drinking or smoking and after work.
- KEEP OUT OF STORE DURING TREATMENT. DO NOT ENTER treated areas for at least 24 hours after treatment.
- VENTILATE TREATED AREAS thoroughly when fog has cleared.
- WASH PRODUCT from skin or eyes immediately.
- WHEN USING DO NOT EAT, DRINK OR SMOKE.

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WORKER PROTECTION

- Engineering control of worker exposure must be used where reasonably practicable in addition to the following personal protective equipment:
- WEAR SUITABLE PROTECTIVE GLOVES * when handling treated material.

*Meeting at least glove safety standard EN374-2:2019, Level 2 and CE category III. Such gloves can be identified by a CE Mark with four digits below and the EN374 pictogram for micro-organisms. However, engineering controls may replace personal protective equipment if a COSHH assessment shows they provide an equal or higher standard of protection.

ENVIRONMENTAL PROTECTION

Do not contaminate water with product or its container. Do not clean equipment near surface water. Avoid contamination via drains from farmyards and roads.

STORAGE AND DISPOSAL

- DO NOT RE-USE CONTAINER for any purpose.
- KEEP AWAY FROM FOOD, DRINK AND ANIMAL FEEDINGSTUFFS.
- KEEP IN ORIGINAL CONTAINER, tightly closed, in a safe place.
- EMPTY CONTAINER COMPLETELY and dispose of safely.
- This container must not be re-used for any purpose.

DIRECTIONS FOR USE

IMPORTANT: This information is approved as part of the Product Label. All instructions within this section must be read carefully in order to obtain safe and successful use of this product.
ARGOS is a sprout inhibitor for the post-harvest treatment of potatoes.

RESTRICTIONS OR WARNINGS

DO NOT USE on seed potatoes.
To protect aquatic organisms, respect a period of 24 hours between the last application and the industrial rinsing of potatoes.
Potatoes can be removed from the store a minimum of 48 hours after treatment.

STORE DESIGN

Only treat potatoes stored in purpose designed or dedicated potato stores. The efficacy of ARGOS® will decline in buildings without proper insulation, circulation of airflow and temperature controls.
Use in stores with forced air/ducted ventilation to ensure uniform air flow and to avoid blockage of air spaces between the tubers which can impede efficacy of the product and lead to a build- up of condensation.

CROP CONDITION

To be used only on potatoes intended for consumption. Consult processors before using on potatoes destined for processing. DO NOT fog potatoes with a high level of skin spot. Potatoes should be clean, dry and free from signs of disease. Ensure skin is sufficiently cured before treatment. Daily crop inspection is essential to check curing and onset of sprouting.

TIMING

Start treatment with the first signs of sprouting on dry potatoes. Up to 9 repeat applications may be necessary and regular inspection for the onset of sprouting should be made to ensure timely application.

CIRCULATION & VENTILATION

It is important to get slow speed air re-circulation through the crop for evenness of deposition and improved efficacy.

BULK AND BOX STORES

Preferably, fogging should only be done while employing positive ventilation which ensures an active movement of the fog between the tubers inside the boxes. Run fans during and after the fogging treatment until the fog has cleared in order to achieve even distribution of the product and improved efficacy. For stores without positive ventilation (ambient air flows), maintain gentle movement of air during the fogging operation.

RATE OF APPLICATION

Apply at a rate of 100 ml per ton of potatoes. Regular crop inspections should be made to identify when repeat applications are required (i.e. onset of sprouting). A 21 days minimum interval must be observed between applications. The frequency of application is dependent on the variety of potato and susceptibility to sprouting. Consult your processor for guidance on number of applications and effects on fry colour.

APPLICATION METHOD

ARGOS® is a ready to use product to be applied as a cold or hot fog, using suitable fogging equipment. Follow the manufacturer's instructions when using this type of machine. Consult your supplier of Argos for further information on the appropriate settings for the application equipment. Hot-fogging application should only be carried out with temperature-controlled equipment. Hot-fogging machinery without the possibility to regulate the temperature must not be used. The temperature-controlled hot-fogging machinery should be set to produce a fogging temperature no higher than 175 ^{0}C. This is to avoid the risk of auto-ignition (auto-ignition temperature of Argos is 248 ^{0}C).

Fogging should be carried out with the fogging machine outside the warehouse with the fog being fed into the store through a treatment port or other secure means. Only stores dedicated for potato storage should be treated.

A distance of at least 5m is recommended between the nebulization pipe or the equipment and the potatoes to ensure a good fog distribution.

A forced air ventilation system should be in place to allow distribution of the fog through the potatoes and to avoid the build-up of condensation. All other external vents and doors should be closed during treatment to ensure the store is airtight. It is important to maintain a gentle flow of air during treatment.

The doors and external ventilation openings of the potato storage sites must be properly closed during treatment. Only internal ventilation is required. After treatment, allow the internal ventilation to continue to run until the fog has settled. After this, keep the store closed for a minimum of 48 hours, after which external ventilation is possible in the normal way. The treated store may only be entered after brief ventilation with outside air (at least 30 minutes).

Unprotected persons must be kept out of treated areas for a minimum of 24 hours.

CONDITIONS OF SUPPLY

Seller warrants that this product conforms to the chemical description on the label thereof and is reasonably fit for purposes stated on such labels, only when used in accordance with directions under normal use conditions. It is impossible to eliminate all risks inherently associated with use of this product. Crop injury, ineffectiveness or other unintended consequences may result because of such factors as weather conditions, presence of other materials, or manner of use or application, all of which are beyond the control of the seller. In no case shall seller be liable for consequential, special or indirect damages resulting from the use of handling of this product. All such risks shall be assumed by the buyer. Seller makes no warranties of merchantability or fitness for a particular purpose nor any other express or implied warranty except as stated above.

COMPANY ADVISORY INFORMATION

This section is not part of the Product Label under the Plant Protection Products Regulations 1995 and serves to provide additional advice or information on the product use at the discretion of the applicant.

PERSONNEL

ARGOS® should only be applied by specialist contractors qualified to NPIC PA1, PA9. They should be current members of the National Association of Agricultural Contractors (NAAC) Post Harvest Treatment Group.
Applicators must adhere to best practice as detailed in this manual.

ADVISORS

Recommendations for **ARGOS®** must be made by BASIS qualified advisors.

APPLICATION EQUIPMENT

Hot fogging should only be carried out using temperature-controlled equipment such as CROPFOG. Fogging machinery must not be left unattended during application.

3. MODE OF ACTION

The suppression of sprouting in potato tubers by orange oil is by physically damaging the sprouts. D-limonene, the active ingredient, produces a physical mode of action on contact - drying and disrupting the soft tissues on which it is applied. The treated tissues rapidly undergo irreversible superficial drying that leads to a loss of cell fluid followed by rapid and complete necrosis.

Fig 1:
*Burned sprouts after **ARGOS®** application*

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4. PHYSICAL AND CHEMICAL PROPERTIES

- Active ingredient in **ARGOS®** Orange oil is 843.2 g/L D-Limonene
- **ARGOS®** is a colourless liquid
- Odour: orange
- Flash point: 51.5 °C
- Auto-flammability of liquid: the auto ignition of **ARGOS®** is 248 °C
- **ARGOS®** is not considered to have explosive properties in the conditions used

5. EFFICACY MANAGEMENT

The dose rates and applications timings for full season are dependent on many factors, such as:

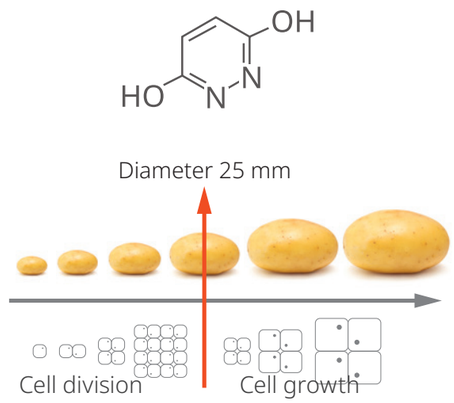
- Seed health, Crop growing / harvesting conditions.
- Crop dormancy / Quality at harvest.
- Variety stored.
- Crop holding temperature.
- Ambient ventilation and/or refrigeration.
- Store construction.
- Store fill-level: stores should be filled to designed capacity to get most effective efficient use of applied **ARGOS®**.
- If the storage area is not completely filled, it is advisable to take measures to ensure the correct dosage and efficient distribution of **ARGOS®**.
- **ARGOS®** can be used with or without a pre-harvest **FAZOR®** application.

PROGRAM FAZOR® AND ARGOS®

5.1 FAZOR® (MALEIC HYDRAZIDE)

A field application of **FAZOR®** can play a key role in a sprout control program.
The correct timing and quality of application of **FAZOR®** and **ARGOS®** are essential to maximize performance.

FAZOR® is a plant growth regulator applied in the field before potato harvest. **FAZOR®** is transported to the tubers and inhibits cell division but not enlargement of existing cells. Once tubers have reached 25 mm in size, the cells are formed and there is no negative effect on the yield. **FAZOR®** extends dormancy by approximately 2 to 3 months.
For efficient activity, it's important that **FAZOR®** is properly absorbed and translocated to the growth points of the tubers. The right timing of application will be important to prevent potato sprouting in store.



- **FAZOR®** is applied 3 to 5 weeks before haulm treatment and must be applied whilst the crop is still green and actively growing.
- At application time, check that 80% of the tubers are larger than 25 mm.
- Temperature during application must not exceed 25°C (risk of foliage discoloration and or poor uptake at higher temperatures).
- On warm days, it is recommended to apply **FAZOR®** in the evening
- When the crop is irrigated a delay of one or two days is recommended before **FAZOR®** application.
- A water volume of minimum 300 litres/Ha is recommended and can be increased to 500 litres/Ha if the relative humidity is below 60%.
- Do not use wetting agents or other additives or tank-mix with blight fungicides.

5.2 IN-STORE TREATMENT WITH ARGOS®

ARGOS® is applied either by hot or cold fogging on potatoes in storage. White sprouts are burned off. Even small sprouts that cannot be seen with the naked eye are removed. Effective application will prevent sprouting for several weeks.

- Maximum dose per treatment is 100 ml per ton of potatoes.
- A maximum of nine treatments are possible in a storage cycle.
- The minimum interval between applications is three weeks.
- There is no waiting period. Potatoes can be delivered shortly after application.

5.3 WHEN TO APPLY?

WHEN FAZOR® HAS BEEN APPLIED AS A FIELD TREATMENT

First application of ARGOS®
First treatment can start as soon as the dormancy has been broken (2 to 3 months after storage). That's also the ideal time for the first **ARGOS®** application.
Experience is important in this respect and if necessary, **UPL** specialist advice should be sought.

Subsequent treatments and intervals
A follow- up treatment will depend on several factors such as general state of the potatoes, type of storage, variety, storage temperature and effect of **FAZOR®** but it must start when the first small sprouts on the tubers become visible again. With **FAZOR®** as the base, this will probably happen between two and three months after the previous application.
Regular monitoring of the potatoes is very important.

WITHOUT FAZOR®

First application of ARGOS®
Usually the first application will be made two to six weeks after storage at the break of dormancy. The break in the dormancy will be visible when the first small sprouts on tubers appear and start to grow. It is important to check the potatoes in storage every week. A magnifying glass is a useful aid. Starting on time is important and gives the best result and the least chance of internal sprouting.

Subsequent treatments and intervals
A follow-up treatment will depend on several factors such as general state of the potatoes, type of storage, potato variety and storage temperature, and must be made when new sprouts on tubers become visible again.
As a rule, an interval of 3 weeks applies.
Regular monitoring of the potatoes is important.

5.4 DOSE RATES

The recommended dosage of **ARGOS®** is 100 ml per ton of potatoes.
With application of **FAZOR®** the dose of 100 ml of **ARGOS®** is always the recommendation.
Knowledge of the potato variety dormancy is essential and regular monitoring is important.

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6. POTATO VARIETIES SENSITIVITY

In principle **ARGOS®** can be applied on a wide range of varieties. Trials have been carried out on a range of different commercial widely grown and representative cultivars of potato and under storage conditions that are representative of commercial practice in EU countries. Potato cultivars on which **ARGOS®** was applied without any issue are given on the non-exhaustive list below:

CULTIVARS	CULTIVARS
Agria	Magnum
Amigo	Manitou
Arsenal	Markies
Artemis	Melody
Asterix	Mozart
Bintje	Nicola
Challenger	Royal
Fontane	Russet Burbank
Innovator	Samba
Lady Amarilla	Victoria
Lady Anna	Voyager
Lady Christl	VR808
Lady Claire	King Russet

If grower has any doubt on a potato variety, it is recommended to test **ARGOS®** on a small sample or to contact your distributor or UPL team.

7. THE STORE

Before using **ARGOS®** make sure only dedicate storage areas as well as storage boxes have been carefully cleaned in order to prevent residues of previous anti-sprout products which could be the cause of phytotoxicity. Only stores equipped with ventilation systems where the air is blown or sucked through the potatoes are suitable for the use of **ARGOS®**.
The mode of action of **ARGOS®** is based on the contact action followed by the necrosis of the sprouts and the prevention of sprout growth. The effect takes place shortly after application. As soon as **ARGOS®** has been distributed evenly on the potatoes by the forced air, the product does its work.
Following several years practical experience, positive results have been obtained in all types of storage.
Thanks to its short- term effect, **ARGOS®** can be used efficiently in older storage sheds and non-optimally filled bulk and box storage. It is most important to ensure that **ARGOS®** will go through the bulk of potatoes or boxes containing potatoes. Ensure that **ARGOS®** is not diluted by taking proper measures.
If the equipment is outside the storage area, the building will have to be equipped with a minimum hole of 15/15cm to introduce the **ARGOS®** nebulization pipe. This one will be introduced in the potato storage area through a non-flammable (e.g: rock wool) panel (min 1m^2) in the case of hot fogging application.

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8. STORE APPLICATION

ARGOS® APPLICATION IN COLD STORES

1. Completely fill the potato storage and ensure all soil is removed from the potatoes.
2. Dry potatoes with adequate ventilation.
3. 24 hours before **ARGOS®** application, disable relative humidity control (if present) to ensure all materials in the store are dry.
4. Switch off cooling system at least 24 hours before application and maintain the ventilation in “manual” mode to homogenize the temperature of all units in the building (structure, potatoes, ...) and avoid condensation.
5. Ensure there is no ice or moisture on the cooling system.
6. For the fresh market and under mechanical cooling situation, cool down progressively the potatoes from the harvest. Before the first application, reach a plateau between 8 and 12 °C (according the harvest temperature). Be aware that store temperature below 5 °C will increase the risk of tubers condensing.
7. Check the building for leaks and close all openings (eg: CO_2 extractors, etc, ...).
8. In boxes and bulk, provide enough internal ventilation before treatment to remove all traces of condensation and ensure a uniform temperature.
9. Before the start of application, it is important to get internal slow speed air re-circulation through the crop for evenness of distribution and improved efficacy.
10. Carefully choose the fog introduction point in the store. The fog should be introduced and allowed to mix with air, to aid dispersal, before being drawn into the ventilation for distribution around the store. Ensure the fog is distributed evenly across the bulk potatoes and it isn’t directed at just one part of the pile.
11. Apply the dose appropriate for the store with the internal recirculation, maintain a consistent fog temperature of 175 °C to ensure product is applied as a dry fog and does not drip from the end of the application nozzle.
12. Continued moderate internal recirculation of **ARGOS®** fog, during and for a period of at least 30 minutes after application will help the distribution through the store and subsequent distribution on the potatoes
13. Every 6 hours, it is advised to establish an additional internal ventilation for a period of 30 minutes to re-homogenize **ARGOS®** in the store area.
14. It’s recommended to maintain the storage area closed for approximately 48 hours to optimize the efficacy. After 48 hours, it is advised to establish an additional internal ventilation for a period of 15 minutes before switching on the cooling system.
15. It is advised to wait 48 hours before entering the storage area.

ARGOS® APPLICATION IN PROCESSING STORES (AMBIENT ± FRIDGE)

1. Completely fill the potato storage and remove soil from the potatoes.
2. Dry potatoes with adequate ventilation.
3. 24 hours before **ARGOS®** application, disable relative humidity control (if present) to ensure screen and store fabrics are dry.
4. Switch off the cold air at least 24 hours before application and maintain the ventilation in "manual" mode to homogenize the temperature of all units in the building (structure, potatoes, cooling equipment, ...) and avoid condensation
5. Ensure there is no ice or moisture on the cooling system.
6. Before the start of application, it is important to get internal slow speed air re-circulation through the crop for evenness of distribution and improved efficacy.
7. Apply the dose appropriate for the store with the internal recirculation running a reduced speed, maintain a consistent fog temperature of 175 °C to ensure product is applied as a dry fog and does not drip from the end of the application nozzle.
8. Continued moderate internal recirculation of **ARGOS®** fog, during and for a period of at least 30 to 60 minutes after application will help the distribution through the store and subsequent distribution on the potatoes.
9. It's recommended to maintain the storage area closed for approximately 48 hours to optimize the efficacy. After 48 hours, external ventilation is possible under normal regime.
10. It is advised to wait 48 hours before entering the storage area.

9. APPLICATION EQUIPMENT

The treatment of potatoes in storage with **ARGOS®** is done by hot and cold fogging. **ARGOS®** is converted into a fog by the equipment and distributed by the air flow from the ventilation. Due to its low viscosity, **ARGOS®** is volatile and penetrates well and easily into the potato heap or boxes.

HOT FOGGING

With hot fogging application, it's imperative avoid a risk of fire. Consequently, only temperature-controlled equipment can be used.
The recommended constant temperature of fogging of **ARGOS®** must be below 175 °C.

CURRENTLY TESTED AND SUITABLE EQUIPMENT:
- **Hot fogging: CROPFOG MkV AND RESONATOR HOTFOG.**

✓

ARGOS® cannot be used with any thermal fog generators which are not temperature controlled.
In case of use of other temperature-controlled hot fogging equipment available on the market, it is necessary to contact the manufacturer.

✗

COLD FOGGING

With cold fogging application, it is recommended to follow equipment installation advice from the manufacturer in order to avoid any contact between the applicator and the nebulized product.

CURRENTLY TESTED AND SUITABLE EQUIPMENT:V
- **Cold fogging: FONTAN MOBILSTAR AND FONTAN STARLET**

✓

CAUTION:
ARGOS® has a self-ignition temperature of 248 °C. **ARGOS®** is introduced into a fogging chamber, where it is heated and vaporized for application. It is important to avoid contact of undiluted **ARGOS®** with hot working parts inside machinery. This does NOT occur under normal operation.

In the case of machinery failure, application should be stopped and where delivery pipes are used, these should immediately be removed from the store wall. In the event of failure in a machine approved for use inside the store, the machine should be removed from the building.

It is important that application machinery must be attended by the operator during application.

EQUIPMENT CLEANING PROCEDURES:
For all temperature-controlled equipment there is a risk when using flammable liquid, it's mandatory to carefully clean the equipment after each use. For this purpose, we recommend to refer to the technical manual of the manufacturer.

10. NOZZLE AND FLOW RATE

- Ensure the most appropriate nozzle is used to produce a "dry fog" (no drip from the end of applicator). It may depend on the size of the machine, external conditions and internal crop/air temperatures.
- There should not be any wet spots on the floor.

11. OTHER CROPS – CROSS CONTAMINATION

Today, regarding residue on other crops, we cannot guarantee there will be no cross contamination to subsequent crops in **ARGOS®** treated stores or boxes.
Due to the volatile nature of **ARGOS®**, crops in adjoining stores may also be at risk of contamination. Increased ventilation during summer when stores are empty will help remove residues. **ARGOS®** does not have approval for other crops. The risk of having contamination in subsequent storage is greatly decreased compared to CIPC.

12. WAITING PERIOD

After complete treatment.

13. STORE MATERIAL PRECAUTION AND WARNING

ARGOS® may damage certain building and insulating materials and electrical components. If any doubt, samples of such material should be tested prior to the application of **ARGOS®** or advice sought from the supplier. These effects can be avoided or reduced if the methods of application of **ARGOS®** are carefully respected. If in any doubt, contact your local appointed UPL representative or appointed UPL distributor.

14. PHYTOTOXICITY

Condensation or dripping of ARGOS® on the potato tubers, should be avoided, as scorch could occur. This damage can be avoided by using the proper applications techniques described in this manual.

15. LEGAL NOTICE

RESPONSIBILITY
It is mandatory to refer to the product application guideline as described above before each use and, whenever it seems necessary to you. In case of doubt, do not hesitate to contact UPL before proceeding with the application.
UPL declines all responsibility in the event of non-compliance with the instructions.
The equipment chosen for the **ARGOS®** application is the sole responsibility of the user.

The purpose of this technical manual is to present the conditions of use of the potato anti-sprout germination **ARGOS®**.

Therefore, by using the product **ARGOS®** you acknowledge having read the technical manual and the specifics related to the application of **ARGOS®**.

This manual is intended as an extension of the legal instructions for use set by the authority on the date of writing of this manual. In all cases, all legal instructions for use apply to all situations and are to be followed and are therefore considered to be the primary instructions.

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