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Vitenskapskomiteen for mat og miljø
Norwegian Scientific Committee for Food and Environment

Risk ranking and prioritization of plant pests for Norway

Progress report No. 2

Paal Krokene, Beatrix Alsanius, Jorunn Børve, Daniel Flø, Christer Magnusson, Mogens Nicolaisen, Line Nybakken, Johan A. Stenberg, Selamawit Tekle, Iben M. Thomsen, Sandra A. I. Wright, May-Guri Sæthre

Scientific Opinion of the Panel on Panel on Plant Health of the Norwegian Scientific Committee for Food and Environment

EPPO-listed plant pests were assessed and ranked according to the overall risk they pose to Norwegian plant health. Based on probability of entry, probability of establishment (including spread), and potential impact on plant health, pests were classified into five risk classes: very high, high, moderate, low, and very low risk. In this second progress report VKM has assessed 69 pests: 53 insects and mites, eight bacteria, four viruses, three fungi, and one chromista. No pests were assessed to pose very high or high risk. Six pests were assessed to pose moderate risk: *Choristoneura fumiferana*, *Dendrolimus superans*, *Grapholita packardi*, *Potexvirus pepini*, *Tobamovirus fructirugosum*, and *Xylella fastidiosa*. The remaining 63 pests were assessed to pose low risk (20 pests) or very low risk (43 pests) to Norwegian plant health.

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Preparation of the opinion

The Norwegian Scientific Committee for Food and Environment (Vitenskapskomiteen for mat og miljø, VKM) appointed a project group to draft the opinion. The project group consisted of ten VKM committee members and two VKM staff members. The VKM Panel on Plant Health evaluated and approved the final opinion.

Authors of the opinion

The authors have contributed to the opinion in a way that fulfils the authorship principles of VKM (VKM, 2023). The principles reflect the collaborative nature of the work, and the authors have contributed as members of the project group and the VKM Panel on Plant Health.

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Expertise of VKM experts

Individuals working for VKM, either as appointed members of the Committee or as external experts, do this by virtue of their scientific expertise, not as representatives for their employers or third-party interests. The provisions on impartiality in the Norwegian Public Administration Act apply to all work carried out by VKM.

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Summary

Background: The Norwegian Food Safety Authority (NFSA) commissioned the Norwegian Scientific Committee for Food and Environment (VKM) to assess and rank plant pests that are listed in EPPO's (European and Mediterranean Plant Protection Organization) A1 and A2 lists and that are currently not regulated in Norway. The lists include plant pests that EPPO recommends member countries to regulate as quarantine pests. The objective of the commission is to support NFSA's future regulatory decision making by identifying pests that pose high risks to Norwegian plant health. The commission is an ongoing assignment. This report presents the results of the second round of assessments. Out of 305 EPPO-listed pests that are not currently regulated in Norway (including 30 pests on the EPPO Alert List), 69 pests were assessed in this second round of assessments. The total number of pests assessed in the first two assessment rounds is 129.

Methodology and data: Pests were assessed using FinnPRIO, a semi-quantitative, rapid and cost-effective pest ranking tool. FinnPRIO follows the steps of a standard full-scale pest risk assessment by scoring probabilities of entry, establishment and impact of a pest in a specified pest risk assessment area (i.e., Norway in this case). To guide the scoring, import statistics for relevant commodities and monetary values for different plant production sectors in Norway were retrieved from Statistics Norway and Totalkalkylen, respectively. Lists of available host plants in Norway were made by cross-referencing listed host species of each pest in the EPPO Global Database with plant species recorded in Norway. Climate suitability in Norway was modelled for all pests with sufficient presence data using the Maxent machine learning algorithm, incorporating global pest occurrence records and bioclimatic variables for both current and projected future climate conditions. An AI option was provided to assessors for selected pests to assist in setting FinnPRIO scores.

Risk classification of pests: Pests were assessed and ranked based on the total risk they pose to plant health in Norway. The total risk posed by each pest was calculated by aggregate assessments of probability of entry, probability of establishment (including spread), and potential impact on Norwegian plant health. The joint probability of entry and establishment was used as a measure of the probability of invasion. Pests were classified into five groups:

1. *Very high risk* pests pose very high risk to Norwegian plant health. These pests are considered to have both high probability of invasion and high impact of invasion.

2. *High risk* pests pose high risk to Norwegian plant health because they have either high probability of invasion combined with moderate impact, or high impact of invasion combined with moderate probability of invasion.

3. *Moderate risk* pests pose moderate risk to Norwegian plant health. These pests have intermediate combinations of probability and impact of invasion (high probability-low impact, low probability-high impact, or moderate probability and impact).

4. *Low risk* pests pose low risk to Norwegian plant health because they have low to moderate probability and impact of invasion (low probability-moderate impact or moderate probability-low impact). Impact may, for example, be low if the pests' host plants are minor crops in Norway or make up a very small proportion of natural ecosystems. Pests are also considered to have a low probability of invasion if the

Norwegian plant health regulation prohibits the import of goods that can serve as import pathways or there have been no registered imports of relevant goods in the past 10 years.

5. *Very low risk* pests have both low probability of invasion and low impact and are considered to pose very low risk to Norwegian plant health. Many pests in this group have no cultivated or natural hosts in Norway, climatic conditions are usually unsuitable for their establishment and spread, and probability of entry is usually low because potential import pathways are absent.

Key findings: VKM assessed and ranked 69 EPPO-listed pests in this second progress report. These included 53 arthropods (52 insects and one mite), eight bacteria, four viruses, three fungi, and one chromista.

High risk and very high risk pests: Using the risk classification outlined above, none of the 69 pests assessed in this second progress report were identified to pose very high or high risk to Norwegian plant health.

Moderate risk pests: Six pests were assessed to pose moderate risk.

Two pests were assessed to have moderate probability and impact of invasion:

- The virus *Potexvirus pepini* (PEPMV0) is mechanically transmitted with plant sap and can infest tomato and pepino, causing considerable yield losses. Its main entry pathway is infected tomato fruits and, to a lesser extent, seeds. The pest is present in many countries in Europe, including countries with a temperate climate. The risk of introduction and spread in Norway with infected fruits is considerable. Establishment will probably have significant economic consequences, as symptoms and yield losses in tomato are considerable.
- The virus *Tobamovirus fructirugosum* (TOBRFV) was described as recently as 2015 and infests tomato and peppers. The virus is considered 'present' or 'transient and under eradication' in several countries in Europe and elsewhere. Pathways for movement are seeds, fruits or vegetables, and plants for planting. Entry is likely by seeds and fruits (mechanical transmission), and to a lesser extent by plants for planting. Establishment is likely in greenhouses and the economic impact for tomato production would be significant.

Four pests were assessed to have low probability of invasion but high potential impact:

- The moth *Choristoneura fumiferana* (CHONFU) attacks several hosts in the pine family, including species that are important forest trees in Norway. The main pathway for movement is plants for planting and other living conifer plant parts. Import of conifers from the pest's current distribution is not allowed. Most forested areas in Norway have similar climatic conditions as the pest's native range in North America, suggesting that outdoor establishment in Norway is likely. The potential impact is high because the pest is a highly destructive pest of spruce and fir trees, causing widespread defoliation, reduced growth and periodic tree mortality in its native range.

- The moth *Dendrolimus superans* (DENDSU) is a severe defoliator of conifers in its native range in China, Japan, and Russia. Documented host plants include species of *Pinus*, *Larix*, *Abies*, and *Picea*, including species that are important forest trees in Norway. The most likely entry pathways are plants for planting and timber but such imports from the pest's current range is small, and phytosanitary measures further

reduce the likelihood of entry. The pest's climatic requirements are uncertain, but it can probably establish in the southernmost parts of Norway. The potential impact is high, as the pest probably will cause repeated defoliation and possibly tree mortality in some areas during outbreak years, with significant consequences for timber production.

- The moth *Grapholita packardi* (LASPPA) has larvae that feed in fruit or terminal shoots. It has a relatively wide host range, including plants used in commercial fruit orchards, gardens, as ornamentals and in natural habitats in Norway. The pest's current distribution in Northern America suggests that it may establish in southern Norway, but the probability of entry is low. Due to the large number of potential hosts, significant economic losses could be expected in a situation with few or no pesticides available for Norwegian production.
- The bacterium *Xylella fastidiosa* (XYLEFA) is a serious plant pathogen that can cause wilt disease in several hundred host plants, including species of *Prunus*, other deciduous trees, and ornamental plants. The pest is established in several European countries, and the most likely entry pathway is with plants for planting. Infected plants can remain asymptomatic, and this makes early detection difficult. There are suitable vectors in Norway (mainly native xylem sap feeders) and susceptible wild and cultivated host plants. It is moderately likely (with high uncertainty) that the pest can establishment in protected conditions and outdoors in Norway.

Low risk and very low risk pests: The remaining 63 pests were considered to pose low risk (20 pests) or very low risk (43 pests) to Norwegian plant health. The 43 pests assessed to pose very low risk scored low on both probability of invasion and impact. Of the 20 pests that were assessed to pose low risk, 19 had low probability of invasion but moderate potential impact, whereas one pest was assessed to have medium probability of invasion combined with low impact.

Implications: The FinnPRIO risk ranking tool provides risk assessments that are rapid and limited in scope. While this is useful for screening large numbers of pests, a standard risk assessment will provide firmer support for NFSA's regulatory decision making. The need for firmer support can be addressed by preparing standard pest risk assessments for the six pests that were assessed to pose moderate risk and that currently lack a standard pest risk assessment specific to Norway. The need for more detailed assessments is lower for pests that are considered to pose very low or low risk to Norwegian plant health.

Key words: Pest prioritization, pest risk ranking, plant health, quarantine pests, risk assessment

Sammendrag

Bakgrunn: Mattilsynet ba Vitenskapskomiteen for mat og miljø (VKM) om å vurdere og rangere planteskadegjørere som er oppført på EPPO (European and Mediterranean Plant Protection Organization) sine A1- og A2-lister, og som per i dag ikke er regulert i Norge. Listene inkluderer skadegjørere som EPPO anbefaler medlemsland å regulere som karanteneskadegjørere. Målet med oppdraget er å støtte Mattilsynets arbeid ved å identifisere skadegjørere som utgjør en høy risiko for norsk plantehelse. Dette er et løpende oppdrag og denne rapporten presenterer resultatene fra den andre runden med artsvurderinger. Av de 305 EPPO-listede skadegjørerne som ikke er regulert i Norge (inkludert 30 skadegjørere på EPPO sin Alert List) er 69 arter vurdert i denne andre delrapporten. Så langt er 129 planteskadegjørere vurdert.

Metodikk og data: Skadegjørerne ble vurdert ved å bruke FinnPRIO, et semi-kvantitativt, raskt og kostnadseffektivt verktøy for rangering av skadegjørere. FinnPRIO er utviklet i Finland og følger trinnene i en standard fullskala risikovurdering («pest risk assessment») ved å score sannsynligheten for innførsel, etablering og effekt på plantehelse for skadegjørere i et spesifisert område (i dette tilfellet Norge). Som grunnlag for scoringen hentet vi importstatistikk for relevante varer og økonomiske verdier for ulike planteproduksjoner i Norge fra henholdsvis Statistisk sentralbyrå og Totalkalkylen. Lister over tilgjengelige vertsplanter i Norge ble skaffet til veie ved å koble oppførte vertsplanter for hver skadegjører i EPPO Global Database med plantearter registrert i Norge. Skadegjørernes toleranse for klimaet i Norge ble modellert ved hjelp av Maxent, en maskinlæringsalgoritme som bruker artenes globale forekomst og bioklimatiske variabler for både nåværende og fremtidige klimaforhold i Norge. Et KI-basert såkalt «retrieval-augmented generation» (RAG)-system som søkte i relevant vitenskapelig litteratur ble brukt for noen skadegjørere som et hjelpemiddel for å score FinnPRIO-vurderingene.

Risikoklassifisering av skadegjørere: Skadegjørerne ble rangert ut fra den totale risikoen de utgjør for plantehelse i Norge. Total risiko ble beregnet som produktet av sannsynlighet for innførsel, sannsynlighet for etablering (inkludert spredning), og skadepotensial for norsk plantehelse. Samlet sannsynlighet for innførsel og etablering ble brukt som et mål på invasjonssannsynlighet. Skadegjørerne ble klassifisert i fem grupper:

1. *Svært høy risiko*: disse utgjør svært høy risiko for norsk plantehelse og har både høy sannsynlighet for invasjon og stort skadepotensial ved invasjon.
2. *Høy risiko*: disse utgjør høy risiko for norsk plantehelse. De har enten høy sannsynlighet for invasjon kombinert med moderat skadepotensial eller moderat sannsynlighet for invasjon kombinert med stort skadepotensial.
3. *Moderat risiko*: disse utgjør moderat risiko for norsk plantehelse. De har moderate kombinasjoner av sannsynlighet for og skadepotensial ved invasjon (høy sannsynlighet-lite skadepotensial, lav sannsynlighet-stort skadepotensial, eller moderat sannsynlighet og skadepotensial).
4. *Lav risiko*: disse utgjør liten risiko for norsk plantehelse. De har lav til moderat sannsynlighet for og skadepotensial ved invasjon (lav sannsynlighet-moderat skadepotensial eller moderat sannsynlighet-lite skadepotensial). Skadepotensialet kan for eksempel være lite hvis vertsplantene har liten økonomisk betydning eller marginal forekomst i naturlige økosystemer. Skadegjørere er i tillegg vurdert å ha lav sannsynlighet for invasjon dersom plantehelseregelverket forbyr import av varer som

kan tjene som importveier eller det ikke er registret import av varer som kan tjene som importveier de siste ti årene.

5. *Svært lav risiko*: disse utgjør svært lav risiko for norsk plantehelse fordi både sannsynligheten for og skadepotensialet ved en invasjon er liten. Mange skadegjørere i denne gruppen har ingen kommersielle eller naturlige vertsplanter i Norge, de klimatiske forholdene er vanligvis uegnet for etablering og spredning av skadegjørerne, og importveier er fraværende.

Hovedfunn: VKM har vurdert og rangerte 69 EPPO-listede planteskadegjørere i denne andre runden. Disse omfattet 53 leddyr (52 insekter og én midd), åtte bakterier, fire virus, tre sopper og én chromista.

Planteskadegjørere med høy og svært høy risiko: I henhold til risikoklassifiseringen beskrevet ovenfor ble ingen av de 69 skadegjørerne vurdert i denne andre runden identifisert å utgjøre svært høy eller høy risiko for norsk plantehelse.

Planteskadegjørere med moderat risiko: Seks skadegjørere ble vurdert til å utgjøre moderat risiko.

To av disse ble vurdert til å ha moderat sannsynlighet for invasjon og moderat skadepotensial:

- Viruset *Potexvirus pepini* (PEPMV0) overføres mekanisk med plantesaft og kan infisere og forårsake betydelige avlingstap i tomat og pepino. Den viktigste innførselsveien er infiserte tomatfrukter og, i mindre grad, frø. Viruset finnes i mange land i Europa, inkludert land med et temperert klima. Risikoen for introduksjon og spredning med infiserte frukter er betydelig. Konsekvensene ved etablering i Norge ville være betydelige, ettersom avlingstapene er store i tomat.
- Viruset *Tobamovirus fructirugosum* (TOBRFV) ble beskrevet så sent som i 2015 og smitter tomat og paprika. Det anses å være etablert, eller forbigående til stede og under utrydding, i en rekke land i og utenfor Europa. Innførselsveier er frø, frukt eller grønnsaker, og levende planter. Innførsel er mest sannsynlig via frø og fukt (mekanisk overføring) og i mindre grad via levende planter. Viruset vil trolig kunne etablere seg i veksthus i Norge og de økonomiske konsekvensene for veksthusproduksjon av tomat vil være betydelige.

Fire planteskadegjørere ble vurdert til å ha lav sannsynlighet for invasjon, men høyt skadepotensial:

- Møllen *Choristoneura fumiferana* (CHONFU) angriper flere arter i furufamilien, inkludert arter som er viktige skogstrær i Norge. Den viktigste innførselsveien er import av levende planter og plantedeler av bartrær. Slik import fra møllens nåværende utbredelsesområde i Nord-Amerika er ikke tillatt. De fleste skogområder i Norge har lignende klimatiske forhold som i møllens utbredelsesområde, noe som tilsier at utendørs etablering i Norge er sannsynlig. Det potensielle skadeomfanget er stort fordi møllen gjør stor skade i gran- og edelgranskoger i Nord-Amerika, med omfattende avnåling, redusert vekst og periodisk tredød.
- Møllen *Dendrolimus superans* (DENDSU) er en alvorlig skadegjører i sitt naturlige utbredelsesområde i Kina, Japan og Russland. Dokumenterte vertsplanter er arter av *Pinus*, *Larix*, *Abies* og *Picea*, inkludert arter som er viktige skogstrær i Norge. De mest

sannsynlige innførselsveiene er import av levende planter og tømmer. Import volumet fra skadegjørerens nåværende utbredelsesområde er lavt. Plantesanitære tiltak reduserer også sannsynligheten for innførsel. Møllens klimakrav er ikke godt kjent, men den kan trolig etablere seg i de sørligste delene av Norge. Skadepotensialet er stort, ettersom møllen sannsynligvis kan forårsake gjentatt avnåling og muligens tredød, med negative konsekvenser for tømmerproduksjon.

- Møllen *Grapholita packardi* (LASPPA) borer i frukt og nye skudd. Den har et relativt bredt vertsspekter som inkluderer planter i kommersielle frukthager, privathager, prydplanter og planter som lever i naturlige habitater i Norge. Klimaet i møllens naturlige utbredelsesområde i Nord-Amerika tilsier at den vil kunne etablere seg i Sør-Norge, men sannsynligheten for innførsel ansees som lav. Fordi møllen har mange mulige vertsplanter, kan den sannsynligvis gjøre stor økonomisk skade i en situasjon der få eller ingen plantevernmidler er tilgjengelige for norsk produksjon.
- Bakterien *Xylella fastidiosa* (XYLEFA) er en alvorlig skadegjører som kan gi visnesykdom i flere hundre vertsplanter, inkludert arter i slekten *Prunus*, andre løvtrær og ulike prydplanter. Bakterien har etablert seg i flere europeiske land, og den mest sannsynlige innførselsveien til Norge er med import av levende planter. Tidlig oppdagelse er vanskelig fordi infiserte planter kan forbli symptomfrie. Bakterien har egnede vektorer i Norge (hovedsakelig sugende insekter) samt mottakelige ville og dyrkede vertsplanter. Det er moderat sannsynlig at bakterien vil kunne etablere seg under beskyttede forhold og utendørs i Norge, men denne vurderingen har høy usikkerhet.

Planteskadegjørere med lav og svært lav risiko: De resterende 63 skadegjørerne ble vurdert å utgjøre lav risiko (20 skadegjørere) eller svært lav risiko (43 skadegjørere). De 43 skadegjørerne som utgjorde svært lav risiko, scoret lavt både på sannsynlighet for invasjon og skadepotensial. Av de 20 skadegjørerne som ble vurdert å utgjøre lav risiko, hadde 19 lav sannsynlighet for invasjon, men moderat skadepotensial, mens én skadegjører ble vurdert å ha middels sannsynlighet for invasjon og lavt skadepotensial.

Implikasjoner: FinnPRIO-verktøyet som ble brukt gir risikovurderinger som er raske og av begrenset omfang. Selv om dette er nyttig for å screene mange planteskadegjørere, vil en standard risikovurdering gi et mer solid grunnlag for Mattilsynets beslutninger. Behovet for et sikrere beslutningsgrunnlag kan ivaretas ved å utarbeide standard risikovurderinger for de seks skadegjørerne som ble vurdert å utgjøre moderat risiko for norsk plantehelse, og som per i dag mangler en standard risikovurdering spesifikk for Norge. Behovet for mer detaljerte vurderinger er lavere for planteskadegjørere som anses å utgjøre svært lav eller lav risiko.

Nøkkelord: Karanteneskadegjørere, plantehelse, prioritering av skadegjørere, risikorangering, risikovurdering

Glossary

Table 1: All definitions are according to the ISPM 5 Glossary of phytosanitary terms published on behalf of the International Plant Protection Convention (IPPC, 2024).

Term	Definition
Commodity	A type of plant, plant product, or other article being moved for trade or other purpose
Country of origin (of a consignment of plants)	Country where the plants were grown
Endangered area	An area where ecological factors favour the establishment of a pest whose presence in the area will result in economically important loss
Entry (of a pest)	Movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled
Establishment (of a pest)	Perpetuation, for the foreseeable future, of a pest within an area after entry
Host range	Species capable, under natural conditions, of sustaining a specific pest or other organism
Introduction (of a pest)	The entry of a pest resulting in its establishment
Non-quarantine pest	Pest that is not a quarantine pest for an area
Pathway	Any means that allows the entry or spread of a pest
Pest	Any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products
Pest categorization	The process of determining whether a pest has or has not the characteristics of a quarantine pest or those of a regulated non-quarantine pest
Pest risk (for quarantine pests)	The probability of introduction and spread of a pest, and the magnitude of the associated potential economic consequences
Pest risk (for regulated non-quarantine pests)	The probability that a pest in plants for planting affects the intended use of those plants with an economically unacceptable impact
Pest risk analysis	The process of evaluating biological or other scientific and economic evidence to determine whether an organism is a pest, whether it should be regulated, and the strength of any phytosanitary measures to be taken against it
Pest risk assessment	Evaluation of the probability of the introduction and spread of a pest and the magnitude of the associated potential economic consequences
Plants for planting	Plants intended to remain planted, to be planted or replanted
Quarantine pest	A pest of potential economic importance to the endangered area and not yet present there, or present but not widely distributed and being officially controlled
Regulated non-quarantine pest	A non-quarantine pest whose presence in plants for planting affects the intended use of those plants with an economically unacceptable impact and which is, therefore, regulated within the territory of the importing contracting party
Regulated pest	A quarantine pest or a regulated non-quarantine pest
Spread (of a pest)	Expansion of the geographical distribution of a pest within an area

Background as provided by the Norwegian Food Safety Authority

The Norwegian Food Safety Authority (NFSA) is responsible for developing regulations and proposing measures to protect Norwegian agriculture and nature from serious plant pests. Many different plant pests can pose a risk to Norway, and the risk is constantly changing due to increased global trade, changes in trade patterns and cultivation practices, climate change and lack of control measures.

To meet this challenge, NFSA needs comprehensive and up-to-date information. Through systematic and continuous monitoring of available knowledge, NFSA can collect data on new pests relevant to Norway. This information will provide NFSA with a basis for prioritizing work toward the pests considered to represent the highest risk.

Through the work of EPPO, member countries receive support for risk assessment of plant pests and relevant countermeasures. EPPO standard PM1/2 with A1 and A2 lists provides recommendations to at-risk member countries on the regulation of quarantine pests. Norway can use these recommendations as a basis for national regulations, but a follow-up analysis and assessment for Norwegian conditions are needed. NFSA has a backlog in following up EPPO's recommendations and needs support for these assessments.

With this order, NFSA aims to obtain a running overview of the risk posed by the pests on EPPO's lists for Norway. The assignment will provide NFSA with a basis for prioritizing which new pests should be included in further work aimed at regulation. NFSA's follow-up of the delivery may include ordering more detailed risk assessments for certain pests.

Terms of reference as provided by the Norwegian Food Safety Authority

The Norwegian Scientific Committee for Food and Environment (VKM) is requested to deliver the following:

Assessment and ranking of plant pests: We ask VKM to provide running assessments of the pests that EPPO recommends at-risk member countries to regulate as quarantine pests (cf. EPPO's A1 and A2 lists, as specified in EPPO standard PM1/2, last updated September 2024), and which NFSA has not yet assessed for regulation in Norway.

Scope: EPPO's A1 and A2 lists also include some parasitic and invasive plants. These groups of organisms are not included in this assignment.

The delivery should include a simple assessment of plant health risk for Norway, as well as a ranking of the pests according to plant health risk.

VKM will choose the most appropriate method and tool to assess and rank the pests according to risk.

The methodology chosen by VKM should be presented to NFSA once it has been tested on a limited number of pests, so that NFSA can provide input on criteria for risk assessment and method for ranking pests.

Reporting: We ask VKM to prepare a report every six months summarizing the results. In addition, VKM is requested to publish completed analyses of individual pests continuously. Critical findings should be immediately reported to NFSA for prompt response and action.

The report should, at a minimum, include the following points for each pest:

- The identity of the pest,
- Current knowledge of the pest's absence or presence in Norway,
- The pest's potential for introduction, establishment, and spread in Norway, and
- Potential consequences of establishment and spread in Norway.

1 Introduction

Many plant pests may be introduced to Norway and pose potential threats to plant health. The Norwegian Food Safety Authority (NFSA) is responsible for developing regulations and proposing measures to protect Norwegian agriculture and natural ecosystems from serious plant pests. To do this, NFSA needs comprehensive and up-to-date information on new pests that are relevant to Norway, usually in the form of comprehensive and work-intensive pest risk assessments.

Pest risk assessment is a science-based evaluation of the probability of introduction and spread of a pest into a defined area and the magnitude of the associated potential economic consequences. The outcome of a pest risk assessment is usually documented in the form of a comprehensive report. In Norway, pest risk assessments are usually prepared by the Panel on Plant Health of the Norwegian Scientific Committee for Food and Environment (VKM). Given the very large number of potential plant pests that could be introduced into Norway, it is not efficient or even feasible to perform a comprehensive pest risk assessment for every pest.

In this assignment, VKM used FinnPRIO, a structured and simplified pest ranking tool that can be used to effectively screen and prioritize among many pests (Heikkilä et al., 2016). FinnPRIO was selected because (i) it is one of the few peer-reviewed pest ranking models, (ii) it is developed for Nordic conditions and (iii) it systematically quantifies uncertainty using Monte Carlo simulations. Pest risk ranking was based on the pests' potential for introduction, establishment, spread and impact in Norway.

The scope of this assignment is limited to plant pests that are listed on EPPO's (European and Mediterranean Plant Protection Organization) A1, A2 and Alert lists and that are currently not regulated in Norway. EPPO's A1 and A2 lists include plant pests that pose a phytosanitary risk for the European and Mediterranean region and hence are recommended for regulation as quarantine pests. The A1 List contains pests that are absent in the EPPO region, whereas the A2 List contains pests that are locally present in the region. The purpose of the Alert List is to provide EPPO member countries with an early warning about pests that may represent phytosanitary risk. Pests on the Alert List are not yet recommended for phytosanitary regulations but may eventually be transferred to the A1 or A2 list.

The objective of this report is to support NFSA's regulatory decision making by assessing and ranking pests according to the risk they pose to plant health in Norway.

2 Methods and data sources

Readers are referred to the first progress report (VKM, 2026) for detailed descriptions of methods and data sources. In short, pests were assessed using FinnPRIO, a rapid semi-quantitative pest ranking model. FinnPRIO follows the steps of a standard full-scale pest risk assessment by letting expert assessors score probabilities of entry, establishment and impact of pests in a specified pest risk assessment area (Figure 1). The model also includes an assessment of the manageability of pests, i.e., to what extent invasion can be prevented and controlled. The outcome is a structured risk ranking of pests based on the likelihood and consequences (impacts) of entry and establishment and subsequent spread. An overview of the FinnPRIO risk ranking model is given in the flowchart below (Figure 1).

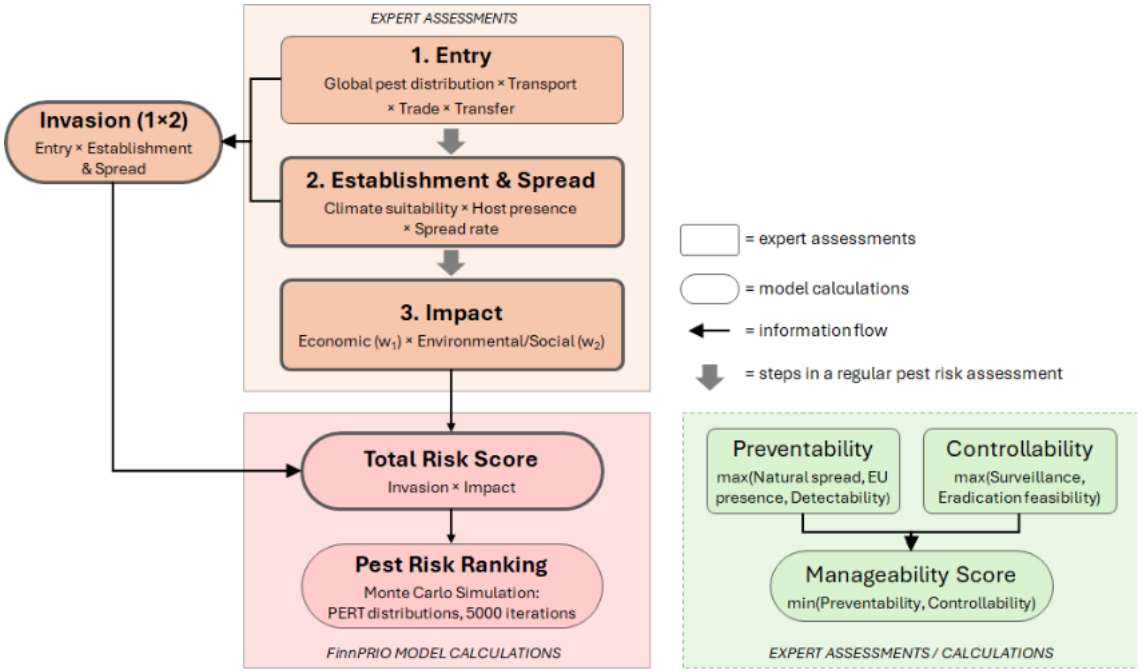

Figure 1. Overview of the FinnPRIO pest risk ranking model used in this project. FinnPRIO follows the structure of a full pest risk assessment and separately assesses a pest's potential for entry, establishment (and spread), and impact. Preventability of pest entry and controllability of a pest after entry are assessed in the manageability module (green box), but these assessments do not influence pest risk ranking.

To guide scoring by the expert assessors, import statistics for relevant commodities were retrieved from Statistics Norway (Statistics Norway, 2024). In addition, available monetary values of different plant production sectors in Norway were retrieved from Totalkalkylen (https://www.nibio.no/tjenester/totalkalkylen-statistikk#groups). Lists of available host plants in Norway were generated by cross-referencing listed host species of each pest in the EPPO Global Database with plant species recorded in Norway (extracted from Lids flora; Lid & Lid, 2005). Climate suitability in Norway was modelled for each pest using the Maxent machine learning algorithm, incorporating global pest occurrence records and bioclimatic variables for both current and projected climate conditions.

2.1 New FinnPRIO

All assessments in this progress report were conducted using the newly developed FinnPRIO-Assessor tool (Ruete et al., 2025), an R adaptation of the original Excel-based FinnPRIO model (Heikkilä et al., 2016). The Assessor tool is built in R using the Shiny framework and stores all assessment data in a SQLite relational database.

The FinnPRIO-Assessor interface guides assessors through the complete FinnPRIO questionnaire of multiple-choice questions, organized into four modules: likelihood of entry (ENT), likelihood of establishment and spread (EST), potential impact (IMP), and manageability (MAN). For each question, assessors select minimum, most likely and maximum answer values from predefined ordinal answer options, following the scoring criteria defined by Heikkilä et al. (2016). Different entry pathways are assessed individually, and multiple pathways can be scored for each pest.

2.2 AI-assisted assessment support option

An AI option was provided for selected pests to help answer FinnPRIO questions. This option relied on an automated two-step pipeline developed in Python. In the first step, justification texts were generated using GPT Researcher (Elovic, 2023), an open-source retrieval-augmented generation framework. For each pest and each FinnPRIO question, GPT Researcher queried a Tavily web search and scientific databases, Semantic Scholar, and PubMed Central, and synthesized the retrieved information into an answer. Three OpenAI models were used: GPT-4o-mini for sub-query generation and summarization, GPT-4.1 for report writing, and o4-mini to divide the entire task at hand into smaller subtasks. In a second step, GPT-4o-mini read each generated justification alongside the question's predefined answer options and selected the most appropriate minimum, most likely, and maximum values. All AI-generated justifications and proposed answer values were reviewed by assessors before they were accepted into the database. When AI-generated content contained unexpected or erroneous claims or lacked sufficient supporting context, assessors cross-checked the information against primary literature and adjusted answer values as needed.

2.3 FinnPRIO explorer

Assessment results were visualized and explored using FinnPRIO-Explorer Adapted (Ruete et al., 2026), a Shiny web application that reads directly from the FinnPRIO-Assessor database. FinnPRIO-Explorer Adapted was deployed on shinyapps.io and made accessible to assessors and stakeholders as an interactive online supplement to this report. The application visualizes Monte Carlo simulation outputs across all assessed pests and all risk dimensions: entry, establishment and spread, invasion, impact, preventability, controllability and manageability. Uncertainty is displayed as error bars spanning from the 5^{th} to the 95^{th} percentile range. Points representing individual pests can be filtered by the pests' quarantine status, taxonomic group, presence or absence in Europe, and the agricultural or natural sectors that they threaten.

2.4 Review process for expert assessments

Reliable comparisons of pest risk between species and higher taxonomic groups of pests require that all individual evaluators have a similar understanding of the questions asked in

FinnPRIO and their corresponding answer options/scores. The use of multiple individual assessors may introduce subjective biases, particularly for pests where the knowledge is incomplete or missing. To reduce potential biases, we implemented an internal review process where two assessors worked together to give feedback on each other's assessments. This ensured that the final risk assessments were more standardized among and within different taxonomic groups of pests.

2.5 Defining risk classes and risk thresholds

FinnPRIO ranks pest risk based on probability of pest invasion, defined as the likelihood that a pest will enter and establish in Norway, and impact of pest invasion, defined as the economic, environmental and social consequences if the pest enters and establishes. A total risk score is calculated for each pest as probability of invasion multiplied by pest impact (VKM 2026). In the first progress report (VKM 2026), five pest risk classes were defined by plotting probability of invasion against impact of invasion. These "invasion probability vs. impact plots" represent total pest risk (referred to as 'total risk' or 'total pest risk' in this report). Pest risk was assessed further by plotting probability of establishment and spread against impact of invasion. Such "establishment probability vs. impact plots" show the conditional risk posed by a pest if it enters Norway, disregarding any barriers to entry such as phytosanitary measures or absence of current import pathways. This is referred to as "risk, given pest entry" in this report.

The five pest risk classes were defined by dividing each axis in the "invasion probability vs. impact plots" into three segments of similar size, with threshold values representing 33 and 66% probability or impact of invasion. Based on their position within this nine-cell risk space, pests were assigned to one of five total risk classes: very low risk, low risk, moderate risk, high risk or very high risk, corresponding to the colour-coded areas shown in Figure 3 (see also VKM 2026). The same approach was applied to "risk, given pest entry", using probability of establishment instead of probability of invasion on the x-axis. These latter plots were used to assess potential risks from pests with low current probability of entry under existing phytosanitary measures and trade patterns. The "risk, given pest entry" plots supplement the total pest risk plots, while total pest risk formed the basis for assessing and ranking pests according to the risk they pose to plant health in Norway.

3 Results

A total of 69 pests were assessed and ranked in this second progress report. These included 53 arthropods (52 insects and one mite), eight bacteria, four viruses, and one oomycete. Below we first present the total risk score for all pests (section 3.1), before we explore the pests' total risk profile by plotting invasion probability vs. impact of invasion (section 3.2) and their 'risk, given pest entry' by plotting establishment (and spread) probability vs. impact of invasion (section 3.3). Finally, in section 3.4 we group the 69 assessed pests by the five classes of total pest risk defined in section 2.5 and provide brief descriptions of the pests that pose the highest total risk to Norwegian plant health.

3.1 Total risk score for all pests

The total risk score sums up the overall risk presented by each pest and expresses this as a single number between zero and one (total risk score = probability of invasion × impact of invasion). Thirty-three out of 69 pests had a total risk score of zero. This is because they scored zero on one or more of the components of total risk: probability of pest entry, probability of pest establishment (including spread), and impact of pest invasion. The remaining 36 pests had total risk scores that ranged from 0.001 to 0.313 (Figure 2). Total risk scores are not discussed further in this report, since we consider the plots of invasion probability vs. impact of invasion (section 3.2) and establishment (and spread) probability vs. impact (section 3.3) to be more informative. Details on the probability and potential impact of invasion for all assessed pests are provided in Appendix I.

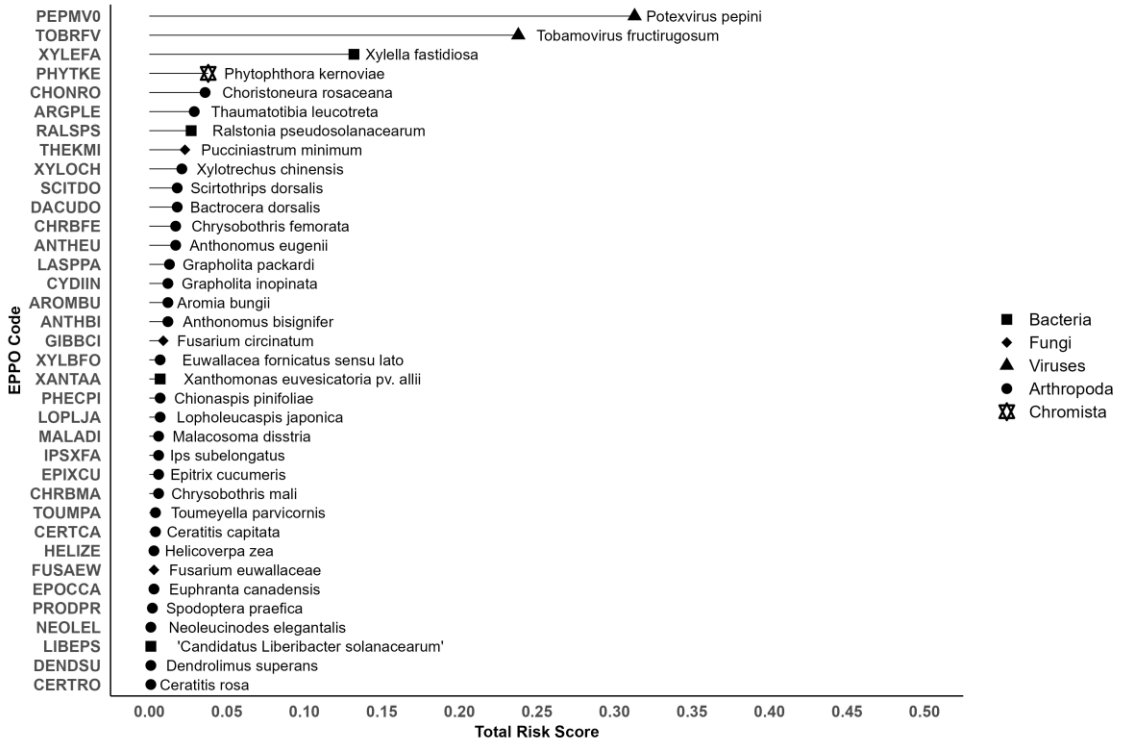

Figure 2. Total risk score for 36 assessed plant pests that have a score > 0. Total risk score was calculated as the product of probability of invasion and impact of invasion. Pest risk was scored using the FinnPRIO risk ranking model. FinnPRIO follows the structure of a full pest risk assessment and scores a pest's potential for invasion (i.e., entry, establishment, and spread) and impact in Norway.

3.2 Total pest risk: invasion probability vs. impact of pest invasion

The total risk score for each pest was explored by plotting its two main components, probability of invasion and impact of invasion, against each other (Figure 3). The probability of pest invasion is the likelihood that a pest will enter and establish in Norway, and the impact of pest invasion is the economic, environmental and social impacts of the pest if it enters and establishes in Norway. The plots of total pest risk can, for example, reveal whether a low total risk score is due to a low probability of invasion, a low impact of invasion, or both. Below we present the total risk profile of five different groups of pests: arthropods (i.e., insects and mites; Figure 4), chromista (Figure 5), bacteria (Figure 6), fungi (Figure 7), and viruses (Figure 8). Based on these plots we identified six moderate risk pests: three insects (Figure 4), one bacterium (Figure 6), and two viruses (Figure 8). These six pests are presented in more detail in section 3.4.2.

The total risk profile of individual pests can lean towards high scores on probability of invasion or high scores on impact of invasion. Two special cases along this continuum are pests that score low or high on both values. This corresponds to the very low and very high-risk class, respectively (section 2.5). Other pests may have a relatively high probability of invasion and less impact on plant health. These pests often have several possible import pathways, but their host plants are minor crops in Norway or make up a very small proportion of natural ecosystems.

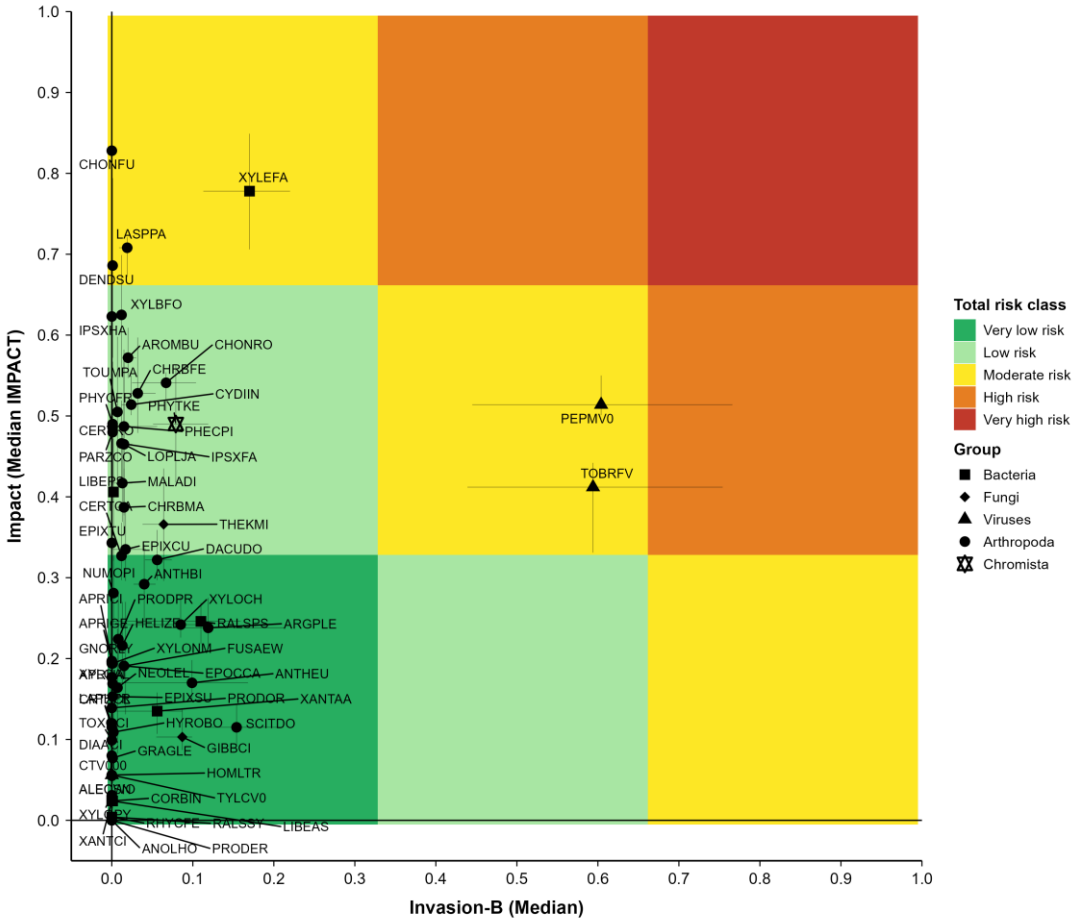

Figure 3. Total risk profile of the 69 EPPO-listed pests included in this progress report, illustrating their estimated probability of invasion (x-axis) and potential impact (y-axis) assessed using the FinnPRIO risk rating model. The total risk score of each pest is defined as the probability of pest invasion multiplied by pest impact. Background colours indicate five classes of total risk. The values represent the median risk for each pest, labelled with EPPO code. Horizontal and vertical error bars show parameter range (5th to 95th percentiles) derived from Monte Carlo simulations, reflecting uncertainty in individual FinnPRIO question scores. For definitions of EPPO codes, refer to Appendix II.

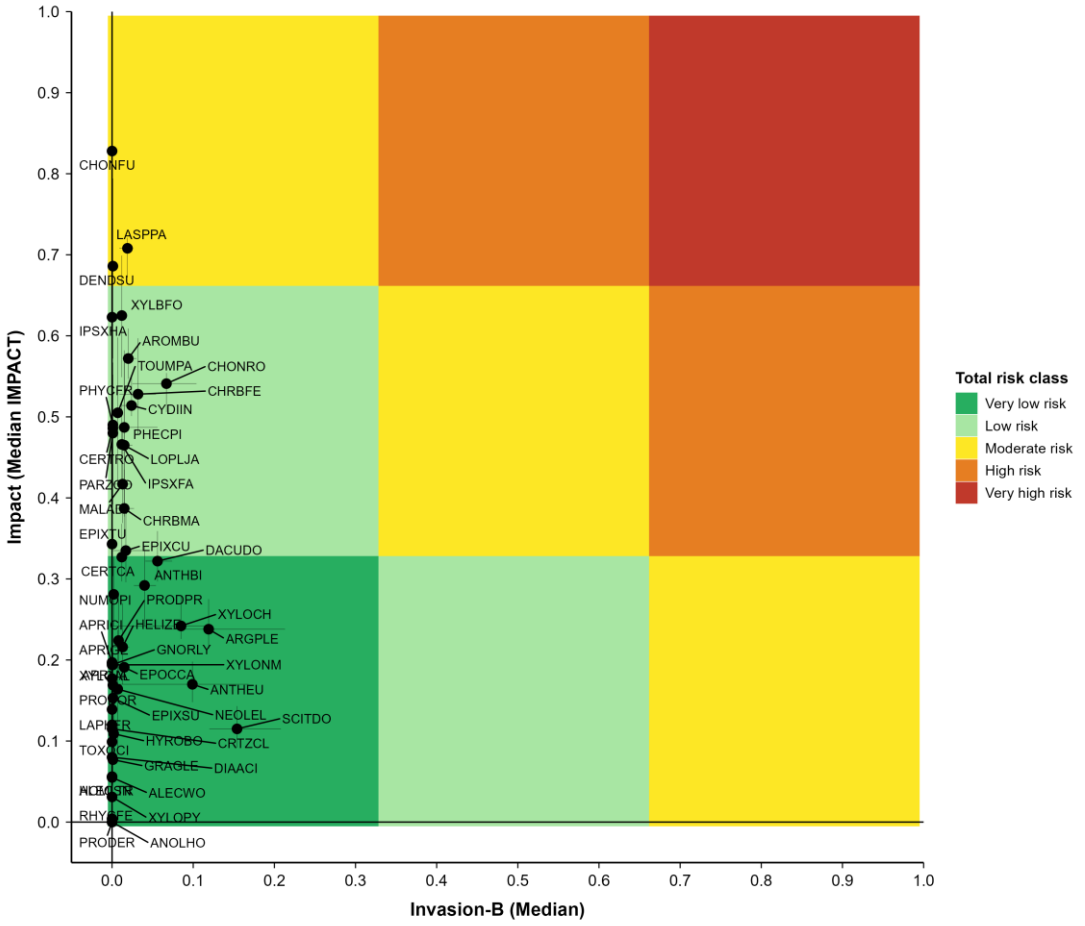

Figure 4. Total risk profile of 53 EPPO-listed insects and mites, illustrating their estimated probability of invasion (x-axis) and potential impact (y-axis) as assessed using the FinnPRIO risk rating model. The total risk score of each pest is defined as the probability of pest invasion multiplied by pest impact. Background colours indicate five classes of total risk. Black circles represent the median risk value for each pest, labelled with EPPO code. Horizontal and vertical error bars show parameter range (5th to 95th percentiles) derived from Monte Carlo simulations, reflecting uncertainty in individual FinnPRIO question scores. For definitions of EPPO codes, refer to Appendix II.

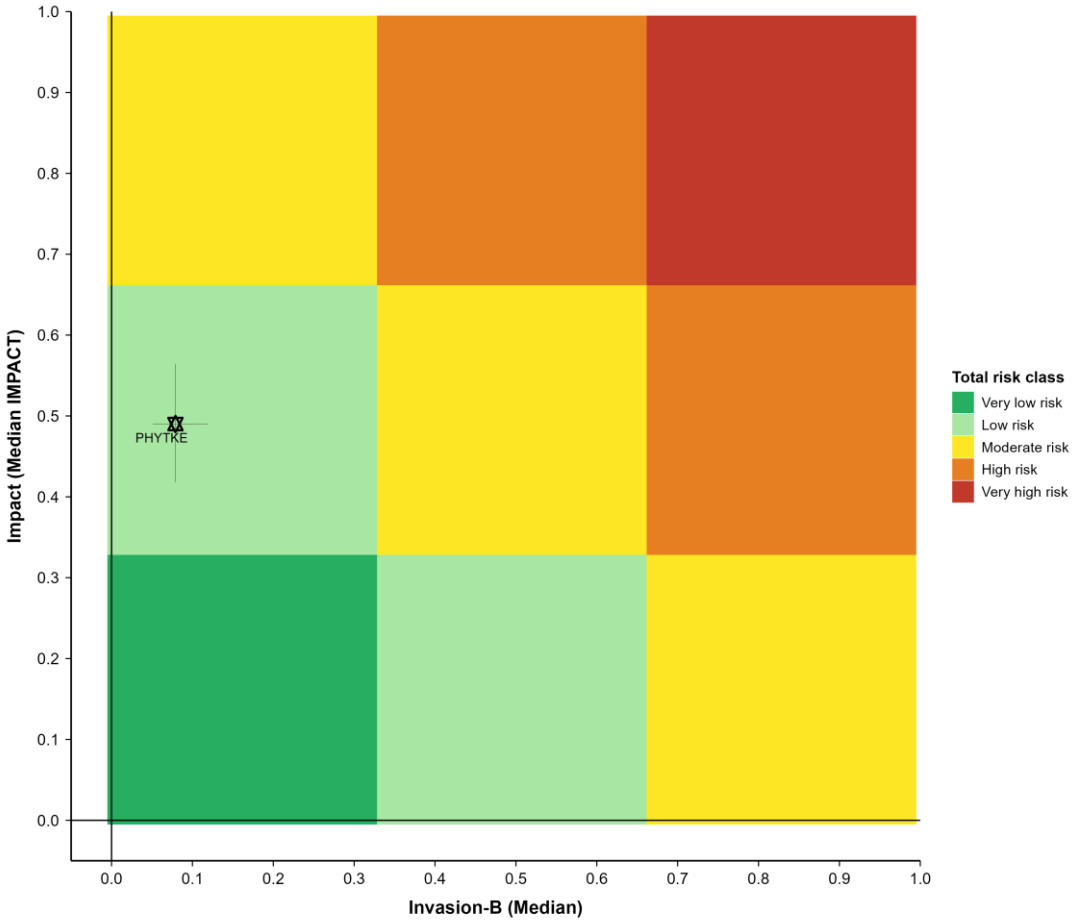

Figure 5. Total risk profile of one EPPO-listed Chromista (*Phytophthora kernoviae*), illustrating its estimated probability of invasion (x-axis) and potential impact (y-axis) as assessed using the FinnPRIO risk rating model. The total risk score is defined as the probability of pest invasion multiplied by pest impact. Background colours indicate five classes of total risk. Black star represents the median risk value, labelled with EPPO code. Horizontal and vertical error bars show parameter range (5th to 95th percentiles) derived from Monte Carlo simulations, reflecting uncertainty in individual FinnPRIO question scores. For definitions of EPPO codes, refer to Appendix II.

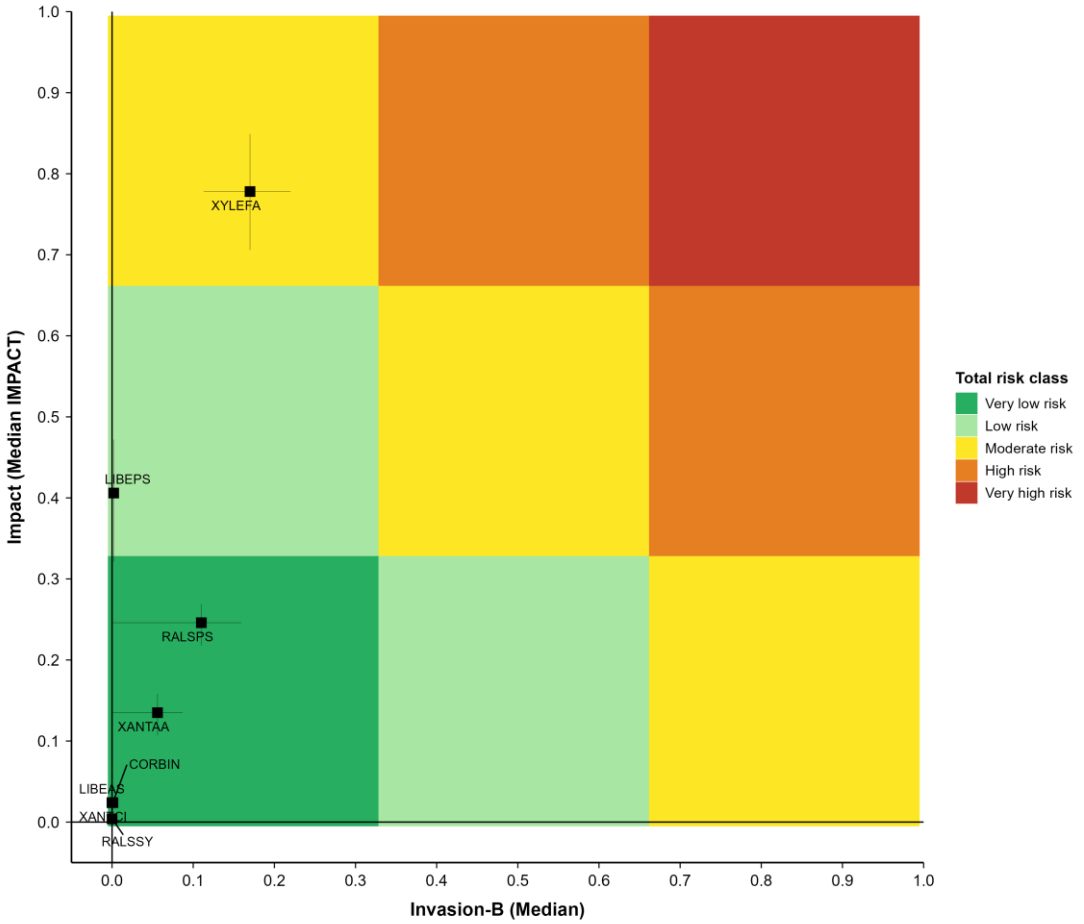

Figure 6. Total risk profile of eight EPPO-listed bacterial pests, illustrating their estimated probability of invasion (x-axis) and potential impact (y-axis) as assessed using the FinnPRIO risk rating model. The total risk score of each pest is defined as the probability of pest invasion multiplied by pest impact. Background colours indicate five classes of total risk. Black squares represent the median risk value for each pest, labelled with EPPO code. Horizontal and vertical error bars show parameter range (5th to 95th percentiles) derived from Monte Carlo simulations, reflecting uncertainty in individual FinnPRIO question scores. For definitions of EPPO codes, refer to Appendix II.

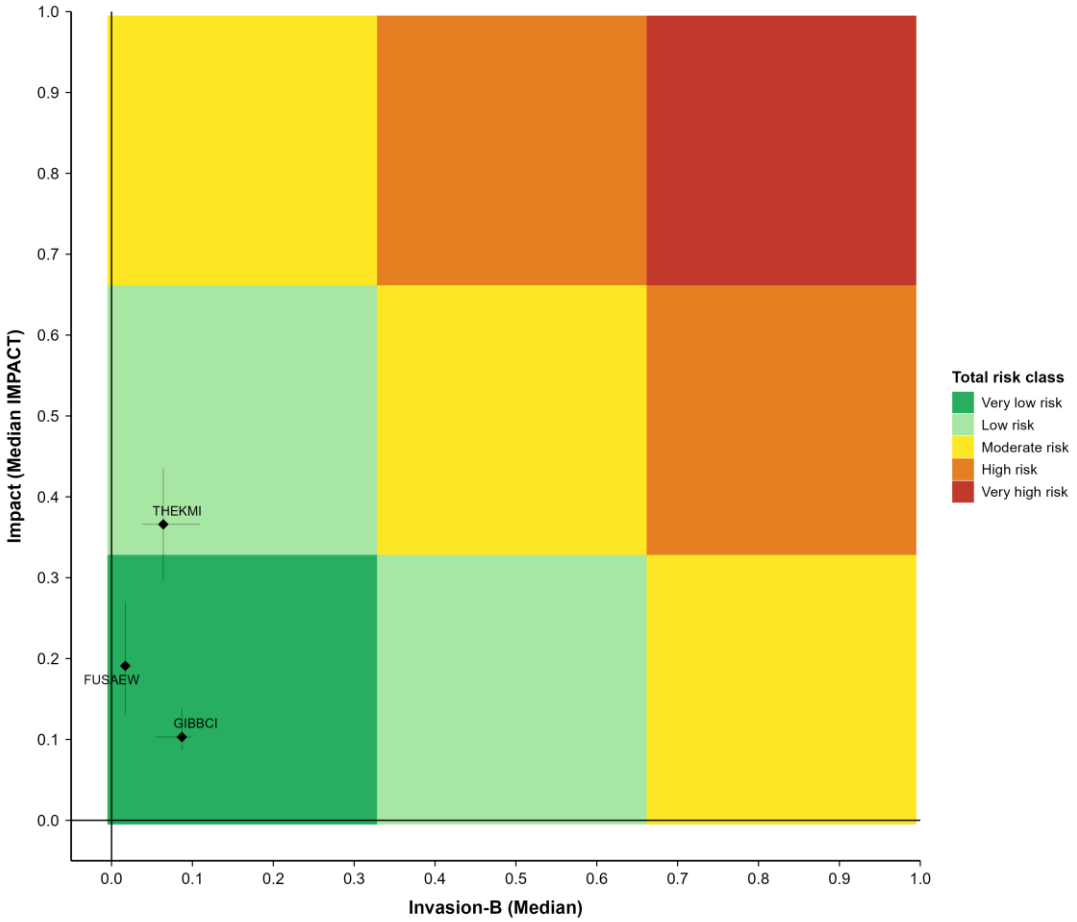

Figure 7. Total risk profile of three EPPO-listed fungal pests, illustrating their estimated probability of invasion (x-axis) and potential impact (y-axis) as assessed using the FinnPRIO risk rating model. The total risk score of each pest is defined as the probability of pest invasion multiplied by pest impact. Background colours indicate five classes of total risk. Black diamonds represent the median risk value for each pest, labelled with EPPO code. Horizontal and vertical error bars show parameter range (5th to 95th percentiles) derived from Monte Carlo simulations, reflecting uncertainty in individual FinnPRIO question scores. For definitions of EPPO codes, refer to Appendix II.

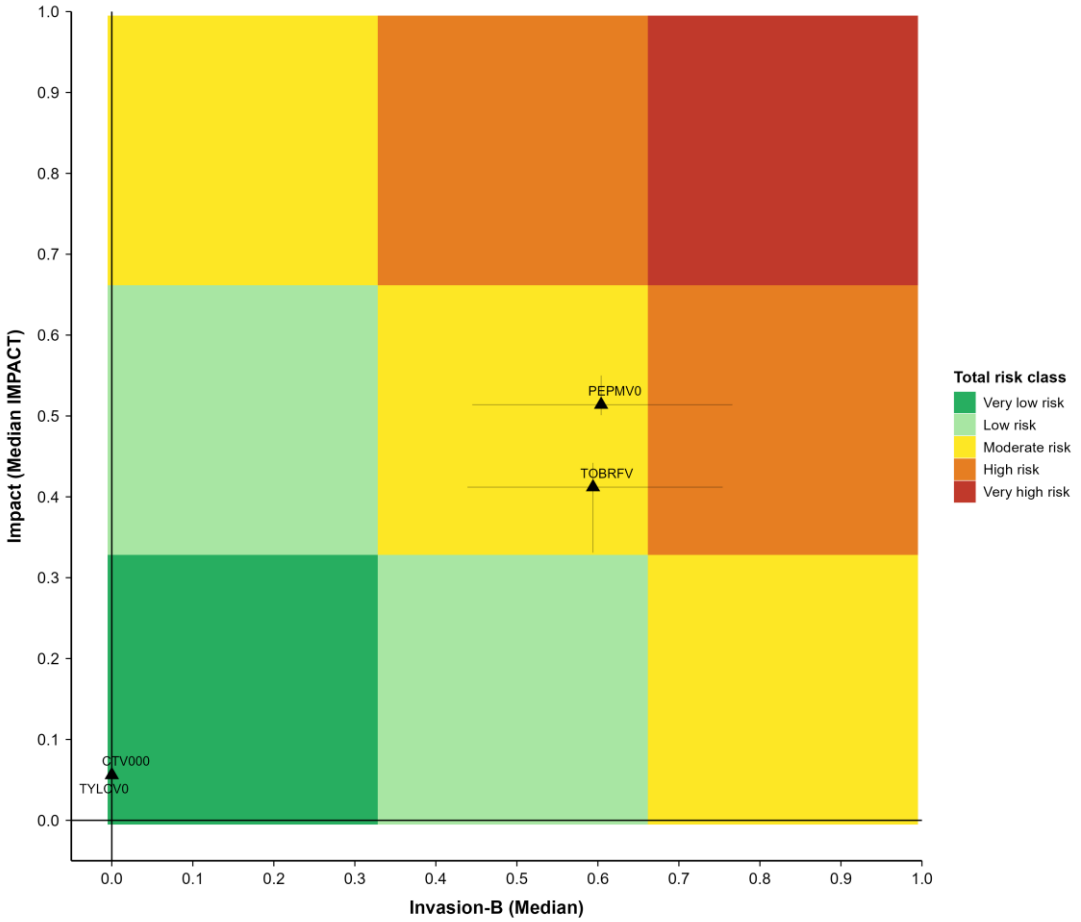

Figure 8. Total risk profile of four EPPO-listed virus pests, illustrating their estimated probability of invasion (x-axis) and potential impact (y-axis) as assessed using the FinnPRIO risk rating model. The total risk score of each pest is defined as the probability of pest invasion multiplied by pest impact. Background colours indicate five classes of total risk. Black triangles represent the median risk value for each pest, labelled with EPPO code. Horizontal and vertical error bars show parameter range (5th to 95th percentiles) derived from Monte Carlo simulations, reflecting uncertainty in individual FinnPRIO question scores. For definitions of EPPO codes, refer to Appendix II.

3.3 Risk, given pest entry: probability of pest establishment vs. impact

In addition to plotting total pest risk (i.e., invasion probability vs. impact of invasion), we explored pest risk, given entry, by plotting establishment (and spread) probability vs. impact of invasion (Figure 9). These plots can identify pests that are unlikely to enter Norway under current conditions but that might establish and have large impacts on plant health if they enter. Thus, the plots highlight the impact a pest may have if we assume it is able to enter Norway (i.e., assuming that the probability of pest entry is 1). Establishment probability is determined by factors such as suitability of climatic conditions, availability of suitable host plants, and pest-specific traits promoting establishment and/or spread. Below we present risk, given pest entry for five different groups of pests: arthropods (insects and mites; Figure 10), chromista (Figure 11), bacteria (Figure 12), fungi (Figure 13), and viruses (Figure 14). These plots have the same background colouring as the plots showing total pest risk (Figure 3 to 8), but in Figure 9 to 14 the colours show risk, given pest entry.

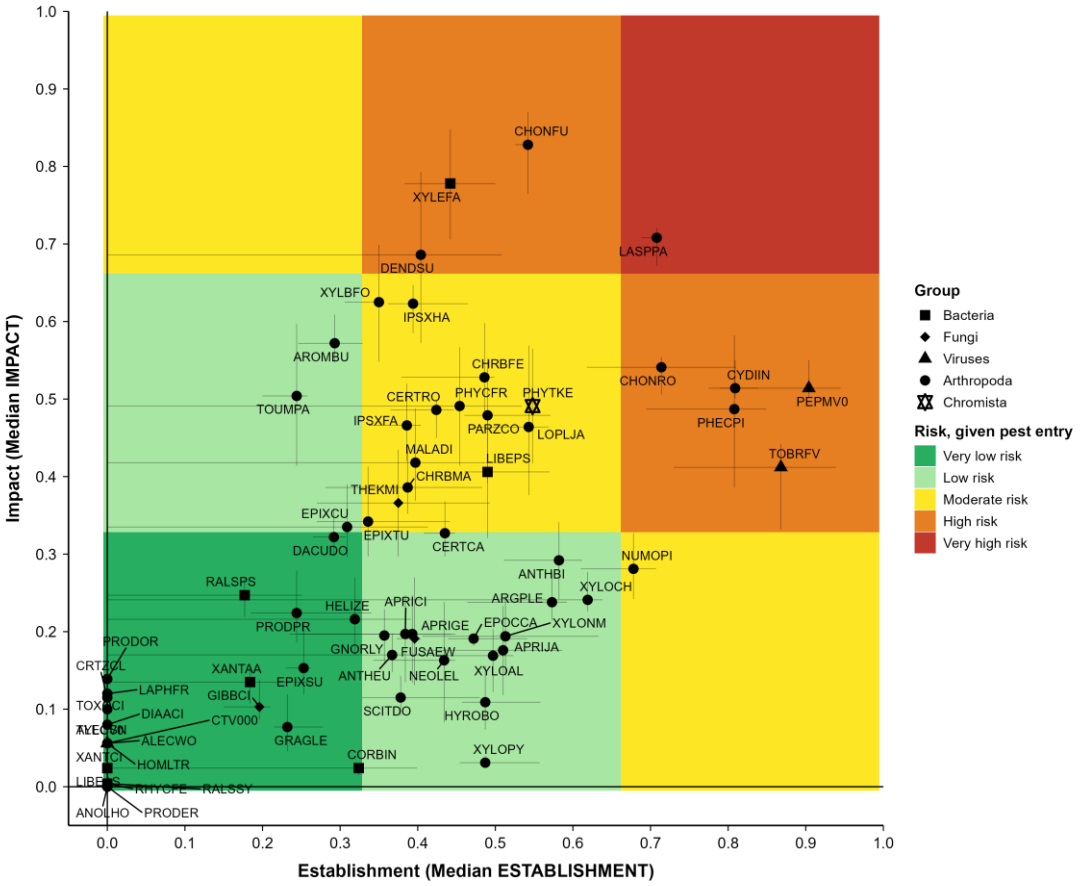

Figure 9. Conditional risk profile (risk, given pest entry) of the 69 EPPO-listed pests included in this progress report, illustrating their estimated probability of establishment (x-axis) and potential impact (y-axis) as assessed using the FinnPRIO risk rating model. Probability of pest establishment is one of two components of pest invasion probability: P(establishment) × P(entry) = P(invasion). Background colours indicate five classes of risk, given pest entry. Black symbols represent the median risk value for each pest, labelled with EPPO code. Horizontal and vertical error bars show parameter range (5th to 95th percentiles) derived from Monte Carlo simulations, reflecting uncertainty in individual FinnPRIO question scores. For definitions of EPPO codes, refer to Appendix II.

One insect pest (*Grapholita packardi*, LASPPA) was assessed to pose very high risk to Norwegian plant health, given pest entry (Figure 10). See section 3.4.2 for more details on this pest. Five other insect pests (*Choristoneura fumiferana (*CHONFU), *Choristoneura rosaceana* (CHONRO), *Chionaspis pinifoliae (*PHECPI), *Grapholita inopinata* (CYDIIN), and *Dendrolimus superans* (DENDSU)) were classified as posing high risk, given pest entry (Figure 10). Three of these insect pests were among the pests that posed moderate total risk (Figure 4). Twelve insect pests posed moderate risk, given pest entry (Fig 10). These were *Acrobasis pirivorella* (NUMOPI), *Bactericera cockerelli* (PARZCO), *Ceratitis rosa* (CERTRO), *Chrysobothris femorata* (CHRBFE), *Chrysobothris mali* (CHRBMA), *Epitrix tuberis* (EPIXTU), *Euwallacea fornicatus* sensu lato (XYLBFO), *Ips hauseri* (IPSXHA), *Ips subelongatus* (IPSXFA), *Lopholeucaspis japonica* (LOPLJA), *Malacosoma disstria* (MALADI), and *Phyllocoptes fructiphilus* (PHYCFR). See Appendix I for more details on these pests.

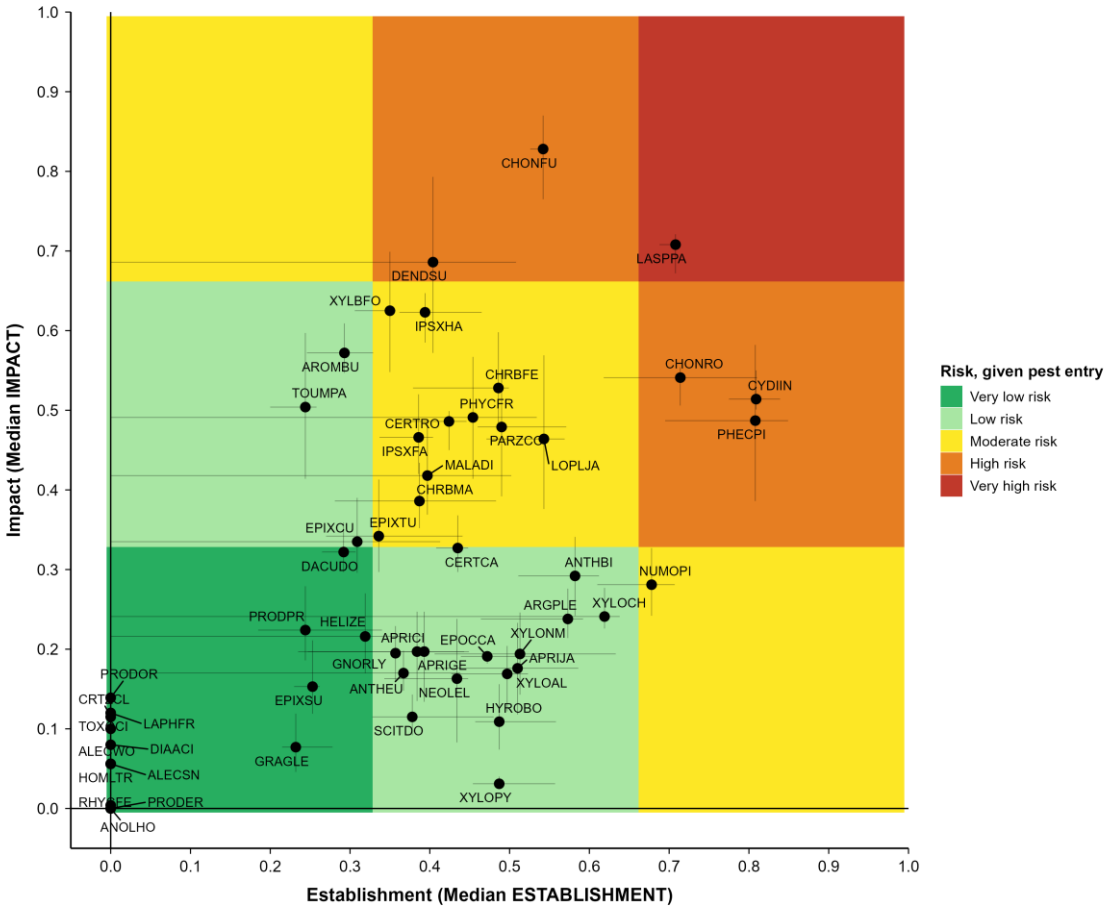

Figure 10. Conditional risk profile (risk, given pest entry) of 53 EPPO-listed insects and mites, illustrating their estimated probability of establishment (x-axis) and potential impact (y-axis) as assessed using the FinnPRIO risk rating model. Probability of pest establishment is one of two components of pest invasion probability: P(establishment) × P(entry) = P(invasion). Background colours indicate five classes of risk, given pest entry. Black circles represent the median risk value for each pest, labelled with EPPO code. Horizontal and vertical error bars show parameter range (5th to 95th percentiles) derived from Monte Carlo simulations, reflecting uncertainty in individual FinnPRIO question scores. For definitions of EPPO codes, refer to Appendix II.

The one oomycete pest that was assessed in this report (*Phytophthora kernoviae*, PHYTKE) was classified as posing moderate risk, given pest entry (Figure 11). See Appendix I for more details on this pest.

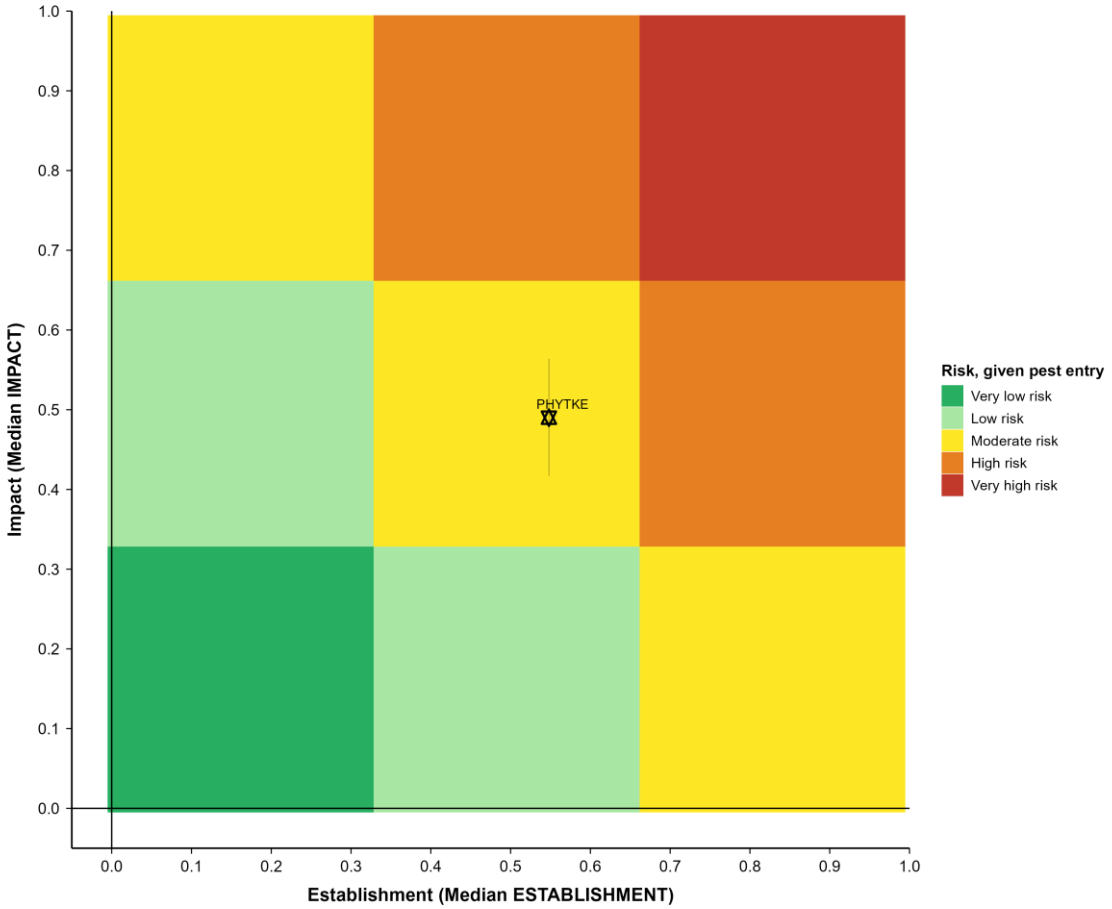

Figure 11. Conditional risk profile (risk, given pest entry) of one EPPO-listed Chromista (*Phytophthora kernoviae*), illustrating their estimated probability of establishment (x-axis) and potential impact (y-axis) as assessed using the FinnPRIO risk rating model. Probability of pest establishment is one of two components of pest invasion probability: P(establishment) × P(entry) = P(invasion). Background colours indicate five classes of risk, given pest entry. The black star represents the median risk value for each pest, labelled with EPPO code. Horizontal and vertical error bars show parameter range (5th to 95th percentiles) derived from Monte Carlo simulations, reflecting uncertainty in individual FinnPRIO question scores. For definitions of EPPO codes, refer to Appendix II

Among the assessed bacterial pests, *Xylella fastidiosa* (XYLEFA) was assessed to pose high risk to Norwegian plant health, given pest entry, while *'Candidatus Liberibacter solanacearum'* (LIBEPS) posed moderate risk, given pest entry (Figure 12). See section 3.4.2 and Appendix I for more details on these pests. *Xylella fastidiosa* was also assessed to pose moderate total risk, whereas *'Candidatus Liberibacter solanacearum'* was assessed to pose low total risk (Figure 6).

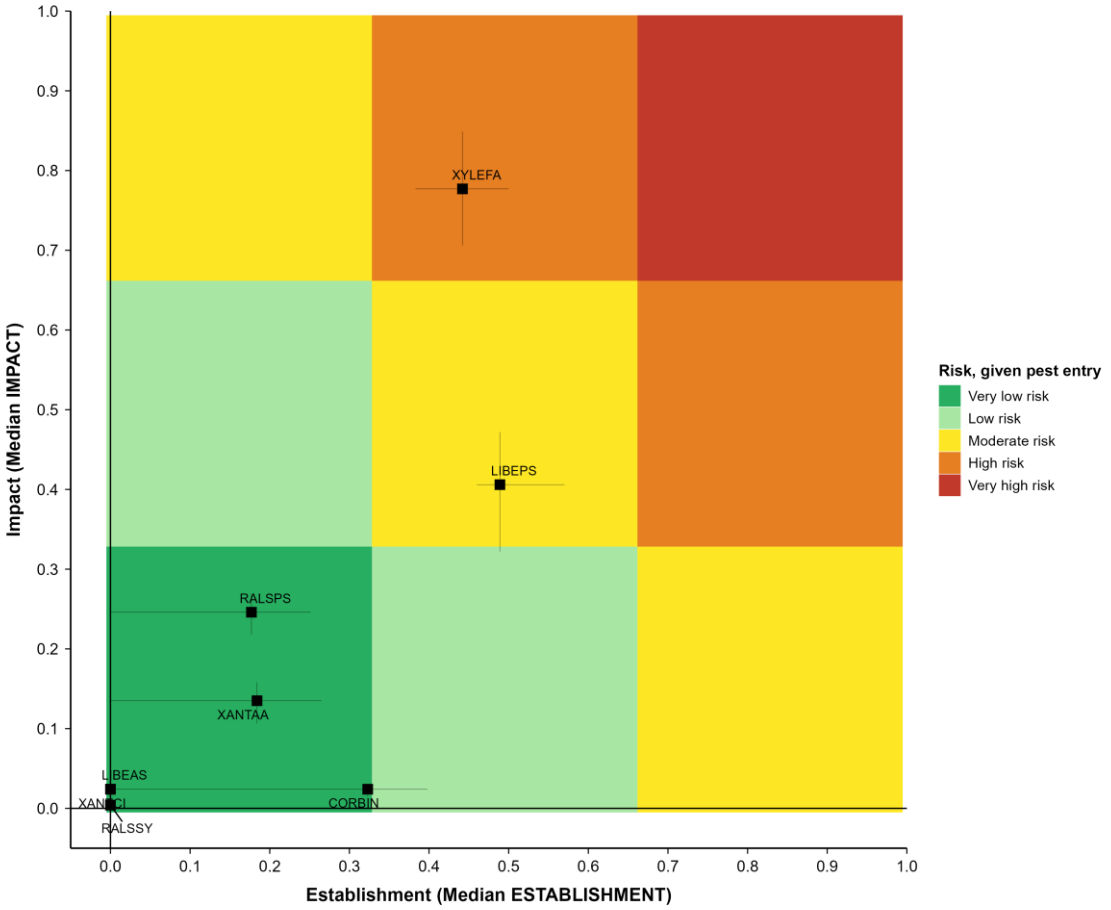

Figure 12. Conditional risk profile (risk, given pest entry) of eight EPPO-listed bacterial pests, illustrating their estimated probability of establishment (x-axis) and potential impact (y-axis) as assessed using the FinnPRIO risk rating model. Probability of pest establishment is one of two components of pest invasion probability: P(establishment) × P(entry) = P(invasion). Background colours indicate five classes of risk, given pest entry. Black squares represent the median risk value for each pest, labelled with EPPO code. Horizontal and vertical error bars show parameter range (5th to 95th percentiles) derived from Monte Carlo simulations, reflecting uncertainty in individual FinnPRIO question scores. For definitions of EPPO codes, refer to Appendix II

One of the three fungal pests that were assessed in this report was classified to pose moderate risk, given pest entry (*Pucciniastrum minimum*, THEKMI; Figure 13). See Appendix I for more details on this pest.

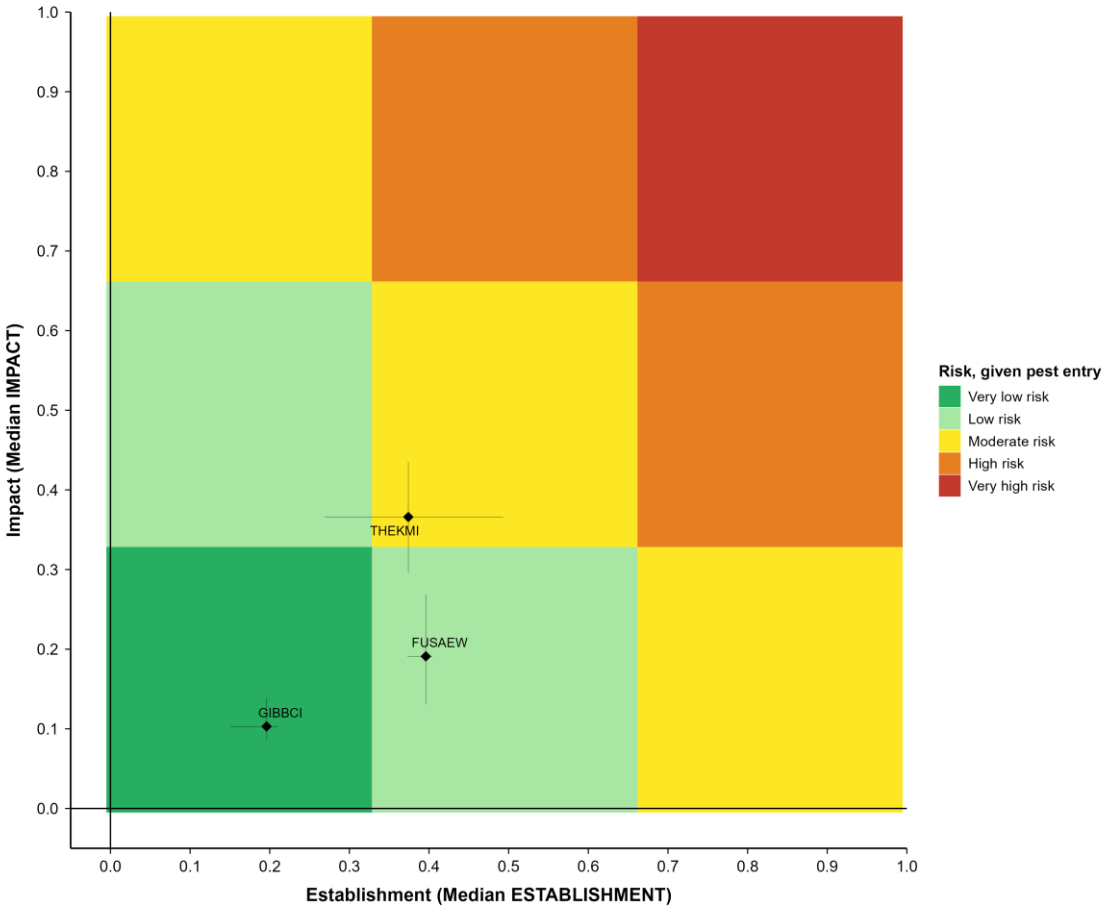

Figure 13. Conditional risk profile (risk, given pest entry) of three EPPO-listed fungal pests, illustrating their estimated probability of establishment (x-axis) and potential impact (y-axis) as assessed using the FinnPRIO risk rating model. Probability of pest establishment is one of two components of pest invasion probability: P(establishment) × P(entry) = P(invasion). Background colours indicate five classes of risk, given pest entry. Black diamonds represent the median risk value for each pest, labelled with EPPO code. Horizontal and vertical error bars show parameter range (5th to 95th percentiles) derived from Monte Carlo simulations, reflecting uncertainty in individual FinnPRIO question scores. For definitions of EPPO codes, refer to Appendix II

Two of the four virus pests assessed in this report were assessed to pose high risk, given pest entry (*Potexvirus pepini*, PEPMV0 and *Tobamovirus fructirugosum*, TOBRFV; Figure 14). These viruses were also assessed to pose moderate total pest risk (Figure 8). See section 3.4.2 and Appendix I for more details on these pests.

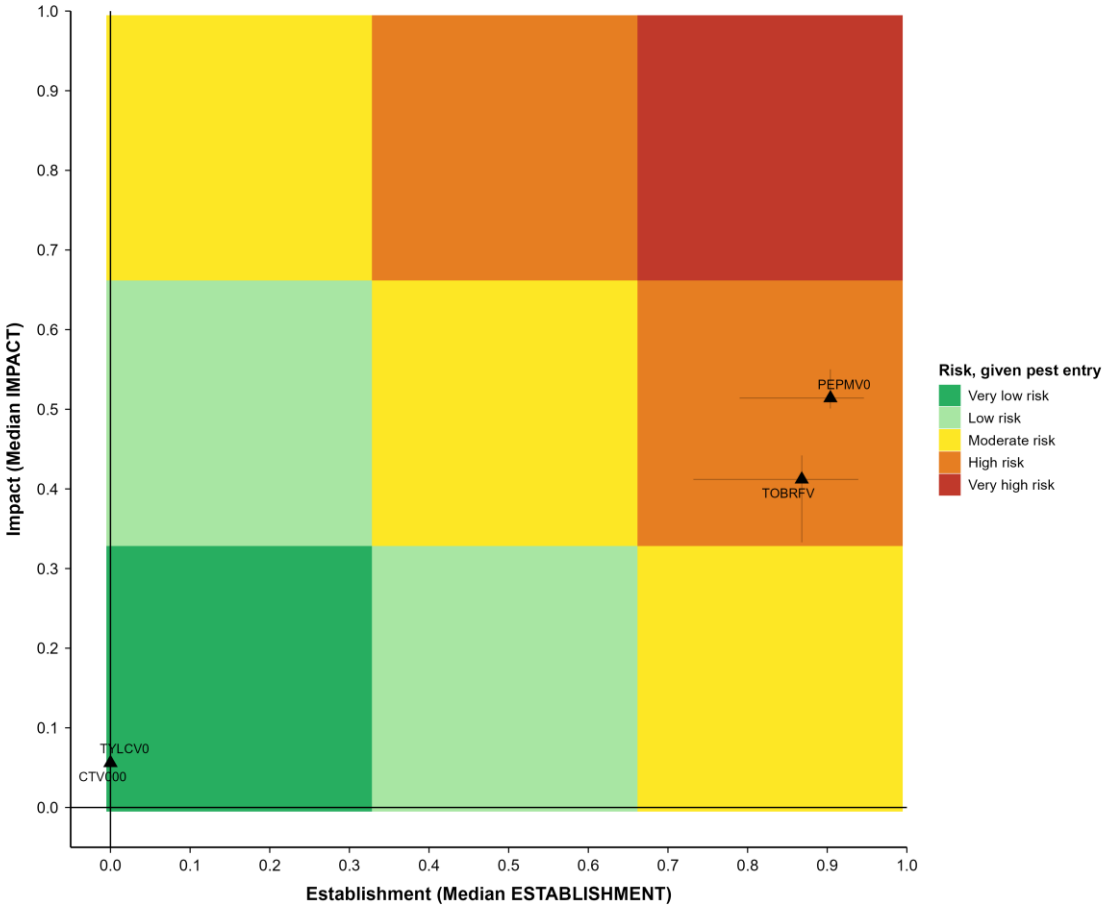

Figure 14. Conditional risk profile (risk, given pest entry) of four EPPO-listed virus pests, illustrating their estimated probability of establishment (x-axis) and potential impact (y-axis) as assessed using the FinnPRIO risk rating model. Probability of pest establishment is one of two components of pest invasion probability: P(establishment) × P(entry) = P(invasion). Background colours indicate five classes of risk, given pest entry. Black triangles represent the median risk value for each pest, labelled with EPPO code. Horizontal and vertical error bars show parameter range (5th to 95th percentiles) derived from Monte Carlo simulations, reflecting uncertainty in individual FinnPRIO question scores. For definitions of EPPO codes, refer to Appendix II.

3.4 Risk classification of all assessed pests

Based on the total risk profiles presented in Figures 3 to 8, we here summarize the risk classification of all the 69 pests assessed in this report. The pests are grouped by the total risk they pose to Norwegian plant health, according to the five risk classes described in section 2.5.

3.4.1 Very high and high risk pests

None of the 69 assessed pests were considered to pose very high or high risk to Norwegian plant health, i.e., no pests were considered to simultaneously have a high probability of invasion and large economic, environmental and/or social impacts of invasion. Pests with high invasion probability have one or more likely entry pathways, high survival during transport, and high probability of being transferred to a suitable habitat upon arrival in Norway. Such pests can also find suitable host plants and climatic conditions in Norway and are thus well adapted to establish and spread.

3.4.2 Moderate risk pests

Six pests were assessed to pose moderate risk to Norwegian plant health.

Two of these were assessed to have moderate probability and impact of invasion:

- The virus *Potexvirus pepini* (PEPMV0) is mechanically transmitted with plant sap and can infest tomato and pepino, causing considerable yield losses. Its main entry pathway is infected tomato fruits and, to a lesser extent, seeds. The pest is present in many countries in Europe, including countries with a temperate climate. The risk of introduction and spread in Norway with infected fruits is considerable. Establishment will probably have significant economic consequences, as symptoms and yield losses in tomato are considerable.
- The virus *Tobamovirus fructirugosum* (TOBRFV) was described as recently as 2015 and infests tomato and peppers. The virus is considered 'present' or 'transient and under eradication' in several countries in Europe and elsewhere. Pathways for movement are seeds, fruits or vegetables, and plants for planting. Entry is likely by seeds and fruits (mechanical transmission), and to a lesser extent by plants for planting. Establishment is likely in greenhouses and the economic impact for tomato production would be significant.

Four pests were assessed to have low probability of invasion but high potential impact:

- The moth *Choristoneura fumiferana* (CHONFU) attacks several hosts in the pine family, including species that are important forest trees in Norway. The main pathway for movement is plants for planting and other living conifer plant parts. Import of conifers from the pest's current distribution is not allowed. Most forested areas in Norway have similar climatic conditions as the pest's native range in North America, suggesting that outdoor establishment in Norway is likely. The potential impact is high because the pest is a highly destructive pest of spruce and fir trees, causing widespread defoliation, reduced growth and periodic tree mortality in its native range.

- The moth *Dendrolimus superans* (DENDSU) is a severe defoliator of conifers in its native range in China, Japan, and Russia. Documented host plants include species of

Pinus, *Larix*, *Abies*, and *Picea*, including species that are important forest trees in Norway. The most likely entry pathways are plants for planting and timber but such imports from the pest's current range is restricted, and phytosanitary measures further reduce the likelihood of entry. The pest's climatic requirements are uncertain, but it can probably establish in the southernmost parts of Norway. The potential impact is high, as the pest probably will cause repeated defoliation and possibly tree mortality in some areas during outbreak years, with significant consequences for timber production. A pest risk assessment for *D. superans* was published by VKM (VKM, 2018).

- The moth *Grapholita packardi* (LASPPA) has larvae that feed in fruit or terminal shoots. It has a relatively wide host range, including plants used in commercial fruit orchards, gardens, as ornamentals and in natural habitats in Norway. The pest's current distribution in Northern America suggests that it may establish in southern Norway, but the risk of entry is low. Due to the large number of potential hosts, significant economic losses could be expected in a situation with few or no pesticides available for Norwegian production.
- The bacterium *Xylella fastidiosa* (XYLEFA) is a serious plant pathogen that can cause wilt disease in several hundred host plants, including species of *Prunus*, other deciduous trees, and ornamental plants. The pest is established in several European countries, and the most likely entry pathway is with plants for planting. Infected plants can remain asymptomatic, and this makes early detection difficult. There are suitable vectors in Norway (mainly native xylem sap feeders) and susceptible wild and cultivated host plants. It is moderately likely (with high uncertainty) that the pest can establishment in protected conditions and outdoors in Norway.

3.4.3 Low and very low risk pests

Pests considered to pose low risk to Norwegian plant health made up the second largest group of assessed pests (20 out of 69 pests). These pests were considered to have low to moderate probability of invasion and low to moderate impact of invasion. The low risk pests included 16 insects, one mite, one bacterium, one oomycete, and one fungus. See Appendix I for details on the probability and potential impact of invasion for each of the 20 low risk pests.

Most of the assessed pests, 43 out of 69, were considered to pose very low risk to Norwegian plant health, i.e. they were considered to have both a low probability of invasion and a low impact of invasion. These pests included 32 insects, six bacteria, two fungi, and two viruses. They all scored low on one or more of the criteria entry, establishment, and impact. See Appendix I for details on the probability and potential impact of invasion for each of the 43 very low risk pests.

3.5 Pest-vector relationships

Many plant pests are transmitted by vectors such as nematodes or sap-sucking insects. This is true for many viruses, but also fungi, bacteria and nematodes may have vectors. For vector-transmitted plant pests, an assessment of pest risk must also consider the vector (or vectors).

Suitability of e.g. climatic factors or host plants for the vector will often be a more important determinant of establishment and impact than the requirements of the pest itself.

Pest-vector relationships may be obligate, where neither partner can survive without the other, or facultative, where the partners can survive without each other and may have pest-vector relationships with several species. An example of an obligate relationship is the mutualistic relationship between ambrosia beetles and fungi, such as that between *Fusarium euwallaceae* (FUSAEW) and *Euwallacea fornicatus* (XYLBFO) assessed in this report. For pests that are involved in obligate pest-vector relationships, the probability and impact of invasion for the weakest partner determines the total risk posed by the pest-vector relationship. For example, if climatic conditions in Norway are unsuitable for the vector, an associated pest cannot establish and will have no economic impact.

For pests that are associated with a broader taxonomic group of vectors, risk assessments should consider the full range of vector species. One example is the bacteria *Xylella fastidiosa* (XYLEFA), assessed in this report, which is transmitted by several taxonomic groups of sap-sucking insects, including spittlebugs (Cercopoidea), cicadas (Cicadoidea), and sharpshooters (Cicadellinae). In such cases, all native species in those insect groups should be considered when assessing the risk that they may vector and spread the bacteria after introduction.

3.5.1 Specific pest-vector relationships assessed in this report

The relationship between the fungus *Fusarium euwallaceae* (FUSAEW) and its bark beetle vector *Euwallacea fornicatus* (XYLBFO) is obligate, where neither partner can reproduce and spread without the other. In the first progress report (VKM, 2026), *F. euwallaceae* was evaluated without considering its vector. *Fusarium euwallaceae* was then assessed to pose high risk, mainly due to limited knowledge about its temperature requirements and its extremely wide host range that includes economically important trees for timber and fruit production. The pest was reassessed in this report when we also considered the requirements of the beetle vector. The reassessment concluded that the pest-vector combination has limited ability to survive and reproduce under current climatic conditions in Norway and that the bark beetle and the fungus therefore pose low (Figure 4) and very low total risk (Figure 7), respectively.

The insect *Homalodisca vitripennis* (HOLMTR) was assessed to pose very low risk (Figure 4), even though it is a possible vector for *Xylella fastidiosa* (XYLEFA), which was assessed to pose moderate risk (Figure 6). This was because *H. vitripennis* is a subtropical pest that is very unlikely to establish in Norway. However, *X. fastidiosa* pose a higher risk than its insect vector because *X. fastidiosa* has several other potential insect vectors in Norway. The most common of these is *Philaenus spumarius*, which also occurs in Denmark, Sweden and Finland. Less common is *Neophilaneus campestris*, which so far has a very limited southern distribution in Norway. These native vectors are not quarantine pests and were not assessed in this report.

'*Candidatus Liberibacter solanacearum*' (LIBEPS) was assessed to pose low risk to plant health in Norway (Figure 6). This is a genetically very diverse pathogen with more than 10 described haplotypes that differ in host range, psyllid vectors, and distribution. Haplotypes infecting Solanaceous plants are transmitted by the psyllid *Bactericera cockerelli* (PARZCO). Neither the Solanaceous haplotypes nor the vector has been detected in Norway or Europe. Although the

bacterium tolerates a wide temperature range, establishment of Solanaceous haplotypes depends on the presence of the vector, which was assessed to pose low risk in Norway (Figure 4). This migratory insect occurs in subtropical and temperate regions and Norway's climate is largely unsuitable for establishment outdoors, though survival in greenhouses is likely. In addition to vectoring *'Candidatus Liberibacter solanacearum', B. cockerelli* is a pest that causes feeding damage and the physiological disorder psyllid yellow that renders tomatoes unmarketable.

3.6 Distribution of pests according to total risk class and EPPO listing

Most of the pests assessed in this report were classified to pose very low (43 pests) or low (20 pests) risk to plant health in Norway. Most plant pests that are highly damaging in their native or introduced range were assessed to pose low to moderate risk in Norway, usually because they have a low probability of entry and/or establishment (Table 2 and Appendix I).

Among the 69 assessed pests, 37 were listed in the EPPO A1 list (i.e., pests absent from the EPPO region), 29 in the EPPO A2 list (i.e., pests present in the EPPO region), and two in the EPPO Alert List (an early warning-list of pests that may present phytosanitary risk but are not yet recommended for phytosanitary regulations). The six pests that were assessed to pose moderate risk to Norwegian plant health were from the A1 list (three pests) and A2 list (four pests) (Table 2). See Appendix I for a complete overview of all 69 assessed pests.

Table 2: Distribution of the 69 assessed pests according to EPPO listing and the total risk they pose to Norwegian plant health.

Risk class	A1	A2	Alert	Sum	Percentage
Very high risk pests	0	0	0	0	0.0
High risk pests	0	0	0	0	0.0
Moderate risk pests	2	4	0	6	8.7
Low risk pests	10	10	0	20	29.0
Very low risk pests	25	16	2	43	62.3
Total	37	30	2	69	100.0

4 Uncertainties

Below we summarize the main uncertainties identified in the first progress report (VKM 2026). The main challenges and uncertainties involved in pest risk assessments are due to incomplete data and limitations in available information. The FinnPRIO model addresses these uncertainties by allowing evaluators to provide ranges of estimates rather than single values. However, additional uncertainty arises from coarse import statistics, changing trade patterns, and unpredictable factors such as climate change. The simplified FinnPRIO model also has methodological limitations compared to full pest risk assessments.

Key points:

- Reliable pest risk assessment depends on detailed knowledge of pest biology, host range, environmental requirements, trade pathways, and pest distribution, which is often not well documented. The FinnPRIO model manages uncertainty by using minimum, most likely, and maximum estimates to generate probability ranges.
- Climate change and other complex factors introduce additional and unavoidable uncertainty in predicting pest distribution and impacts.
- Import statistics are broadly categorized and do not clearly distinguish between country of origin and dispatch, increasing uncertainty in entry assessments. Zero import volumes may reflect either regulatory restrictions or historical trade patterns, leading to different risk interpretations.
- Trade flows can change rapidly, potentially increasing pest introduction risks from new regions. The use of a limited 10-year dataset for trade flows may fail to capture any sudden changes in trade patterns.
- Probability of pest entry is usually considered to be higher for pests that are established in Europe than for pests that only occur on continents further away, such as Asia or North America. If pests from other continents enter and establish in European countries, particularly in countries that export relevant host plants to Norway, entry probabilities may increase.
- FinnPRIO may yield different results than full pest risk assessments due to its simplified scoring approach and lack of detailed expert reasoning. Also, the model cannot include species-specific factors that fall outside the model's predefined structure.
- Although designed for Finland, the model was used in Norway without adjustment due to perceived similarities in trade patterns, host plants and environmental conditions between the countries.
- Environmental and societal impacts have been assessed qualitatively. This reduces the precision of the assessments but circumvents the need to assign precise economic values.

5 Conclusions with answers to the terms of reference

The Norwegian Food Safety Authority (NFSA) asked VKM to provide a simplified assessment of the risks posed to Norwegian plant health by pests that are recommended for regulation as quarantine pests by EPPO. VKM was also asked to rank the assessed pests according to the risk they pose. The assessments and ranking were to be limited to pests that have not yet been regulated or assessed for regulation in Norway. In Appendix I, we answer the terms of reference by summarizing (1) the identity of all the 69 pests that were assessed in this report, (2) the current knowledge of the pests' absence or presence in Norway, (3) the pests' potential for introduction and establishment in Norway (i.e., the probability of pest invasion), and (4) the potential consequences of pest establishment and spread in Norway (i.e., the impact of pest invasion). The ranking of all pests assessed during the first and second round of assessments (129 in total) can be visualized and explored using FinnPRIO Explorer (link shared with NFSA).

The FinnPRIO risk ranking model that was used in this assignment provides risk assessments that are rapid and limited in scope. While this is useful for screening large numbers of pests, more detailed risk assessments will provide firmer support for NFSA's regulatory decision making. The need for firmer support can be addressed by preparing standard pest risk assessments for the six moderate risk pests identified in this report and lack a pest risk assessment specific to Norway. The need for more detailed assessments is lower for pests that are considered to pose very low or low risk for Norwegian plant health.

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Appendix I - Summary of pest assessments

https://vkm.no/download/18.2b1bff1d19ed453c4052334f/1782118709904/Summary%20of%20pest%20risk%20assessments-Progress%20report%20nr%202.xlsx

Appendix II – List of 69 assessed pests with conclusions of pest risk assessment

EPPO code	Scientific name	EPPO list	Conclusion
ALECSN	*Aleurocanthus spiniferus*	A2	Very low risk
ALECWO	*Aleurocanthus woglumi*	A1	Very low risk
ANOLHO	*Anoplophora horsfieldii*	Alert	Very low risk
ANTHBI	*Anthonomus bisignifer*	A1	Very low risk
ANTHEU	*Anthonomus eugenii*	A1	Very low risk
APRICI	*Apriona cinerea*	A1	Very low risk
APRIGE	*Apriona germari*	A1	Very low risk
APRIJA	*Apriona rugicollis*	A1	Very low risk
ARGPLE	*Thaumatotibia leucotreta*	A2	Very low risk
AROMBU	*Aromia bungii*	A2	Low risk
CERTCA	*Ceratitis capitata*	A2	Very low risk
CERTRO	*Ceratitis rosa*	A1	Low risk
CHONFU	*Choristoneura fumiferana*	A1	Moderate risk
CHONRO	*Choristoneura rosaceana*	A1	Low risk
CHRBFE	*Chrysobothris femorata*	A1	Low risk
CHRBMA	*Chrysobothris mali*	A1	Low risk
CORBIN	*Clavibacter insidiosus*	A2	Very low risk
CRTZCL	*Ceratothripoides claratris*	A1	Very low risk
CTV000	*Closterovirus tristezae*	A2	Very low risk
CYDIIN	*Grapholita inopinata*	A2	Low risk
DACUDO	*Bactrocera dorsalis*	A1	Very low risk
DENDSU	*Dendrolimus superans*	A2	Moderate risk
DIAACI	*Diaphorina citri*	A1	Very low risk
EPIXCU	*Epitrix cucumeris*	A2	Low risk
EPIXSU	*Epitrix subcrinita*	A1	Very low risk
EPIXTU	*Epitrix tuberis*	A1	Low risk
EPOCCA	*Euphranta canadensis*	A1	Very low risk
FUSAEW	*Fusarium euwallaceae*	A2	Very low risk
GIBBCI	*Fusarium circinatum*	A2	Very low risk
GNORLY	*Keiferia lycopersicella*	A1	Very low risk
GRAGLE	*Naupactus leucoloma*	A1	Very low risk
HELIZE	*Helicoverpa zea*	A1	Very low risk
HOMLTR	*Homalodisca vitripennis*	A1	Very low risk
HYROBO	*Listronotus bonariensis*	A1	Very low risk
IPSXFA	*Ips subelongatus*	A2	Low risk
IPSXHA	*Ips hauseri*	A2	Low risk
LAPHFR	*Spodoptera frugiperda*	A2	Very low risk
LASPPA	*Grapholita packardi*	A1	Moderate risk
LIBEAS	*'Candidatus Liberibacter asiaticus'*	A1	Very low risk
LIBEPS	*'Candidatus Liberibacter solanacearum'*	A1	Low risk
LOPLJA	*Lopholeucaspis japonica*	A2	Low risk
MALADI	*Malacosoma disstria*	A1	Low risk
NEOLEL	*Neoleucinodes elegantalis*	A1	Very low risk
NUMOPI	*Acrobasis pirivorella*	A2	Very low risk

PARZCO	*Bactericera cockerelli*	A1	Low risk
PEPMV0	*Potexvirus pepini*	A2	Moderate risk
PHECPI	*Chionaspis pinifoliae*	A1	Low risk
PHYCFR	*Phyllocoptes fructiphilus*	A1	Low risk
PHYTKE	*Phytophthora kernoviae*	A2	Low risk
PRODER	*Spodoptera eridania*	A1	Very low risk
PRODOR	*Spodoptera ornithogalli*	A1	Very low risk
PRODPR	*Spodoptera praefica*	A1	Very low risk
RALSPS	*Ralstonia pseudosolanacearum*	A2	Very low risk
RALSSY	*Ralstonia syzygii*	A1	Very low risk
RHYCFE	*Rhynchophorus ferrugineus*	A2	Very low risk
SCITDO	*Scirtothrips dorsalis*	A2	Very low risk
THEKMI	*Pucciniastrum minimum*	A2	Low risk
TOBRFV	*Tobamovirus fructirugosum*	A2	Moderate risk
TOUMPA	*Toumeyella parvicornis*	A2	Low risk
TOXOCI	*Aphis citricidus*	A2	Very low risk
TYLCV0	*Begomovirus coheni*	A2	Very low risk
XANTCI	Xanthomonas citri pv. citri	A1	Very low risk
XANTAA	*Xanthomonas euvesicatoria pv. allii*	A1	Very low risk
XYLBFO	*Euwallacea fornicatus sensu lato*	A2	Low risk
XYLEFA	*Xylella fastidiosa*	A2	Moderate risk
XYLOAL	*Xylotrechus altaicus*	A2	Very low risk
XYLOCH	*Xylotrechus chinensis*	Alert	Very low risk
XYLONM	*Xylotrechus namanganensis*	A2	Very low risk
XYLOPY	*Xylotrechus pyrrhoderus*	A1	Very low risk