

PP 1/338 (1) Assessing the adverse effects of plant protection products on russetting

Specific scope: This Standard provides guidance on the circumstances in which to evaluate the adverse effects of foliar applied plant protection products on russetting in pome and other fruits crops and how to address any possible adverse effects.

Specific approval and amendment: First approved in 2025-09.

1 | INTRODUCTION

Russetting refers to brown, rough ‘corky’ (secondary periderm layer) areas which can develop on the skin of various fruits. Studies¹ highlight that russetting arises from a complex interplay of environmental conditions, such as light, temperature, and relative humidity, as well as nutrient imbalances. It is a natural physiological process usually exhibited as a response to mechanical damage or environmental stresses early on in fruitlet development. It is often more prevalent in cooler temperatures and high humidity. Various fungal and bacterial diseases, yeasts, insects and mites e.g. *Pantoea agglomerans* (ERWIHE), *Podosphaera leucotricha* (PODOLE) and *Pseudomonas* spp. (IPSDMG) can also cause russetting. Additionally, the presence of certain viruses along with the application of specific plant protection products have been implicated in russetting development. These cause plants to produce high levels of the hormone indole-3-acetic acid (IAA), which causes russetting.

Commercially, russetting can reduce the economic value of the crop and cause greater moisture loss during storage which may also reduce shelf life. Fruit varieties vary greatly in their susceptibility to russetting. Many modern commercial varieties are not prone to russetting, but some varieties (e.g. in apples, ‘Cox’, ‘Bramley’, ‘Golden Delicious, Gala, Fuji, Tentation®, Delblush, Pinova, Evelina or Elstar’; in pears ‘Conference’,² Xenia or Novembra) are inherently more susceptible (under certain conditions).

In addition to the above factors, foliar applied chemicals can increase russetting symptoms. Examples are linked to the use of fungicides, (e.g. copper), reflecting their wide use in fruit crops, but there are also examples of insecticides and plant growth regulators.³ More recently, the use of some products containing micro-organisms have also been shown to increase the risk of russetting.⁴ In contrast, there are some plant protection products (PPP) that can decrease symptoms of russetting where they are used to control species which cause russetting. Plant growth regulators used in crop management and for improving fruit quality may also be used as a tool to prevent russetting.

Regulatory authorities are required to consider the potential for PPP to adversely affect various crop quality factors, and observations on russetting for pome fruit are included in EPPO Standard PP 1/135 *Phytotoxicity*.

In the absence of data, or an appropriate case, then suitable label warnings may be required.

2 | WHEN TO ADDRESS RUSSETING IN FRUIT CROPS

Timing of the PPP application is a key factor in whether the risk of russetting needs to be addressed. After fruit set the growth of the fruitlets is brought about by a combination of cell division and cell expansion, which may be influenced by a range of external factors. Generally, russetting only needs to be considered for foliar sprays applied at the susceptible stage, which in pome fruit is from when approximately 20% of flowers are open (BBCH 62) to when fruit size is up to 20mm (BBCH 74).

For most herbicides and other product types applied before this time, russetting does not need to be considered. However, if an active substance is systemic and remains effective for a prolonged period within the plant, a more detailed reasoned case and possibly further assessment may be required.

¹Sharma, N.C., Verma, P., Verma, P. et al. Apple russetting-causes, physiology and control measures: A review. *Planta* 261, 41 (2025). <https://doi.org/10.1007/s00425-025-04614-3>

²Winkler, A., Athoo, T.; Knoche, M. Russetting of Fruits: Aetiology and Management. *Horticulturae* 2022, 8, 231. <https://doi.org/10.3390/horticulturae8030231>

³Same reference as footnote 2.

⁴Floral Colonization Dynamics and Specificity of *Aureobasidium pullulans* Strains Used to Suppress Fire Blight of Pome Fruit (2019), Temple T.N et al., American Phytopathology Society.

The extent of existing evidence-based information regarding both the active substance and the product formulation and/or composition is also important. New active substances, or where there is a major change to chemical composition or change in formulation type may present a higher risk situation than existing actives and formulations where there is a known history of use.

As some varieties are prone to russetting, it is important to consider the commercially grown varieties in the EPPO region where an authorisation is sought. Yellow-fleshed apple cultivars generally exhibit a higher incidence of russetting compared to red-fleshed ones, which is particularly relevant for cultivar selection in trials. Where authorisation is sought in one country, data should encompass national varieties susceptible to russetting. However, data packages are often generated across a wider geographic area using a range of varieties as part of authorisations sought in a number of countries. It may be possible for the applicant to present such data and highlight any varieties that are susceptible to russetting, and argue they are representative for all countries. Applicants may make a case that varieties used in a trial are commercially representative of the areas/region where the trial is conducted and authorisation is sought, and are not prone to russetting. In these situations, assessing russetting and/or adding label warnings is not required. However, where commercial varieties are prone to russetting, an appropriate range of those varieties should be included in trials or label warnings may be required. Applicants should also be aware that relevant varieties will change over time.

If a case can be made that there is a low risk of PPP-caused russetting based on: appropriate validated information on the known properties of the active substance and formulation, type and timing of application and varieties on which the PPP will be used, then no further assessment or label warnings are required.

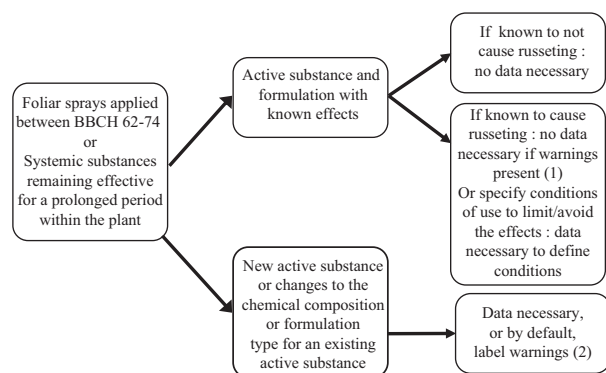


FIGURE 1 Decision-support scheme to determine the extent of testing to examine russetting.

(1) For example: 'There is a known risk of russetting on....'

(2) For example: 'Caution: Effects on russetting on susceptible varieties has not been studied' or 'A risk of russetting cannot be excluded'.

An appropriate decision-support scheme to determine the extent of testing to examine russetting is presented in Figure 1.

3 | HOW TO ADDRESS RUSSETING

Where an appropriate case that there is a low risk of PPP-caused russetting based on the Decision-support scheme above cannot be made, then data addressing russetting may be required. These data can be generated from effectiveness and/or crop safety trials. Assessments in effectiveness trials (compared with the untreated control), where trials are pest free or pest pressure remains low, can be helpful to fully understand whether the PPP itself can increase russetting. If the PPP is recommended to be used with an adjuvant, trials should be conducted using both products and should include observations on russetting. This is because adjuvants themselves may cause russetting. However, it is recognised that many edaphic and agronomic factors contribute to russetting, which may only occur under a combination of circumstances, and appropriate label warnings may be added in lieu of data.

Data are required from apple and pear trials conducted with the most russet prone varieties, ideally in different years and in conditions conducive to russetting e.g., two fully supportive trials on apple and two on pear.

The key consideration in assessments and interpreting results is the comparison between the untreated plots (or reference products with no known effects on russetting), and the degree of symptoms in the PPP trials. Generally, an increase in russetting above that reported in the untreated or reference product may trigger the need for a label warning (usually in relation to specific susceptible varieties). The reference product should have the same use or the same type of action as the test product, avoiding products that are known to reduce russetting e.g. gibberellins.

On pome fruit, observations on russetting symptoms should be made in accordance with PP 1/135, on 100 fruits at harvest and expressed as a percentage of the fruit surface area. The scale described in PP 1/158 *Regulation of growth in pome fruits by orchard applied, pre-harvest applications* may be appropriate for recording russetting symptoms. Other scales may be used if fully described.

Results should be analysed in relation to appropriate National or International marketing Standards.

Data should be presented in the dossier under the adverse crop safety (quality) section.

4 | LABEL WARNINGS

1. Where data indicates that a PPP increases the symptoms of russetting, or the active substance or product

is known to cause russetting, an appropriate label warning may be added. This may also describe the circumstances under which russetting may occur (for example, naming susceptible varieties and the environmental factors most likely to trigger symptoms). Some example warnings are shown below:

- *Use of this product may cause russetting in susceptible varieties, such as [insert name of variety here]*
- *This product may contribute to russetting when applied to susceptible varieties during flowering. To reduce the risk of russetting in such cultivars, reduce the number of treatments to [insert number here] or avoid application during flowering.*

- *There is a known risk of russetting in susceptible varieties.*

2. Where there is insufficient evidence or data to demonstrate that russetting is unlikely, particularly on susceptible varieties, then it is also appropriate to add a label warning, e.g.,

- *‘Caution: Effects on varieties susceptible to russetting have not been studied/cannot be excluded.’*

To remove such a warning, further data would need to be provided. However, it may be possible to generate such data during the commercial use of the product by growers, provided it has been generated under the supervision of a GEP accredited organization.