AD HOC GROUP OF THE STATES PARTIES TO THE CONVENTION ON THE PROHIBITION OF THE DEVELOPMENT, PRODUCTION AND STOCKPILING OF BACTERIOLOGICAL (BIOLOGICAL) AND TOXIN WEAPONS AND ON THEIR DESTRUCTION

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EVALUATION OF ANIMAL AND PLANT PATHOGENS

INTRODUCTION

Evaluations were done on African horse sickness and Lumpy skin disease on the list of animal pathogens and Pernospora hyoscyami and Claviceps purpurea on the list of plant pathogens.

The results of these evaluations are discussed.

AFRICAN HORSE SICKNESS

This disease is caused by an Orbivirus - there are 9 strains of the virus. There is a wide distribution of some strains.

Evaluation according to criteria

1. Not known to have been developed, produced or used as BW. **Negative**

2. Do not have severe socio-economic and/or significant adverse human impact - horses do not play an important economic role today. **Negative**

Since this pathogen do not satisfy any of the two criteria, it should be deleted from the list.

It was, for the sake of completeness also evaluated against the subcriteria of criterium No. 2 and the results are:

(a) Does have high mortality - 97%. **Positive**

(b) Short incubation period - to late when diagnosed. **Positive**

(c) Needs a vector for transmission. **Negative**

(d) There is effective vaccine available against all 9 strains, no treatment. **Negative**

(e) Low infective dose. **Positive**

(f) Unsure about stability in environment, it is not known how the virus survives in the environment. **Negative**

(g) Relative easy to produce. **Neutral**

LUMPY SKIN DISEASE

This disease is caused by a Pox virus causing damaging skin lesions of cattle that lower the quality of leather.

The disease is very unpredictable, 50% of any cattle population have natural immunity against the virus. Wide distribution.

Evaluation according to the criteria

1. Not known to have been developed, produced or used as BW. **Negative**

2. Only effect on leather industry - socio-economic and/or adverse human effects not that high. **Negative**

(a) Low mortality. **Negative**

(b) Long incubation period. **Negative**

(c) Low contagiousness, 50% natural immunity. **Negative**

(d) Natural immunity and vaccine available - difficult to analyse effectiveness of vaccine sometimes due to natural immunity and unpredictability. **Negative**

(e) High infective dose. **Negative**

(f) Stable in the environment. **Positive**

(g) Ease of production - no - due to unpredictability. **Negative**

This pathogen does not satisfy any of the criteria and should therefore be deleted from the list.

PERNOSPORA HYOSCYAMI

Pernospora hyoscyami de Bary P. sp. *Tabacina* (Adam) Skalicky

Disease

This fungus causes blue mold of tobacco plants and is highly destructive under specific environmental conditions.

Host

Attacks most of the commercial and ornamental varieties of tobacco as well as Tomatoes, Eggplant, Night Shade.

Geographical distribution

World wide.

Strains

3 strains have been described differing in their pathogenicity on specific hosts. This indicates the possibility of manipulation of pathogenicity. The inability of the fungus to be grown on artificial substrates will make such manipulation difficult but not impossible.

Environmental conditions

This pathogen is specific for temperature and relative humidity especially spore production and liberation. Symptom expression may differ depending on the temperature. The temperature and relative humidity requirements can in all probability be adopted.

Evaluation according to the criteria

1. Not known to have been developed, produced or used as weapons. **Negative**

2. Will not impact negatively on staple crops. Will negatively effect tobacco exports. **Negative**

   (a) **Dissemination**: Wind, spores can travel up to 1600 km. **Positive**

   (b) **Incubation period**: Short. Plants can be destroyed within 4 weeks. Spores remain viable up 2 months. Infection can become systemic making diagnosis more difficult. **Positive**

   (c) **Ease of production**: Fungus needs living tissue to grow and cannot be produced on artificial substrates in liquid or solid state fermenters. Large scale

spore production is fairly easy on living hosts (tobacco) in growth chambers with controlled environment capabilities. **Negative**

(d) **Stability in the environment**: Spores are stable and viable for up to 2 months. Mycelium may survive in plant debris causing infection in following (susceptible) crops. **Positive**

(e) **Cost effective protection or treatment**: Most tobacco producing countries have an effective monitoring system to warn of possible epidemics. The timely use of fungicidal sprays as prophylactics during the sensitive weather conditions provides effective protection. When infection is established, is control based on twice weekly spraying possible but uneconomical. Spraying of tobacco under these circumstances, in many cases detracts from its quality and therefore its marketability. Resistant or tolerant tobacco lines/cultivars have been reported. This is manifested as an absence of drastic symptoms but still allows the pathogen to grow. **Negative**

(f) **Infective dose**: Low infective dose is needed. Because of reasonably short life cycle, new spores are produced rapidly and infection spreads quickly. **Positive**

(g) **Infectivity**: This is high only when environmental conditions are right. The pathogen needs specific temperature and humidity. **Negative**

(h) **Life cycle**: Cycle from infection to spore production and liberation can be short but is dependant on temperature and humidity conditions. **Negative**

Suitability as BW agent

The timely use of fungicidal sprays as prophylactics during the sensitive weather conditions, and the fact that the pathogen needs specific temperature and humidity conditions to be infective, makes its biological weapon potential low.

CLAVICEPS PURPUREA (Fr.) Tul.

Disease

This fungus causes ergot of rye and other susceptible grasses. The fungus replaces the seed or grain kernel with a hardened mycelial mat of pink or purple sclerotium commonly called the "ergot". Loss to grain and damage to plants are slight. The "ergot" contains certain powerful alkaloids eg. ergotamine, ergometrine, ergonovine etc. Cattle grazing in infected fields or the consumption of bread baked from infected rye can lead to great suffering and death by both animals and humans where it is known as *St. Anthony's Fire*.

Hosts

Rye, wheat and many other susceptible grasses. It is important to note that infection can only take place during flowering.

Geographic distribution

World wide.

Strains

It is accepted that different strains exist. There is still some confusion wether rye is attacked by the same strains of the fungus; many are restricted to grasses.

Environmental conditions

Infection of the flowers takes place by either ascospores or conidia. For both these spores cool wet conditions are a prerequisite. Ascospores formation needs cold shock.

Evaluation according to the criteria

1. Not known to have been developed, produced or used as weapons. **Negative**

2. **Socio-economic and health impacts**: This disease will undoubtedly have severe socio-economic impacts through livestock losses as well as possible significant adverse human health impacts where proper methods for cleaning grain before milling is not available. **Positive**

   (a) **Dissemination**: Ascospores are spread by wind while conidia are disseminated by insects. **Positive/Negative**

   (b) **Incubation period**: Incubation period is short. An infected flower will produce conidia in time to infect other flowers. The disease is easy to diagnose in its later stages only. **Positive**

   (c) **Ease of production**: The fungus can be produced in fermenters where it will only produce conidia. For ascospore production living hosts are necessary to produce the sclerotia which will result in ascospores upon germination. **Positive/Negative**

   (d) **Stability in the environment**: The conidia are delicate and easily killed by dehydration or elevated temperatures. The ascospores are considerably more resistant as they are depended on wind dispersion. **Negative/Positive**

(e) **Cost effective protection**: No effective fungicide treatment is available. Heavily infected fields will have to be burnt with concomitant loss of produce. **Positive**

(f) **Infective dose**: The fungus appears to need a low infective dose during natural occurring outbreaks. Artificially induced infections seem to be less effective and need high inoculum pressures. **Negative**

(g) **Infectivity**: Once primary infection has occurred, the disease will spread rapidly as long as conditions are conducive for infection. Real epidemics rarely occur as favourable conditions do not persist long enough. **Negative**

(h) **Life cycle**: The fungus has a complex life cycle comprising of an asexual stage which produces conidiospores and a sexual stage culminating in ascospores. Conidia are disseminated by insects while ascospores are wind borne. Conidia are formed by infected flowers and can infect adjacent flowers through insects. Ascospores are produced only from germinating sclerotium (ergot). **Negative**

Suitability as BW agent

Only ascospores are practical for delivery. Ascospores can only be produced by means of living host plants. Some form of microencapsulation of conidia may be an alternative as conidia can be produced in fermenters. The infection window afforded by the flowering stage will make logistics of effective delivery complicated. Because of the important alkaloids used by the pharmaceutical industry, a large amount of research on artificially induced infection has been performed in Portugal. Note that the sexual stage of this fungus can offer an opportunity for genetic manipulation. The potential of *Claviceps purpurea* as biological weapon must be regarded as medium to low.

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