TECHNICAL NOTES FOR TAEGRO®

SUMMARY

- A bacterial based biofungicide for suppression of a range of diseases. Based on a unique strain of a naturally occurring, non genetically modified bacterium.
- Multiple modes of action:
  - Colonisation and competition on the plant surface against pathogens
  - Release of antimicrobial metabolites
  - Inducing systemic resistance in the plant
- Activity on a range of diseases (see page 4 for more information):
  - Label: powdery mildew, botrytis, downy mildew and early blight.
- Use to:
  - Suppress disease
  - Reduce the risk of resistance developing
  - Eliminate or reduce chemical fungicide residues
  - Form part of an IPM programme
- Crops (for more details see page 7):
  - Permanently protected crops with full enclosure:
    - Aubergine, chilli, courgette, cucumber, lettuce, melon, pepper, strawberry, summer squash, tomato, watermelon, ornamental plant production (EAMU* UK), nursery fruit trees (EAMU* UK).
  - Protected crops:
    - Ornamental plant production (EAMU* UK), nursery fruit trees (EAMU* UK)
  - Outdoor crops:
    - Grapevine (table and wine grapes), ornamental plant production (EAMU* UK), nursery fruit trees (EAMU* UK).

Usable in organic production subject to certification body approval. No MRL. Compatible with a range of biological controls, fungicides, insecticides, foliar feeds, see page 9 & 10 for more information. Rate of use 370 g/ha. Harvest interval 1 day. Maximum of 12 applications per crop or 10 per year for grapevine, ornamental plant production and nursery fruit trees.

VERSION CONTROL

Version	Publication Date	Main changes from previous version
10/20	October-2020	New product.
01/23	January 2023	Addition of EAMU (UK) for ornamental plant production and nursery fruit trees. Addition of approval for Ireland.

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Use plant protection products safely. Always read the label and product information before use. Further product information, including warning phrases and symbols, is included in the main product manual or product label.

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These notes are designed to support the main product manual insert or label information on TAEGRO and advise on how to obtain the best possible disease control from the product.

INTRODUCTION

WHAT IS TAEGRO?

TAEGRO is a professional registered biofungicide approved in the UK on MAPP number 19204 and for the Republic of Ireland on PCS 06601. TAEGRO is approved for the suppression of a range of diseases on a number of crops. TAEGRO is formulated as a wettable powder and contains 130 g/kg *Bacillus amyloliquefaciens* strain FZB24 (13% w/w, minimum of $1x10^{13}$ cfu/kg).

Bacillus amyloliquefaciens strain FZB24 is naturally occurring in the environment and is not genetically modified.

TAEGRO is listed under FRAC as code BM02, previously code 44, microbial disruptors of pathogen cell membranes.

WHY USE TAEGRO

To suppress disease.
To eliminate or reduce chemical fungicide use.
To reduce the risk of fungicide resistance developing.
To eliminate or reduce chemical fungicide residues.
To reduce the possibility of environmental problems from use of chemical fungicides.
To reduce the risk to operators.
To form part of an IPM programme.

- Usable in organic production, subject to certification body approval.
- Safe for beneficial insects, pollinators and bees.
- Wide compatibility with fungicides, insecticides and foliar feeds / fertilisers. Tank mix, subject to label restrictions or use as rotational partner.
- Multiple modes of action.
- Short harvest interval.
- No phytotoxicity issues reported.
- Low dose rate.
- Exempt from MRL classification.

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DISEASE TARGETS

TAEGRO is labelled for the suppression of:

Downy mildew on:

Lettuce.

Powdery mildew on:

Cucumber, courgette, summer squash, watermelon and melon.
Tomato, aubergine, pepper and chilli.
Table and wine grapes.

Grey mould (Botrytis) on:

Strawberries
Table and wine grapes

Alternaria (Early blight) on:

Tomato, aubergine, pepper and chilli.

Additional activity has been reported in overseas trials against ***Sclerotinia***, ***Mycosphaerella***, ***Xanthemonas***, ***Pseudomonas*** and also soil born ***Rhizoctonia*** and ***Fusarium*** but these diseases are not on the UK label and efficacy cannot be guaranteed.

The Extension of Authorisation for Minor Use (EAMU) 2404/2022 on ornamental plant production and nursery fruit trees is for the control of **powdery mildew**, **downy mildew**, **Botrytis**, ***Alternaria* spp.** and **Sclerotinia**.

HISTORY AND DEVELOPMENT

TAEGRO is currently registered in a number of European countries including France, Belgium, Spain and Holland with further registrations pending. TAEGRO is also registered in North America. The specific strain FZB24 was originally isolated in Germany.

There are a number of different strains of *Bacillus amyloliquefaciens*. Each strain has different gene expression which may affect its efficacy against specific plant diseases or diseases on different crops.

HOW DOES TAEGRO WORK?

- Surface colonisation - competition on the plant surface against pathogens.
- Release of antimicrobial metabolites.
- Induced systemic resistance - enhances plant resistance.

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Figure 1: Petri dish inhibition of fungal growth
Petri dishes inoculated with *Botrytis cineria* (top), *Phaeospheria nodorum* (left) and *Alternaria solani* (right). Right with TAEGRO "Y" shaped stripe, left without TAEGRO. Demonstrates inhibition of fungal growth. (Note that there is no approval for control of *Phaeospheria nodorum*.)

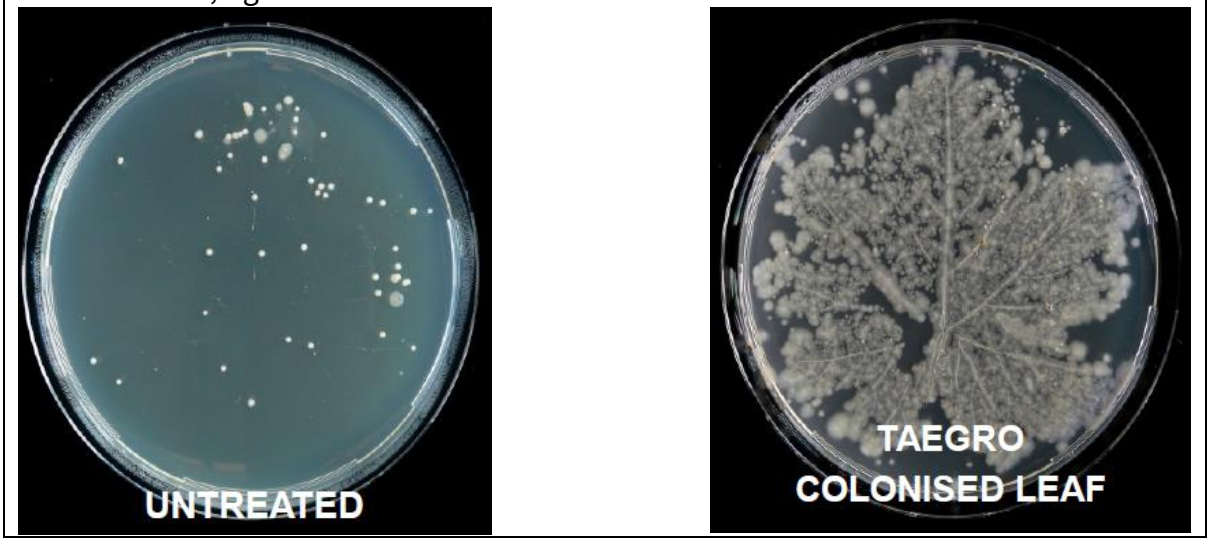


TAEGRO IN USE

When TAEGRO is mixed into water in the spray tank, endospores constituting the active start to germinate.
Multiplying cells:

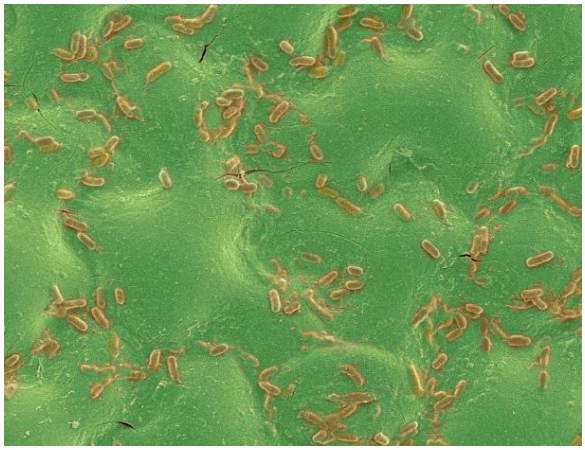
- Create a temporary physical barrier.
- Produce antimicrobial compounds.
- Trigger natural plant defences.

Figure 2: Competition on the surface of leaf
3 days after an application of TAEGRO, stamp of grapevine leaf on Petri dish agar. Left untreated, right treated with TAEGRO.

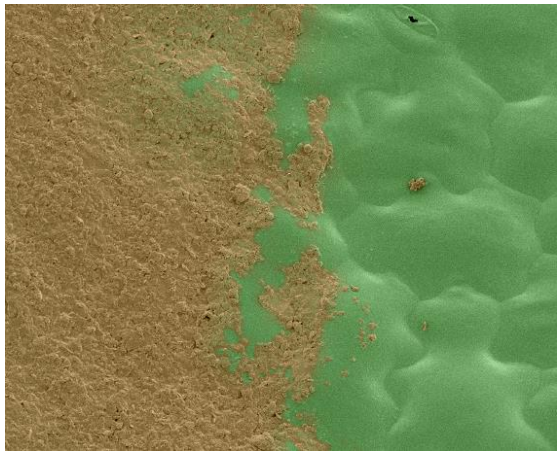


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Figure 3: Image of TAEGRO (*Bacillus amyloliquefaciens*) cells lying and multiplying on the leaf surface.



Colonisation via cell chains

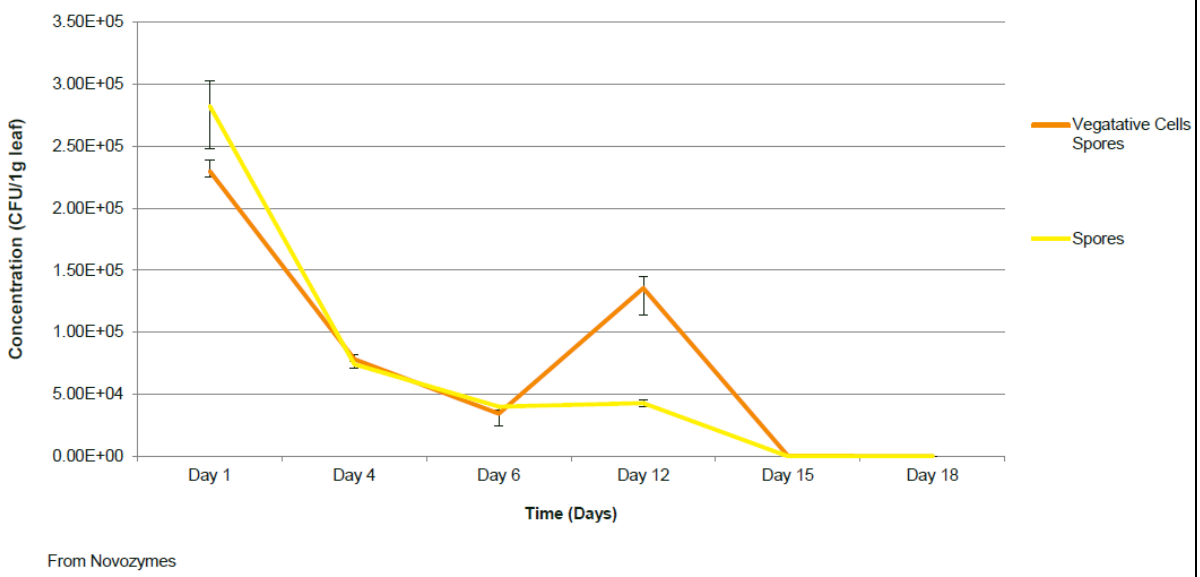


Border of a colony

TAEGRO PERSISTENCE ON LEAF

TAEGRO survived on greenhouse lettuce for a maximum of 2 weeks. Potential for multiplication after 5-6 days.
Initial population drop during the first 2-3 days but then keeps a flat population.
Multiple applications required at 7 - 10 day intervals.

Figure 4: TAEGRO applied to greenhouse lettuce leaves and monitored over 18 days



From Novozymes

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ON WHAT CROPS AND IN WHAT SITUATIONS CAN TAEGRO BE USED?

CROP LIST

Table 1: Crop list.

Crop	Situation	Label or EAMU*
CUCURBITACEAE		
Cucumber	Permanent protection with full enclosure	Label
Courgette	Permanent protection with full enclosure	Label
Melon	Permanent protection with full enclosure	Label
Watermelon	Permanent protection with full enclosure	Label
Summer squash	Permanent protection with full enclosure	Label
Powdery mildew. Stage BBCH 11-89 (First true leaf on main stem fully unfolded to fruit fully ripe).		
LETTUCE		
Lettuce	Permanent protection with full enclosure	Label
Downy mildew. Stage BBCH 12-49 (Second true leaf unfolded to heads typical size, form and firmness).		
SOLANACEAE		
Tomato	Permanent protection with full enclosure	Label
Aubergine	Permanent protection with full enclosure	Label
Pepper and chilli	Permanent protection with full enclosure	Label
Early blight. Stage BBCH 13-89 (second true leaf on main stem unfolded to fruits fully ripe colour. Powdery mildew. Stage BBCH 20-89 (formation of side shoot to fruits fully ripe colour).		
STRAWBERRY		
Strawberry	Permanent protection with full enclosure	Label
Grey mould. Stage BBCH 61-89 (first flower open to after harvest and beginning of axillary bud formation).		
GRAPEVINE		
Table and wine grapes	Outdoor	Label
Powdery mildew: BBCH stage 00-89 (dormancy to berries ripe for harvest Grey mould: BBCH stage 61-91 (beginning of flowering to after harvest end of wood maturation).		
ORNAMENTAL PLANT PRODUCTION & NURSERY FRUIT TREES		
Ornamental plant production Nursery fruit trees	Outdoor, protected and permanent protection with full enclosure	EAMU* 2404/2022
Powdery mildew, downy mildew, botrytis, *Alternaria* spp., sclerotinia.		

*This extension of authorised use (EAMU) provides for the use of TAEGRO in respect of crops and situations, other than those included on the product label. No efficacy or phytotoxicity data have been assessed and as such the 'extension of use' is at all times done at the user's choosing, and the commercial risk is entirely theirs.
Before use of any pesticide under an extension of authorisation, users must have a copy of the document, which is available for the UK from the HSE/CRD EAMU database. Documents are frequently revised and therefore it is important to check that the documentation is current and correct before any use.

APPLICATION MIXING AND SPRAYING

WHEN TO APPLY

TAEGRO should be applied prior to or in the early stages of disease development.
Alternating or using in block treatments with chemical fungicides can give improved control.

HOW FREQUENTLY TO APPLY

Shorten the spray interval under heavy disease pressure.
Able to persist on leaf surfaces for 2 weeks.
At the time of writing a minimum spray interval of 7 days is specified for grapevine and of 3 days for the other label crops.

HOW BEST TO APPLY

Apply late in the day to avoid spore exposure to UV light.

RATE OF USE

The maximum rate of use from the label in all situations is 370 g/ha.

MIXING

TAEGRO must be pre-mixed thoroughly with water to assure a properly distributed suspension. The label recommends pre-mixing the required quantity of TAEGRO in a container with 2-5 litres of water. Adding half the required quantity of water to the spray tank and begin agitation then slowly empty the TAEGRO pre-mix into the tank. When thoroughly mixed add the remaining water. Maintain agitation whilst spraying.

All the spray solution should be used within a few hours.

WATER VOLUME

The water volume is listed as between 180 and 1000 litres per hectare. Thorough coverage is important but do not spray to run-off.

EFFECTIVE TEMPERATURE RANGE

The optimum temperature range is 15-30°C on label.
Storage stability trials have shown stability at four temperatures: 4°C, 25°C and 35°C.

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STABILITY UNDER DIFFERENT WATER OR SPRAY TYPES

TAEGRO is adaptable to most spray solutions and plant surfaces and grows at pH 5 to pH 9 but the label recommendations are to correct the pH to within the range of pH 5 to 8 before adding TAEGRO.

HARVEST INTERVAL

At the time of writing a 1 day harvest interval is specified for on-label edible crops.

CROP SAFETY

TAEGRO has been tested on a wide range of crops and conditions without causing crop damage. When used as directed no unacceptable crop effects are expected but growers are recommended to test a small area before widespread use.

COMPATIBILITIES

TANK MIXING

TAEGRO is physically and biologically compatible with most crop protection products, however growers are recommended to test a small area before widespread use.

Table 2: Compatibilities (see notes and restrictions at the end of this table)

Active	UK Example	Physical compatibility	Biological compatible
Fungicides			
azoxystrobin	Amistar	Y	-
azoxystrobin + difenoconazole	Amistar Top	Y	Y
boscalid + pyraclostrobin	Bellis / Signum	Y	Y
captan	Captan	-	Y
copper hydroxide	-		N
cyprodinil + fludioxonil	Switch	Y	Y
difenoconazole	Plover	-	Y
fluazinam	Shirlan (different formulation)	-	Y
mancozeb	e.g. Dithane 945	Y	Y
mancozeb + metalaxyl-m	Fubol Gold	Y	Y
mandipropamid	Revus	Y	Y
metalaxyl-m	SL567A	Y	Y
penthiopyrad	Fontellis	N	-
pyraclostrobin	Vivid	Y	-
sulphur	Thiovit Jet	Y	Y

Continued on page 10

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Continued from page 9			
Insecticides			
abamectin	Dynamec (not UK formulation)	Y	-
chlorantraniliprole	Coragen	Y	-
spirotetramat	Movento	Y	-
Fertilisers			
diammonium phosphate		Y	-
mono ammonium phosphate		Y	-
potassium sulphate		Y	-
urea		Y	-
Adjuvants			
Elasto G5		Y	Y
Li 700		Y	-
Nufilm P		Y	-

The label warns the user not to use chlorinated water sources at a concentration of 5 ppm or more.
The directions for use on the label say that a fungicide treatment should only be applied at least 7 days after a treatment with TAEGRO.
Key 'Y' = compatible, 'N'= not compatible, '-' no information.
Trials on physical compatibility may have been carried out overseas with formulations which may differ from UK versions.
This information is prepared as guidance of physical compatibility only. No tests have been carried out on crop safety for tank mixtures. Some of the products listed may not be approved for the crops included on the approval. Some products listed may not be available in the UK or Ireland.
Do not use any tank-mix if the mixture cannot be applied within the recommendations for individual products or if specific tank mix restrictions apply.
This additional information is for guidance purposes only and use is at grower's risk. No liability can be accepted for any compatibilities beyond the label. For any new mixture, users are advised to carry out small scale tests on a small sample of crop before wider use.

COMPATIBILITY WITH BENEFICIAL INSECTS AND MITES.

It is thought that TAEGRO will be compatible with beneficial insects and mites.

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USE IN ORGANIC SYSTEMS

TAEGRO is usable in organic production subject to the certification body approval. TAEGRO has been approved for use in organic systems by Organic Farmers and Growers.

SHELF LIFE AND RECOMMENDED STORAGE CONDITIONS

TAEGRO has a shelf life of 36 months at room temperature (around 23°C).
Do not freeze, do not store above 30°C.
The label says once opened, use entire contents. However, experience has shown that if the opened container is closed tightly and stored in low humidity, the contents will remain viable until the expiry date.

PACKAGING

TAEGRO is packed in 375g flexible packs, 10 per outer.

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*EAMUs Extension of Authorisation for Minor Use. This extension of authorised use (EAMU) provides for the use of TAEGRO in respect of crops and situations, other than those included on the product label. No efficacy or phytotoxicity data have been assessed and as such the 'extension of use' is at all times done at the user's choosing, and the commercial risk is entirely theirs.
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Safety data sheet available on request.

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Pack size 375g, outer of 10

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