Strategic Guidance for Applicants to call for crop pests and diseases business collaboration awards

CALL SCOPE

Applicants are invited to propose research activities to test approaches and develop strategies to improve the understanding, management and control of priority crop pests and diseases. Proposals should address the following challenge areas:

- **Fundamental study of the biology of pests and diseases** - including studies of host-pest interactions, population biology and epidemiology, diversity and abundance studies, mechanisms of infection and dispersal.
- **Prevention and biosecurity** – studies and approaches to prevent pest incidence and proliferation. Including, but not limited to; genetics of crop/host tolerance and resistance, novel cultural and rotational approaches, habitat and environmental management to maximise the presence of natural enemies and approaches to limit the introduction and spread of pests and diseases.
- **Detection and forecasting** – studies that develop new approaches and applications for detection, monitoring and forecasting of crop pests. Including, but not limited to real-time and remote sensing, development of novel sensors and molecular diagnostics and integration of these new tools into forecasting and decision-support applications.
- **Novel control** - development of new approaches that provide new control solutions for crop pests, including chemical, biological and genetic interventions.
- **Development of IPM approaches** – development of proof-of-concept for novel IPM approaches that combine prevention, detection and control to deliver truly integrated solutions, including approaches that integrate pest and disease control and modelling/simulation of IPM systems.

Applicants may investigate weeds as part of the pest and disease complex, for example, where controlling the weed is an effective route to controlling the target pest as part of an IPM approach.

Applicants are encouraged to consider how the activities may generate preliminary findings that underpin high-quality proposals to UKRI and other funding opportunities for research, innovation and knowledge exchange, or to de-risk direct industry investment and commercialisation.

CROP PEST AND DISEASE THREATS

The following list contains crop pests and diseases that have been identified, in consultation with farmers and growers, as a significant threat to UK agriculture and horticulture, and a high priority for research and innovation.

Proposals will be assessed for relevance to industry. While this list is not exclusionary, this information is provided to inform applicants of potential target species that will be considered highly relevant.

Crop pests

Pests	**Latin Name**	**Crop**
Aphid species	Various spp. including vectors of viruses	Cereals, OSR, pepper, lettuce, babyleaf salads, strawberry, raspberry, blackcurrant, tree fruit, potato and field vegetable crops
Bean seed fly	*Delia* spp.	Onion, leek, babyleaf brassicas, legumes
Wheat bulb fly	*Delia coarctata*	Cereals
Common green capsid	*Lycocoris pabulinus*	Stone fruit, soft fruit
European tarnish bug	*Lygus rugulipennis*	Strawberry
Brown marmorated stink bug	*Halyomorpha halys*	Invasive pest (100+ host species incl, tree fruit, soft fruit, field vegetables)
Forest bug	*Pentatoma rufipes*	Tree fruit
Mealybug	*Pseudococcus viburni*	Tomato
Cabbage white fly	*Aleyrodes proletella,*	Vegetable brassicas
Greenhouse whitefly	*Trialeurodes vaporariorum*	Strawberry, protected edibles,
Slugs	*Deroceras spp.*, *Arion* spp., *Tandonia* spp.	Brassicas, asparagus, lettuce, rhubarb, potato, cereals, OSR
Plant parasitic nematodes	*Globodera* spp., Free-living plant parasitic nematodes, *Ditylenchus* spp.	Potato, Onions field vegetable crops Potato
Mites	*Tetranychus cinnabarinus, Tetranychus urticae, Auculops lycopersica, Cecidophyopsis ribis*	Tomato, Blackcurrant, Soft fruit, stone fruit, protected edibles
Thrips	*Frankliniella occidentalis, Thrips tabaci, Thrips* spp	Strawberry, pepper, cucumber, alliums, vegetable brassicas, Soft fruit
Weevils	*Otiorhynchus sulcatus, Rhynchites* spp. *Anthonomus* spp, *Ceutorhynchus* spp	Blueberry, Apple, pear, OSR, vegetable brassicas
Cabbage stem flea beetle	*Psylliodes chrysocephala*	OSR, vegetable brassicas, spinach
Click beetles / wireworm	*Agriotes spp.*	Potatoes, winter wheat, alliums, carrots, sweetcorn, lettuce

Pests	Latin Name	Crop
South American tomato moth	*Tuta absoluta*	Tomato
Spotted wing drosophila	*Drosophila suzukii*	Soft fruit, stone fruit
Other dipteran pests	*e.g. Delia coarctata, Dasineura spp.,Delia spp., Tipula spp.*	Cereals, soft fruit, field vegetable crops
Apple sawfly	*Hoplocampa testudinea*	Apple, pear

Crop diseases

Diseases	Latin Name	Crop
Downy mildews, Late Blight, Cavity Spot, root and stem rots, damping off.	Oomycetes (*Aphanomyces, Phytophthora spp., Pythium spp., Peronospora spp., Plasmopara spp., Bremia*)	Lettuce, spinach, brassicas, peas, beans, herbs, blackberry, raspberry, strawberry, cucumber, tomatoes, potatoes.
Rots and cankers	*Pseudomonad* spp.	Mushrooms, Brassicas, Cherry, Plum
Nectria canker	*Nectria ditissima*	Apple, Pear
Basal and internal rots	*Fusarium* f.spp.	Lettuce, Rocket, Coriander, Peppers, Onions, Wheat, Potatoes
Black rot	*Xanthomonas* spp.	Brassicas
Leaf spot	*Ramularia collo-cygni*	Spring and winter Barley
Yellow rust	*Puccinia striiformis*	Wheat
Leaf Scald	*Rhynchosporium commune*	Wheat, Barley
Grey mould	*Botrytis spp.*	Soft fruits, onions, tomato,
Leaf spot/Stem Canker	*Leptosphaeria spp.*	Oil seed rape
Soft rots	*Sclerotinia sclerotiorum*	Oil seed rape, carrot, lettuce, beans, peas.
Light leaf spot	*Pyrenopeziza brassicae*	Brassicas, OSR
Net blotch	*Pyrenophora teres*	Barley
Leaf blotch	*Septoria spp.*	Winter Wheat
Brown Rot	*Monilinia spp.*	Cherry
Club root	*Plasmodiophora brassicae*	Oil seed rape, brassicas
Take-all	*Gaeumannomyces tritici* and *G. avenae*	Cereals
Purple spot	*Stemphylium vesicarium*	Asparagus
Common Scab	*Streptomyces spp.*	Potato
Early blight	*Alternaria species*	Potato
Viruses (non aphid-transmitted)	*Tomato brown rugose fruit virus (TOBRFV); Cucumber green mottle mosaic virus (CGMMV)*	Tomato, cucumber

CHALLENGE AREAS FOR DISEASES

Research on pathogens across the crop sectors, which are traditionally controlled by fungicide applications, has shifted to take a step back to consider more fundamental approaches, which may help reduce the reliance on synthetic fungicides.

Understanding pathogen biology

Thorough knowledge of the pathogen and its host and environmental requirements can offer opportunities to manage susceptible crops. Consideration of the pathogen's route of ingress, method of spread, temperature and leaf wetness requirements and survival, and ability to produce genetic variants can all be considered.

Suggested host/pathogen combinations that lend themselves to this approach are;

- Aerial oomycetes (downy mildews, blight), affecting many horticultural crops and potatoes. Sporulation can be inhibited by use of UV light, and research using genetic editing has been shown to inhibit the pathogen's ability to gain entry to host cells.
- Net blotch of barley occurs as two forms in the UK; the net form, caused by *Pyrenophora teres* f. *teres* (Ptt) is the dominant form while the spot form caused by *P. teres f. maculata* (Ptm) has recently become a problem of epidemic proportions in several important barley-producing regions worldwide. Differences in fungicide sensitivity and varietal resistance responses between the two forms means that changes in relative dominance will have implications for field management. Gaining a better understanding of the disease complex could improve field management options.
- Current work through the UK Cereal Pathogen Virulence Survey (UKCPVS) tracks the evolution of pathogen populations. With a primary focus on yellow rust the results from the project help inform when resistance genes are being overcome which in turn inform breeding efforts for future varieties. Monitoring during 2021 identified a shift in host resistance to Septoria, which is likely to be linked to a genetic variant in the pathogen. Understanding the spread of the variants using rapid genotyping would help inform management e.g. variety choice the following season. This approach would be of interest for Yellow rust and Septoria for cereal crops, and pathogens such as Botrytis, Fusarium, *Phytophthora infestans* and *Bremia lactucae* in horticulture.

Elicitors/epiphytes/endophytes/rhizosphere as alternative control options

Exploiting the existing microbiota of the plant, or in the case of elicitors, triggering existing mechanisms within the plant to deal with would-be pathogens provides great potential to develop IPM compatible control strategies. Much work has been conducted in this area focusing on a particular crop x disease target with experiments conducted in controlled environments. Future work should also focus on testing these approaches in the cropping environment and translating existing research to other crop groups and disease targets. Septoria of wheat and leaf spot of barley caused by *Ramularia collo-cygni* are potential targets for this work for cereals, while in horticultural crops, Fusarium rots of lettuce and onions, and other fungal or bacterial foliar diseases lend themselves to this approach.

Next generation spore traps for improved real time monitoring of pathogens

Monitoring the incidence and severity of airborne disease propagules (spores), and linking this information to environmental data to provide disease alerts and forecasts, enables farmers and growers to make targeted applications when needed, rather than being

prophylactic. Technologies for this are developing but are still some way from automated field sensors, linked to environmental data sources, which inform a grower when the risk is sufficiently high to warrant intervention. Information of this kind, along with forecasting and other decision-support tools help growers make data-driven decisions. This can also be linked to genetic approaches for monitoring variants of the captured spores. Current examples are; *Leptosphaeria* spp (Phoma leaf spot) and *Pyrenopeziza brassicae* (light leaf spot) in oilseed crops, and downy mildews in onions (*Peronospora destructor*) and lettuce (*Bremia lactucae*) and blight in potatoes (*Phytophthora infestans*).

Increasing soil diversity

Soilborne pathogens, which are often long term, intractable crop problems e.g. clubroot, Fusarium rots, Phytophthora spp., often require a different approach and new techniques to provide tools for more holistic solutions. Research to help build more robust soils, with high levels of microbial diversity, could offer a way to build disease-suppressive soils. Robust and diverse soils can result in high levels of resilience in crops. Pesticide applications impact negatively on microbial diversity in soils, therefore this approach requires evidence and demonstration to encourage uptake from growers. This approach is being investigated in work on basal rots of onions and lettuce caused by *Fusarium oxysporum* f.spp.

CHALLENGE AREAS FOR CROP PESTS

Management of virus vectors, especially aphids

Effective control options for aphids are becoming limited, and improved targeting of remaining actives is critical. Key knowledge gaps remain in understanding the impacts of aphid mediated virus transmission on crops. This information is needed for farmers to have confidence in reducing insecticide usage. Suggested topic areas include understanding dynamics of virus spread in relation to aphid populations and crop physiology; improved understanding of the impacts of BYDV in oats, particularly in relation to crop physiology and progression of infection compared to wheat or barley and subsequent effects on yield.

Use of semiochemicals to improve monitoring and management of pests

Opportunities to disrupt or enhance plant/pest/natural enemy interactions using semiochemicals for the purposes of IPM are yet to be fully explored. Improved understanding of the chemistry of specific tri-tropic interactions can lead to effective interventions for crop protection. Development of tools for reliable detection of pests are a fundamental part of IPM programmes, and also critical for facilitating research programmes in the field. The suggested priority species include dipteran pests in cereals, coleoptera.

Novel molecular techniques for improved monitoring of insects in traps

There have been several recent advancements in the area of automated species detection (e.g. image recognition analysis). However, such systems can struggle with species discrimination in certain scenarios (e.g. visually similar species, overabundance of bycatch). Molecular tools may offer a solution, improving monitoring accuracy and/or speed of sample processing. Such tools could be useful in monitoring both pest and beneficial insect populations. The suggested priority species include aphids/virus vectors in cereals.