



Department
for Environment
Food & Rural Affairs

Pest specific plant health response plan:

Outbreaks of *Tilletia indica* (Karnal bunt) in cereal
crops



Figure 1. Bunted grains of wheat that have been infected by *Tilletia indica* (Karnal bunt).
Image courtesy of: Ruben Durán, Washington State University, Bugwood.org

We are the Department for Environment, Food and Rural Affairs. We're responsible for improving and protecting the environment, growing the green economy, sustaining thriving rural communities and supporting our world-class food, farming and fishing industries.

We work closely with our 33 agencies and arm's length bodies on our ambition to make our air purer, our water cleaner, our land greener and our food more sustainable. Our mission is to restore and enhance the environment for the next generation, and to leave the environment in a better state than we found it.



© Crown copyright 2022

This information is licensed under the Open Government Licence v3.0. To view this licence, visit www.nationalarchives.gov.uk/doc/open-government-licence/

This publication is available at

<https://planthealthportal.defra.gov.uk/pests-and-diseases/contingency-planning/>

Any enquiries regarding this document should be sent to us at:

The UK Chief Plant Health Officer

Department for Environment, Food and Rural Affairs

Room 11G32

York Biotech Campus

Sand Hutton

York

YO41 1LZ

Email: plantpestrisks@defra.gov.uk

www.gov.uk/defra

Executive summary

Background	
Regulation	GB Quarantine pest
Key Hosts	Wheat, durum wheat and triticale
Distribution	Afghanistan, Brazil, India, Iran, Iraq, Mexico, Nepal, Pakistan, South Africa and the USA.
Key pathways	Seed & Soil
Industries at risk	Arable farms
Symptoms (2.2)*	<ul style="list-style-type: none"> • Bunted ears • Black, sooty grains • Fishy smelling grains • Hollow, broken grains at harvest
Surveillance	
Demarcated zones (5.38-5.42)	Infested zone = 1 km around infested field Buffer zone = ≥ 1 km
Surveillance activities (5.43-5.46)	<ul style="list-style-type: none"> • Visual surveys will be carried out in the infested and buffer zone • Confirmation of outbreaks will lead to national surveys to establish Pest Free Areas
Response measures	
Interceptions (5.1-5.17)	<ul style="list-style-type: none"> • Infested consignments should be destroyed (by deep burial or closed incineration) or re-exported • Tracing exercises carried out where required • UKPHINS notification made • Further measures should be implemented if the suspected material has been planted.
Outbreaks (5.47-5.54)	<ul style="list-style-type: none"> • Fungicide treatments to reduce spore load • Crop to be left in field or cut and ploughed in • Restrictions on hosts which can be planted • Disinfection of equipment • Regular tilling of land • Closure or rerouting of footpaths
Key control measures	
Biological	N/A
Chemical	Fungicides and herbicides
Cultural	Disinfection of equipment, machinery and clothing, regular tilling
Declaration of eradication	
Eradication can be declared if no pest is detected during annual surveys for three years during which no host crops are planted, and a further year with host crops being grown.	

* Numbers refer to relevant points in the plan

Contents

Executive summary.....	3
1. Introduction and scope	5
2. Summary of threat.....	5
3. Risk assessments	6
4. Actions to prevent outbreaks	6
5. Response.....	7
Official action to be taken following the suspicion or confirmation of <i>T. indica</i> on imported seeds	7
Official action to be taken following the suspicion or confirmation of <i>T. indica</i> on imported grain.....	Error! Bookmark not defined.
Official action to be taken following suspicion of <i>T. indica</i> in the field...	Error! Bookmark not defined.
Official action to be taken following findings of <i>T. indica</i> in a sample of UK grown wheat at grain or seed processors	Error! Bookmark not defined.
Confirming a new outbreak	10
Criteria for determining an outbreak.....	11
Official Action to be taken following the confirmation of an outbreak.....	12
6. Criteria for declaring eradication / change of policy	16
7. Evaluation and review of the contingency plan	17
8. References.....	18
9. Author and reviewers	19

1. Introduction and scope

- 1.1. This pest specific contingency plan has been prepared by the Defra Risk and Horizon Scanning Team. It describes how the Plant Health Service for England will respond to a finding of *Tilletia indica* (Karnal bunt).
- 1.2. The plant health authorities in Northern Ireland, Scotland, Wales and the Crown Dependencies have been consulted on this plan and will use it as the basis for the action they will take in the event that *T. indica* is detected in their territories.
- 1.3. This document will be used in conjunction with Defra's *Generic Contingency Plan for Plant Health in England* (<https://planthealthportal.defra.gov.uk/assets/uploads/Generic-Contingency-Plan-for-Plant-Health-in-England-FINAL-2.pdf>), which gives details of the teams and organisations involved in pest response in England, and their responsibilities and governance. It also describes how these teams and organisations work together in the event of an outbreak of a plant health pest.
- 1.4. The aims of this response plan are to facilitate the containment and eradication of *T. indica* and to make stakeholders aware of the planned action.

2. Summary of threat

- 2.1. *Tilletia indica* (Karnal bunt) is a fungal pest of wheat (*Triticum* spp.) and occasionally triticale (x *Triticosecale*). It was first described from Karnal, India and is widespread in the North-east of the country. It is also found in Afghanistan, Iran, Iraq, Nepal and Pakistan. *Tilletia indica* has been introduced to the USA, Mexico, Brazil and South Africa.
- 2.2. *Tilletia indica* causes both yield and quality losses by partially converting kernels of wheat (*Triticum*) into sori, a structure that contains a mass of fungal spores. Generally impacts are minor but can be large on a local scale (Carris *et al.*, 2006); if more than 3% of grains are bunted then the milled product will give off a fishy smell caused by the production of trimethylamine, which would cause flour to be rejected. Bunted kernels present no animal or human health risks.
- 2.3. The most likely pathway of entry to the UK is via international trade of seed and grain of wheat or triticale that has been infected with or contaminated with *T. indica*. Detection would most likely be through samples collected at grain or seed processors as the infection level in a growing crop can be very low and difficult to detect during visual inspections. Wheat seed is sown to grow a wheat crop and will be the highest risk of an outbreak of *T. indica*. Wheat grain refers to grain for milling to produce flour and so has a lower risk of resulting in an outbreak.
- 2.4. The UK conducts surveys as part of a multi-annual survey programme for the presence of *T. indica* by sampling grain or seed from UK wheat crops. This survey aims to collect samples from as many geographic locations as possible, with more samples being collected from those regions with the greatest cereal production. Samples of seed and untreated and unprocessed grain are sampled according to ISTA (International Seed Testing Association) sampling rules (ISTA, 2022) and are submitted to the Seeds Export Lab at Fera Science Ltd. Where possible such

samples are traceable to the field of origin and are as representative of the harvest as is practical.

- 2.5. There have been no outbreaks of *T. indica* in the UK or Europe, though in the UK it has been intercepted on imported grain from India in 2003, 2005, 2006, 2018 and 2019. The only interception records for continental Europe are from Italy, where *T. indica* was intercepted on imported durum wheat from Mexico in 1998 and 2006.

3. Risk assessments

- 3.1. *Tilletia indica* has an unmitigated and mitigated UK Plant Health Risk Register score of 80 and 40 respectively. Overall scores range from 1 (very low risk) to 125 (very high risk). These scores are reviewed when new information becomes available (<https://planthealthportal.defra.gov.uk/pests-and-diseases/uk-plant-health-risk-register/viewPestRisks.cfm?cslref=1138>).
- 3.2. *Tilletia indica* has been subject to pest risk analysis at both the UK (Sansford, 2004) and EU level (Sansford *et al.*, 2006), which concluded that the pest fits the criteria for a quarantine organism and should continue to be regulated.

4. Actions to prevent outbreaks

- 4.1. *Tilletia indica* is a GB Quarantine Pest ([Schedule 1](#) of [The Plant Health \(Phytosanitary Conditions\) \(Amendment\) \(EU Exit\) Regulations 2020](#)) and is therefore prohibited from being introduced into, or spread within, GB. Further pest and host specific requirements are listed in [Schedule 7](#).
- 4.2. Prohibitions also exist for the import into GB of soil, which could harbour viable spores, in [Schedule 6](#) of the same regulations.
- 4.3. *Tilletia indica* is an EU Union Quarantine Pest (EU Commission Implementing Regulation 2019/2072, Annex II Part A (Pests not known to occur in the Union Territory) and is therefore prohibited from being introduced into, or spread within, the Union Territory.
- 4.4. *Tilletia indica* is an A1 listed pest for the EPPO region and is therefore recommended for regulation by EPPO member countries.
- 4.5. The Plant Health Service should be aware of the measures described in this plan and be trained in responding to an outbreak of *T. indica*. It is important that capabilities in detection, diagnosis, and risk management are available.

5. Response

Official action to be taken following the suspicion or confirmation of *Tilletia indica* on imported material

Imported seeds

- 5.1. The Plant Health and Seeds Inspectorate (PHSI) of the Animal and Plant Health Agency (APHA) conduct risk based targeted sampling of seed consignments that originate from countries where *T. indica* is known to occur. The inspection rate is reviewed yearly and can be increased based on interceptions on seed from a particular country.
- 5.2. Sampling will also occur if seed lots have been re-exported from within the EU to the UK but are known to have originated from a country where *T. indica* is known to occur. Seed lots are sampled according to ISTA seed sampling rules. Samples should be clearly labelled and sent to Fera Science Ltd., Plant Clinic, York Biotech Campus, Sand Hutton, York, YO41 1LZ (01904 462000) for *T. indica* testing. After sampling the seed, the lot is released to the importer.
- 5.3. If *T. indica* is suspected by laboratory testing, the seed should immediately be traced and held until the diagnosis has been confirmed and any other known recipients of consignments from the same lot notified.
- 5.4. When an infection of *T. indica* is confirmed, the PHSI should advise the client of the action that needs to be taken by way of an official statutory plant health notice. The consignment of seed and its packaging should be destroyed by deep burial or closed incineration. Only closed incineration will be acceptable as spores can be spread in smoke.
- 5.5. If the seed has already been planted, the field(s) should be placed under statutory notice to prevent the movement of plant material and soil from the field. The following measures should be taken:
 - The emerging crop should be destroyed before ear emergence (Ideally before GS41 Flag leaf sheath extending) and the land tilled.
 - Fungicide application prior to destruction would be recommended to decrease spore loads. Plant material should then either be treated with herbicide or physically cut followed by deep ploughing into the field. The Defra Risk and Horizon Scanning Team will recommend approved fungicides and herbicides in the event of a finding in the field.
 - Prior to any pesticides being used, the risk posed by the pesticide to people and the environment will be assessed.

- If the situation demands it, it may be necessary to require the use of pesticides even in organic crops or those where biological control agents are being used.
 - Growers will be placed under notice to apply the recommended pesticides and make the applications using their own or contractor's equipment. Records of applications will be kept, including details of the amount of product and water use. All pesticide applications will be made in accordance with pesticide approvals and in accordance with HSE guidance.
- 5.6. Plant material should not be removed from the field to avoid the risk of spread of spores.
- 5.7. Machinery used in the field should be cleaned as detailed in 5.54.
- 5.8. Actions for confirmed findings in a field should then be carried out (see 5.47 to 5.54).
- 5.9. A UKPHINS (UK Plant Health Interception Notification System) notification should be made upon confirmation of an interception of *T. indica*. UKPHINS is the IT system for recording findings and non-compliance in order to maintain records and notify other National Plant Protection Organisations (NPPO) of plant health issues.
- 5.10. If all or part of the consignment has been distributed to other premises prior to diagnosis, trace forward and trace back inspections should take place upon confirmation of *T. indica*. Details of recent past and future consignments from the same grower/supplier should also be obtained.
- 5.11. A pest factsheet to raise awareness of *T. indica* should be distributed to growers or processors where *T. indica* has been found, and, where appropriate, to those in the local area and those associated with the finding. The pest factsheet can be found on the Plant Health Portal - <https://planthealthportal.defra.gov.uk/assets/factsheets/Karnal-Bunt-Factsheet-FINALupdate003.pdf>.

Grain

- 5.12. The PHSI conduct risk based targeted sampling of grain consignments that originate from countries where *T. indica* is known to occur. The inspection rate is reviewed yearly and can be increased based on interceptions on seed or grain from a particular country. Representative samples (2 kg as grain consignments are often too large to follow ISTA rules as set out elsewhere) are taken and sent to Fera Science Ltd. for testing as in 5.2. Grain consignments are held until initial results are received from Fera Science Ltd, usually within 24 hours.
- 5.13. If *T. indica* is confirmed by laboratory testing, the importer should be given a choice between re-export or destruction by closed incineration or deep burial.
- 5.14. Any containers or packaging that has held the grain should be traced if possible and disinfected or destroyed as appropriate (see 5.54).

- 5.15. Transportation should be in closed containers, and any conveyances or packaging that is not exported with the commodity should be appropriately cleaned after use (See section 5.54).
- 5.16. A UKPHINS (UK Plant Health Interception Notification System) notification should be made upon confirmation of an interception of *T. indica*. UKPHINS is the IT system for recording findings and non-compliance in order to maintain records and notify other National Plant Protection Organisations (NPPO) of plant health issues.

Official action to be taken following the suspicion of a *Tilletia indica* outbreak

- 5.17. Suspect outbreaks will be assessed on a case by case basis. An Outbreak Triage Group (OTG) chaired by the Chief Plant Health Officer (CPHO) or their deputy and including specialists from APHA, Defra and other organisations, should be set up to assess the risk and decide on a suitable response. Where appropriate, the OTG will also decide who will be the control authority, and the control authority will then nominate an Incident Controller. An Incident Management Team (IMT) meeting, chaired by the Incident Controller, will subsequently convene to produce an Incident Action Plan (IAP) to outline the operational plan. See the Defra Generic Contingency Plan for Plant Health in England for full details.
- 5.18. The OTG will set an alert status, which will consider the specific nature of the outbreak. These alert levels, in order of increasing severity, are white, black, amber and red (more details on these levels can be found in table 2 of the Defra Generic Contingency Plan for Plant Health in England). Under most scenarios, an outbreak of *T. indica* suspected in a growing crop is likely to be given an amber alert status. An amber alert status refers to a plant pest/disease with potential for relatively slow but extensive geographical spread leading to host death and/or major economic, environmental or social impacts.

UK grown grain or seed at processors

- 5.19. It is most likely that any detection of an outbreak would be through samples collected at grain or seed processors as the infection level in a growing crop can be very low and difficult to detect during visual inspections.
- 5.20. If *T. indica* is confirmed in a sample of UK wheat at a grain or seed processor then action as detailed in 5.13 to 5.16 should be followed.
- 5.21. In the case of a positive finding at a seed processor, seed which has already left the seed processors must be traced and placed under notice to prevent sowing.
- 5.22. The grain or seed should be traced back to the field of origin (where possible) which should be placed under notice to prevent sowing of any host crops or movement of soil by any means until the source of *T. indica* can be confirmed.

- If the field of origin cannot be traced and the grain is known to come from a single farm, then the whole farm should be placed under notice and further evidence sought to narrow down the field of origin.
 - If the tested lot contains grain from more than one farm, then each farm should be placed under notice and investigations carried out to try to establish the farm and field of origin. If straw is still in the field, then this should be held in the field. It should not be allowed to be moved on for processing as it could be contaminated with spores. If straw has been moved it will be traced and action taken in accordance with the risk posed by the specific situation.
- 5.23. A positive result in UK grain or seed lots may be due to contamination, for example if the grain was being stored in a bin previously used to store grain from a country where *T. indica* is known to occur. Data on all grain or seed that has been processed in the last three months should be examined.
- 5.24. If no processing of grain or seed from countries affected by *T. indica* has taken place in the past 3 months, then it should be assumed that the spores originated from the UK sample. In this case official outbreak actions should commence as detailed in 5.35 to 5.54.
- 5.25. If grain or seed from a *T. indica* affected country has been processed in the past 3 months, the possibility of contamination should be investigated.

Growing crops

- 5.26. If *T. indica* is suspected in a growing crop, any bunted ears should be sent to Fera Science Ltd. for testing as in 5.2.
- 5.27. The field should be placed under notice until the diagnosis is confirmed, and the crop should not be harvested. Measures should be followed as in 5.5.
- 5.28. If the suspected infection was most likely a result of infected seed, then tracing of the seed will commence. This decision will be taken on a case by case basis.

Confirming a new outbreak

How to survey to determine whether there is an outbreak

- 5.29. Information to be gathered on the suspicion of *T. indica* by the PHSI, in accordance with ISPM 6; guidelines for surveillance (<https://www.ippc.int/en/publications/615/>):
- The origin of the wheat/triticale seed.
 - Details of other premises or destinations where the same batch of wheat or triticale seed may have been sent. Other crops sown from the same seed lot should be inspected or grain tested for the presence of *T. indica*.

- The layout of the premises and surrounding area, including a map of the cultivations/buildings, at risk growers and any other growers and any public footpaths that may run through the area.
 - Details of the host plant: the species, variety, growth stage and any other relevant information.
 - Description of the surrounding habitat.
 - Level of infection, including a description of symptoms (photos should be taken where possible).
 - The date and time the sample was taken, how it was identified and by whom.
 - Current controls in place e.g. chemical treatments such as seed treatments that may have been used, or fungicide applications that may have been applied.
 - Details on the movement of people, equipment, machinery etc. to and from the infected area. Also, details should be provided on the inter relationship with other host crops in the locality and if agricultural operations are contracted out.
 - Cultural and working practices.
- 5.30. If a finding occurs at a grain or seed processors action should be taken as detailed in section 5.20 to 5.26.
- 5.31. The seed used to plant the contaminated crop in the previous season should be traced. If the seed originated from a *T. indica* affected country, it should be assumed that the spores originated on the UK crop and an outbreak declared.
- 5.32. If seed did not originate from a *T. indica* affected country other possible routes of contamination should be investigated. It is possible that an outbreak could have been present for a number of years so the origin of seeds planted for the past 5 years should be traced if possible. The locations of nearby mills which could have processed contaminated grains from which spores have been released should also be investigated.

Diagnostic procedures

- 5.33. There are two protocols for identification of *T. indica* in the laboratory: the EPPO diagnostic protocol (EPPO, 2018) and an International Standards for Phytosanitary Measures 27 protocol (IPPC, 2014). Either of these should be followed for laboratory identification of *T. indica*. The EPPO protocol is generally used by Fera Science Ltd.

Criteria for determining an outbreak

- 5.34. An outbreak will be declared if there is confirmed evidence of:

- *T. indica* being found in a growing UK crop; or
- *Tilletia indica* being found in grain sampled from a crop at harvest; or if there are no grounds for reasonable suspicion that a finding in UK grain or seed at a processor is due to contamination.

Official Action to be taken following the confirmation of an outbreak

5.35. The scale of the outbreak will determine the size and nature of the IMT and action taken.

Communication

5.36. The IMT will assess the risks and communicate details to the IPPC and EPPO, in accordance with ISPM 17: pest reporting (<https://www.ippc.int/en/publications/606/>), as well as within government to Ministers, senior officials, other government departments and devolved administrations and agencies (e.g., the Environment Agency) on a regular basis as appropriate; and to stakeholders.

Demarcated Zones

5.37. Once an outbreak has been confirmed, a demarcated zone will be established. This will include two zones:

- The **infected zone** where *T. indica* has been confirmed and will be at least 1 km around the infected field(s). In this zone, no host crops can be planted for 3 years, which is the time for which *T. indica* spores have been demonstrated to survive in European soils, and other procedures as outlined later in the plan must be carried out.
- The **buffer zone** will initially extend to at least 1 km beyond the infected zone. Extensive surveys will be carried out in this area. Any hosts grown will be visually inspected for bunted ears at least once between heading and harvest, and grain and seeds produced from host material within this buffer zone should be held in a secure location, tested by field where possible and found to be free of *T. indica* before it is moved out of the buffer zone.

5.38. Initial maps of outbreak sites should be produced by officials.

5.39. If it is considered possible that the pathogen has spread to other destinations such as those highlighted during tracing exercises, then these areas should be surveyed. These zones should be treated as if they are part of the buffer zone.

- 5.40. The demarcated area should be adjusted in response to further findings. If *T. indica* is found within an area outside the infested zone, this should also be designated as infested and the demarcated areas should be adjusted accordingly.
- 5.41. Further general surveys will be carried out on hosts grown beyond the buffer zone, which may include visual inspection and/or sampling. Any general surveys are likely to focus on wheat rather than triticale and in areas where spread is most likely to occur i.e., land where machinery has been used that has also been used in the infected fields.

Surveillance

- 5.42. In the event of an outbreak being confirmed, it is likely that immediate sanctions will be placed on the UK by other countries for the movement of all wheat or triticale seed or grain. As a consequence, a more intensive national survey will be required so that areas where the pathogen is known not to occur can be identified, allowing for exports to resume from these regions. The UK produced over 13 million tonnes of wheat in 2018, and exports both wheat seed and grain to the EU and beyond.
- 5.43. A national survey to identify Pest Free Areas (PFA) will be conducted. Wheat will be sampled over Triticale as it is much more widely grown and much more likely to be a host. Samples should be submitted to Fera Science Ltd. as in 5.2, for testing via the EPPO diagnostic protocol.
- 5.44. Regions that test negative for *T. indica* can become officially recognised PFAs.
- 5.45. If the outbreak is likely to have occurred prior to the planting of the crop in which *T. indica* has been diagnosed, then the possibility of spread from this previous outbreak must be investigated. In particular if this is a seed crop then seed derived from previous crops in the affected field should be traced.

Pest Management procedures

- 5.46. If *T. indica* is confirmed, the growing crop will need to be destroyed. Burning *in situ* is not an option as smoke is reported to cause the long-distance spread of viable *T. indica* spores. It would be advised that the crop should be treated with an effective fungicide to minimise spore load as much as possible, and thus minimise inoculum load in the field.
- Prior to any pesticides being used, the risk posed by the pesticide to people and the environment will be assessed.
 - If the situation demands it, it may be necessary to require the use of pesticides even in organic crops or those where biological control agents are being used.
 - Growers will be placed under notice to apply the recommended pesticides and make the applications using their own or contractor's equipment. Records of applications will be kept, including details of the amount of product and water use.

All pesticide applications will be made in accordance with pesticide approvals and in accordance with HSE guidance.

- Any applications should be made following the advice on the product label and be in accordance with HSE guidance. In some cases there may be a requirement to carry out a Local Environment Risk Assessment for Pesticides (LERAP) depending on the product used and the situation of the finding.
- 5.47. Following this the crop should either be cut or left in the field and ultimately ploughed into the soil. Plant material should not be removed from the field to minimise the risk of spore transfer. Harvesting of the crop will not be allowed as this process results in a lot of dust generation and will lead to airborne spread of spores to neighbouring fields. All equipment used to cut the contaminated crop or plough it into the soil of the field, as well as any machinery and conveyances must be cleaned appropriately after leaving the infected field. More details of decontamination procedures can be found in sections 5.54.
- 5.48. No host crops can be planted in the infected field and all agricultural fields which fall within the infected zone for three years.
- 5.49. In order to limit the movement of soil from the field(s), which could contain viable spores, no root vegetables or bulbs can be grown within the known infected field(s). The recommended crops to be grown would be combinable non-host crops such as oilseed rape, barley, oats and some fodder crops. Alternatively, the field can be left fallow for some or all of the three years. Herbicide treatments should be applied to prevent emergence of volunteer hosts if left fallow or non-host crops grown.
- 5.50. All equipment and shoes used in the infested field must be properly cleaned and disinfected as described in section 5.54 before they are used in any other fields.
- 5.51. The soil must be tilled at least once a year for the full three years. This action will expose *T. indica* spores that may have become buried and encourage 'suicidal germination'. This should ideally be done during warm weather between 15-25°C and not during a dry period, as relative soil moisture >15% is required for spore germination.
- 5.52. Public footpaths that run through the infected field should be closed or re-routed to avoid movement of soil out of the infected area until eradication can be declared.

Decontamination procedures

- 5.53. The following articles that have come into contact with contaminated grain, seed or are used in contaminated fields will need to be decontaminated. Decontamination procedures are based on USDA (2007) unless otherwise referenced. Full disinfection may also be required this will be at the discretion of the PHSI.
- Conveyances (trucks, trailers etc.) used to transport or store any contaminated grain should be washed down with a high-pressure wash. In some cases, disinfection may also be required as detailed below.

- Sowing, tilling/ploughing/spraying and harvesting equipment used in the outbreak fields should be cleaned thoroughly to remove any soil or plant debris before it is moved to uninfected fields. This can be achieved by first removing excess soil and debris from all parts of the machine and then washing down using a high-pressure wash.
- Appropriate disinfection options are cleaning with a 1.5% sodium hypochlorite solution, a drench with hot water (at least 80°C) and detergent or cleaning with steam (of at least 100°C) (Smilanick *et al.*, 1997, USDA, 2007).
- Footwear worn in contaminated fields should be scrubbed to remove soil, preferably at the exit to the field followed by disinfection with 1.5% sodium hypochlorite solution.
- Any storage containers which have held contaminated grain should be traced and cleaned, including any silos that were used to hold the grain. If there is contaminated grain currently in a silo it should be destroyed by closed incineration or deep burial.
- Decontamination of mills will be required if contaminated grain has been processed ahead of detection. Any flour produced can be released as this does not pose a risk to either plant health or human health. Additionally, any bran produced can also be released as this does not pose a health risk as animal feed or for human consumption. However, any machines used for pelleting will also require disinfection. All waste (dust, screening etc.) must be bagged and disposed of at a PHSI approved landfill site or destroyed by closed incineration. The following methods can be used for cleaning of any equipment used during the processing of the *T. indica* infected grain:
 - applying steam at the critical temperature of 77°C to all surfaces to the point of runoff
 - cleaning with a solution of hot water and detergent (82°C minimum) applied under pressure of at least 1.4 bar (20 psi).
 - wetting all surfaces to the point of run off with a 1.5% sodium hypochlorite solution and letting it stand for 15 minutes, followed by a thorough wash down

Review measures in the case of prolonged official action

5.54. The EPPO protocol states that if continuing official action is required within the demarcated area over a prolonged period, a review of eradication and containment measures should be undertaken regularly to determine the success and cost-effectiveness of measures in the longer term. This review will involve consultation with stakeholders and should include:

- Evaluation of the effectiveness of current measures

- Evaluation of the economic impact and cost-effectiveness of continuing existing measures
- Consideration of further measures to strengthen containment and eradication actions
- Consideration of statutory obligations and impact on import and export procedures

Consideration of alternative approaches, including pursuing measures to contain the pest rather than eradication or even the cessation of statutory action.

- 5.53. In circumstances where it is considered that the pest cannot be eradicated or contained and official action is no longer considered appropriate, stakeholders should be consulted and a timetable and mechanism for the removal of official measures, and for the dissemination of pest management information, should be agreed with the EU commission.

6. Criteria for declaring eradication / change of policy

- 6.1. After three years of growing non-host crops then the growing of hosts will be allowed and these will be tested for the presence of *T. indica*. As the spores can lie dormant for a period of several years and infection is only seen in years with favourable conditions (on average once every four years in areas where *T. indica* is established) then testing of host crops should occur over four years, following the initial three years with no hosts grown. Ideally the host crop grown should be wheat, rather than triticale, as infection on triticale is rare and thus a negative result may not be indicative of the eradication of the pathogen. As infection can be localised within a field the entire field should be planted with wheat.
- 6.2. In order to determine if eradication has been achieved field inspections should occur at least once between heading and harvest. No symptoms of *T. indica* should be seen. Symptoms of bunt which are subsequently demonstrated to be common bunt can be discounted. No *T. indica* spores should be detected in harvested grain when a representative sample is taken at harvest and tested according to the EPPO diagnostic protocol.
- 6.3. *Tilletia indica* will be declared eradicated from an outbreak site after at least three years of growing non-hosts followed by four years of growing host crops (*Triticum*) where *T. indica* is not detected.
- 6.4. If during the four years of testing crops for the presence of *T. indica*, *T. indica* is detected then the field will remain under notice and no host crops should be planted for a further three years, and the process repeated along with consideration of if the period of not growing host crops should be extended.

7. Evaluation and review of the contingency plan

- 7.1. This pest specific contingency plan should be reviewed regularly to consider changes in legislation, control procedures, sampling and diagnosis methods, and any other relevant amendments.
- 7.2. Lessons should be identified during and after any outbreak of *T. indica* or other pest, including what went well and what did not. These should be included in any review of the contingency plan leading to continuous improvement of the plan and response to outbreaks.

8. References

CARRIS, L. M., CASTLEBURY, L. A. & GOATES, B. J. 2006. Nonsystemic Bunt Fungi-*Tilletia indica* and *T. horrida*: A Review of History, Systematics, and Biology*. *Annu. Rev. Phytopathol.*, 44, 113-133.

EPPO 2018. PM 7/29 (3) *Tilletia indica*. *EPPO Bulletin*, 48, 24.

IPPC 2014. ISPM 27: Diagnostic Protocols DP 4: *Tilletia indica* Mitra. Rome: International Plant Protection Convention.

ISTA 2022. International rules for seed testing 2022. Chapter 2: Sampling. .

SANSFORD, C. 2004. *Revised UK Summary Pest Risk Analysis for Tilletia indica* [Online]. UK: CSL. Available:
<https://secure.fera.defra.gov.uk/phiw/riskRegister/downloadExternalPra.cfm?id=4017>
[Accessed 11.01.2016].

SANSFORD, C., MURRAY, G., BRENNAN, J., LETH, V., PORTER, J. R., KELLY, P., MIGLIETTA, F., RICCIONI, L., MAGNUS, H. & PETERSON, G. 2006. Risks associated with *Tilletia indica*, the newly-listed EU quarantine pathogen, the cause of Karnal bunt of wheat: EC 5. framework project QLK5-1999-01554. EC.

SMILANICK, J., HERSHBERGER, W., BONDE, M. & NESTER, S. 1997. Germinability of teliospores of *Tilletia indica* after hot water and sodium hypochlorite treatments. *Plant disease*, 81, 932-935.

USDA. 2007. *Karnal Bunt Manual* [Online]. USA: USDA. Available:
https://www.aphis.usda.gov/import_export/plants/manuals/domestic/downloads/kb.pdf
[Accessed 11.01.2015].

9. Author and reviewers

Authors:

Original: Katie Lacey (Defra) and Melanie Tuffen (Defra) (2020)

Revised by: Simon Honey (2022)

Reviewers:

Matthew Everatt (Defra)

Marian McEwan (SASA)