# Laboratory report on seed health test

- Amount of seed-borne pathogens
- Amount of disease incidence

# Objectives of seed health testing

- Evaluation for planting value
- Seed treatment
- Certification
- Quarantine
- Human consumption & animal feed

# Tolerance/Threshold level

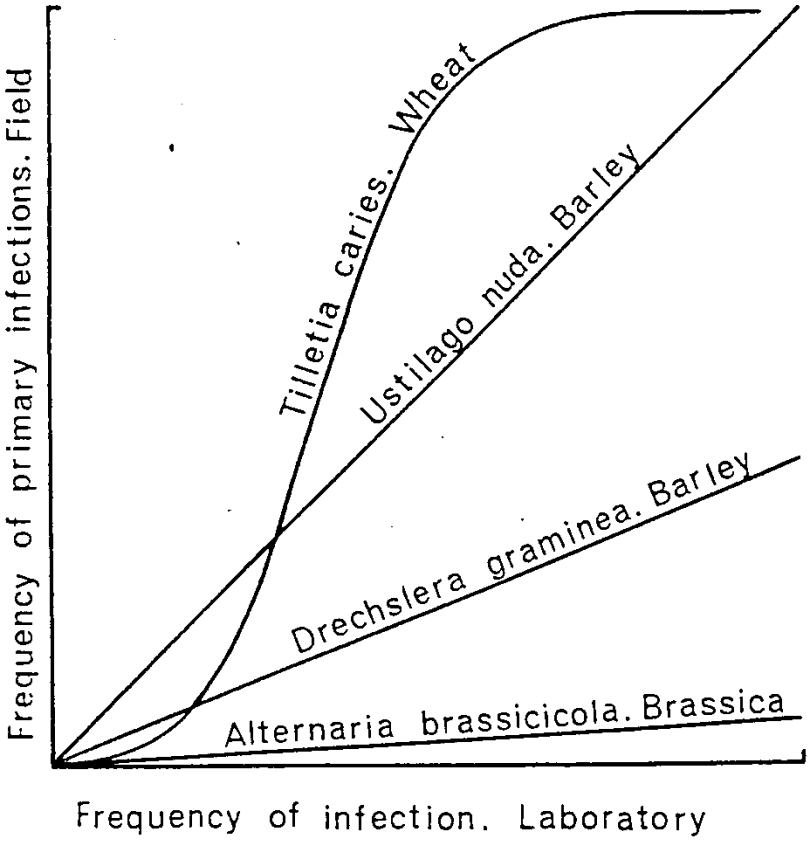
(Evaluation for  planting value)

Importance of primary infections for:

1. Disease development

2. Yield reduction

3. Infection of new seed crop

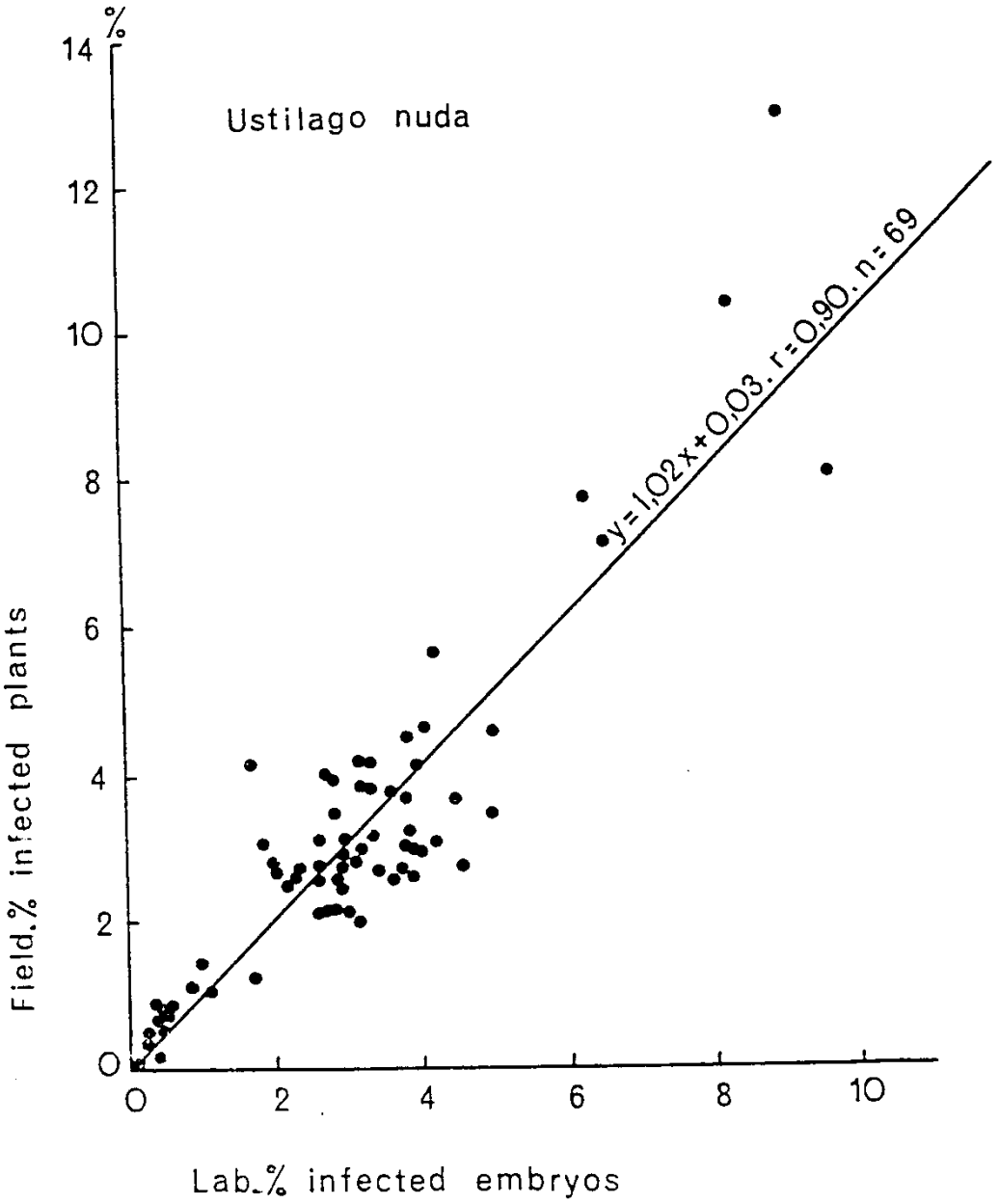


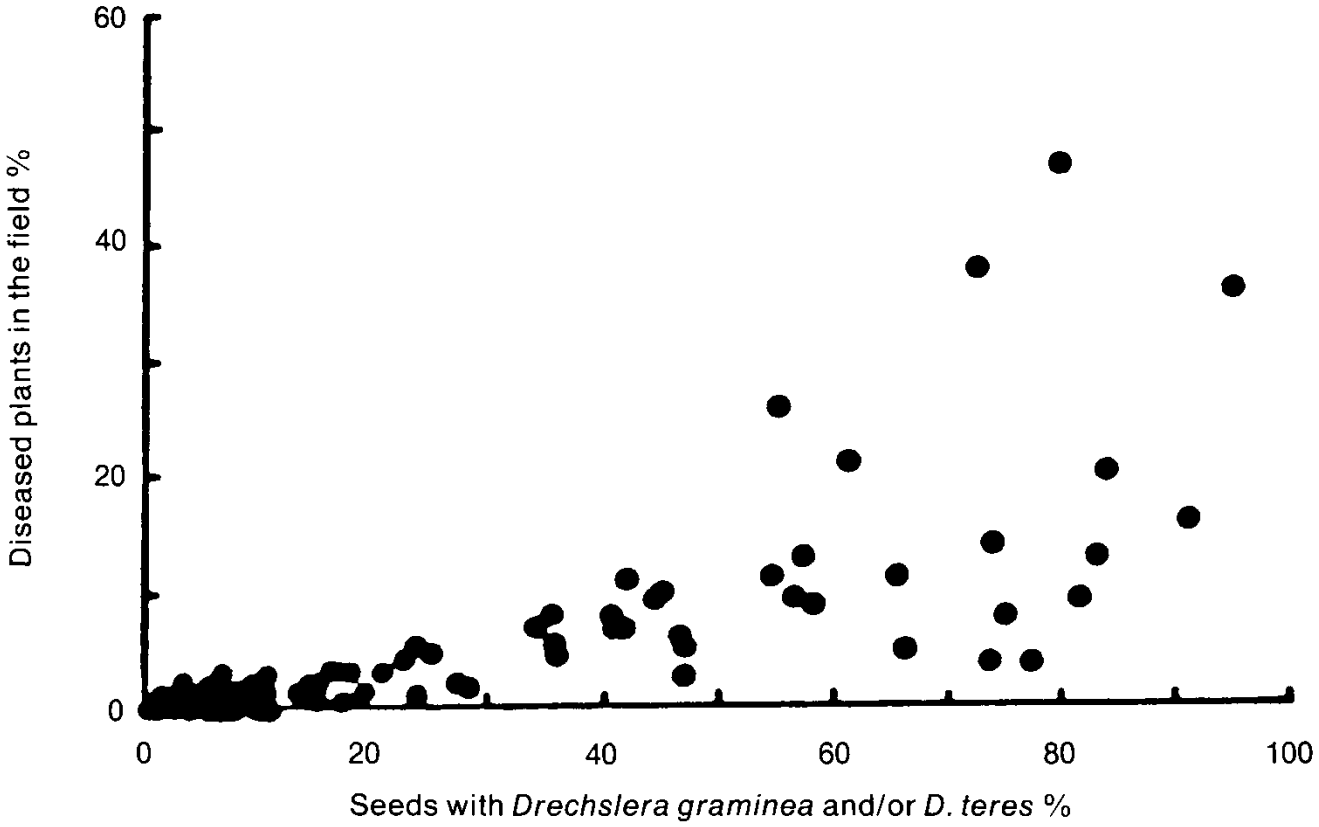

Types of relationships between test results and primary infections in the field.

Seed transmission relationships.

| Pathogen | % infection in Lab/glhse | % infection in Field soil | Transmission ratio | Crop | Reference |
|---|---|---|---|---|---|
| *Polyspora lini* | 15.0 | 1.7 | 9:1 | Flax | Henry and Campbell, 1938 |
| *Colletotrichum lini* | 66.3 | 17.0 | 4:1 | Flax | Henry and Campbell, 1938 |
| *Pyrenophora graminea* and *P. teres* | 50–75 | 5–10 | 10:1 to 7.5:1 | Barley | Jorgensen, 1977 |
| | 50–65 | 0–11 | 0:0 to 6.0:1 | Barley | Jorgensen, 1977 |
| *Ascochyta pisi* | 11.2 | 3.3 | 4:1 | Peas | Maude and Kyle, 1970 |
| | 6.3 | 0.4 | 16:1 | Peas | Maude and Kyle, 1970 |
| | 34.0 | 6.5 | 5:1 | Peas | Maude and Kyle, 1970 |
| *Alternaria brassicicola* | 62.0 | 11.0 | 6:1 | Cabbage | Maude and Humpherson-Jones, 1980b |
| | 11.5 | 1.2 | 10:1 | Kale | Maude and Humpherson-Jones, 1980b |
| | 1.5 | 0.0 | 0:0 | Kale | Maude and Humpherson-Jones, 1980b |
| *Alternaria brassicae* | 28.0 | 9.3 | 3:1 | Cabbage | R.B. Maude, pers. comm., 1991 |
| | 10.5 | 1.2 | 9:1 | Oilseed rape | R.B. Maude, pers. comm., 1991 |
| | 14.0 | 1.2 | 12:1 | Oilseed rape | R.B. Maude, pers. comm., 1991 |
| *Pseudomonas syringae* pv. *phaseolicola* | 9.2 | 0.84 | 11.0:1 | Phaseolus bean | Taylor, 1970b |
| | 3.5 | 0.37 | 9.5:1 | Phaseolus bean | Taylor, 1970b |
| | 1.4 | 0.15 | 9.3:1 | Phaseolus bean | Taylor, 1970b |
| | 0.1 | 0.0 | 0:0 | Phaseolus bean | Taylor, 1970b |
| *Pseudomonas syringae* pv. *phaseolicola* | 16.1 | 1.80 | 8.9:1 | Phaseolus bean | Taylor *etal.*, 1979b |
| | 1.1 | 0.13 | 8.5:1 | Phaseolus bean | Taylor et al., 1979b |
| | 2.4 | 0.22 | 10.9:1 | Phaseolus bean | Taylor *et al.*, 1979b |
| | 2.4 | 0.42 | 5.7:1 | Phaseolus bean | Taylor *et al.*, 1979b |
| | 5.4 | 0.57 | 9.5:1 | Phaseolus bean | Taylor *et al.*, 1979b |

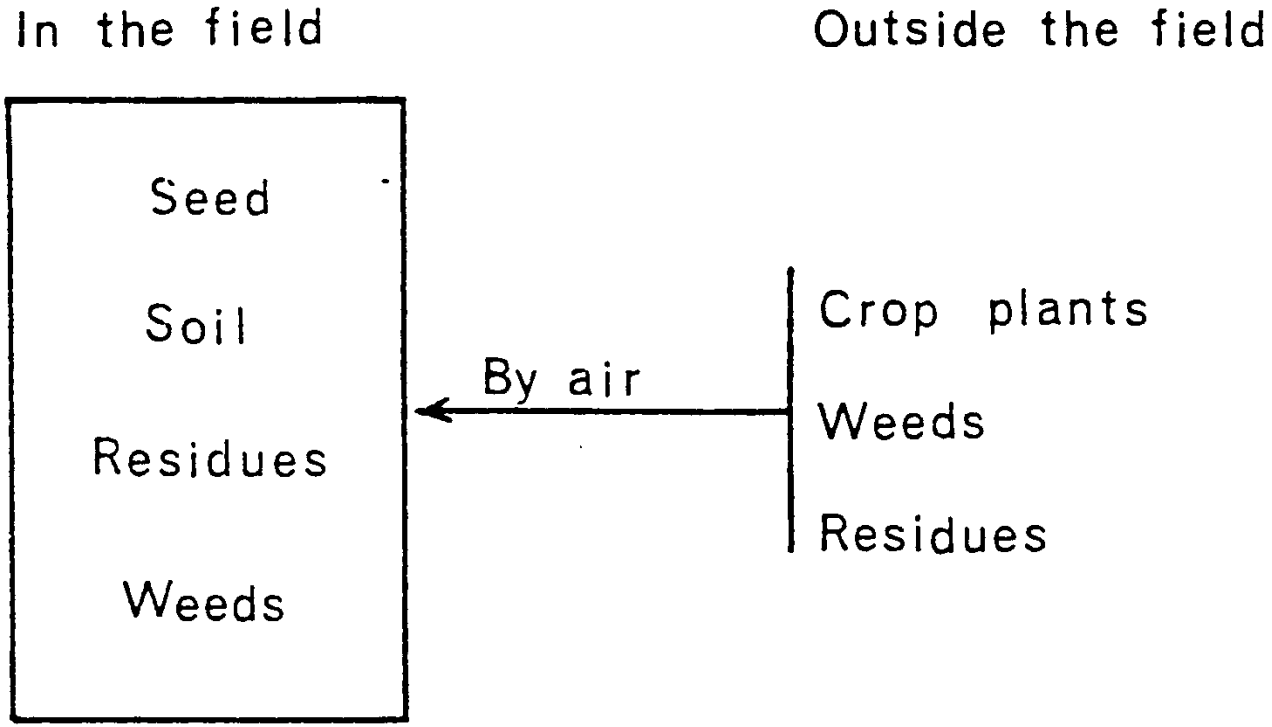
Lab/glhse, laboratory/glasshouse tests

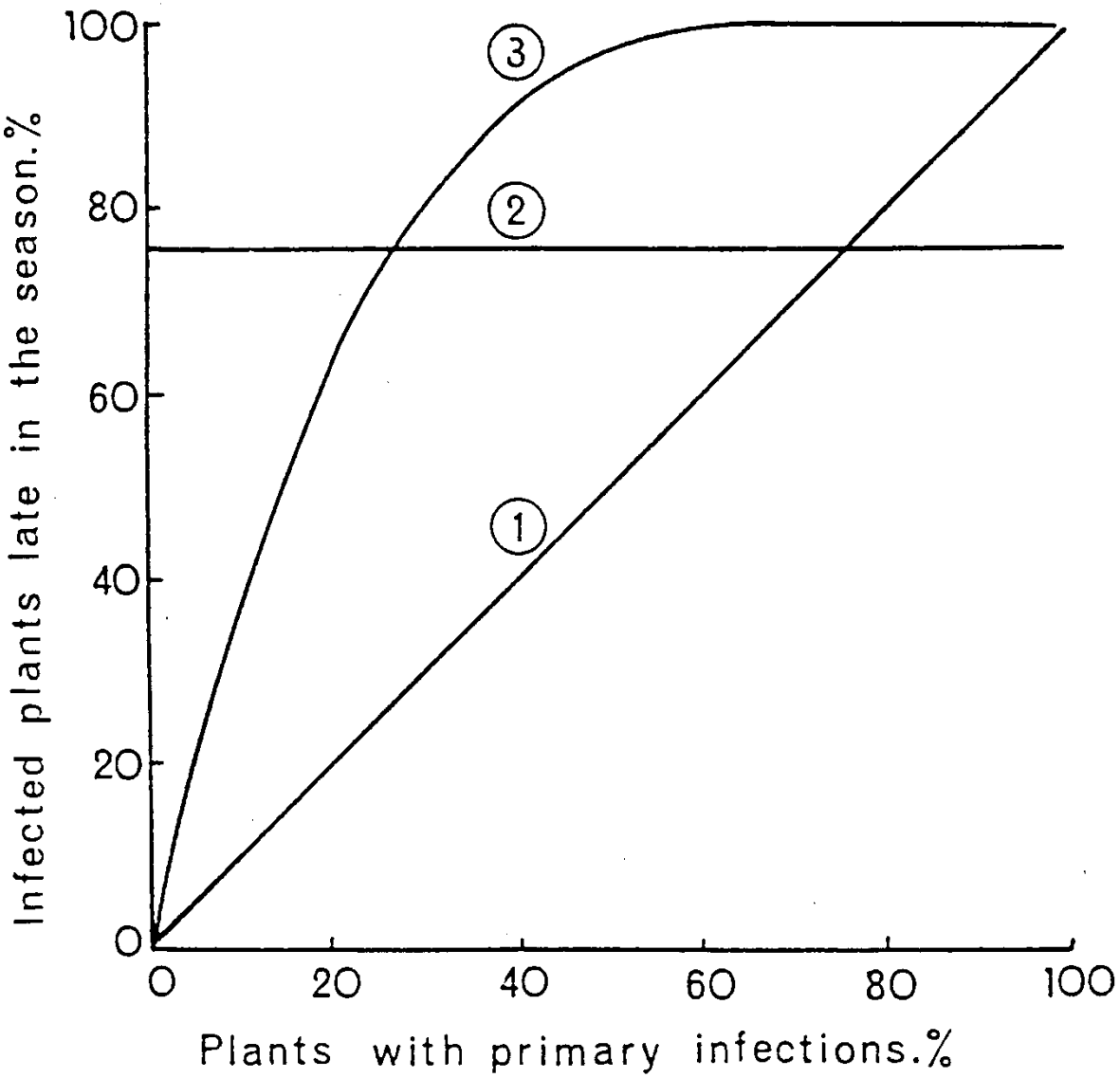

%
14
12
10
8
6
4
2
0
Ustilago nuda
y=1,02x+0,03. r=0,90. n=69
Field.% infected plants
0
2
4
6
8
10
Lab.% infected embryos




Correlation between percentage seeds infected with *Drechslera graminea* and/or *D. teres* according to the freezing blotter method and percentage diseased plants in the field

Sources of inoculum




100
80
60
40
20
0
Infected plants late in the season.%
0
20
40
60
80
100
Plants with primary infections.%
①
②
③

Average infection of species of *Fusarium* and *Drechslera* in about 100 samples of barley seeds in each of 10 years.

| Species | Average percentage of infected seeds | | | | | | | | | | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | |
| *Fusarium avenaceum* | 1.1 | 0.7 | 0.6 | 0.2 | 0.2 | 2.1 | 2.0 | 1.2 | 1.0 | 2.4 | 1.2 |
| *Fusarium culmorum* | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.3 | 0.4 | 0.1 | 0.1 | 0.1 | 0.1 |
| *Fusarium graminearum* | 0.6 | 0.2 | 0.1 | 0.1 | 0.1 | 0.4 | 0.2 | 0.1 | 0.1 | 0.1 | 0.2 |
| *Fusarium nivale* | 1.3 | 0.3 | 0.1 | 0.5 | 0.1 | 0.5 | 0.9 | 5.1 | 0.2 | 1.4 | 1.0 |
| *Fusarium poae* | 0.4 | 0.5 | 0.5 | 0.6 | 0.9 | 2.9 | 1.6 | 1.2 | 1.8 | 2.1 | 1.3 |
| *Fusarium* spp. | 0.1 | 0.5 | 0.2 | 0.5 | 0.1 | 1.3 | 4.7 | 3.5 | 2.1 | 5.1 | 1.8 |
| All species of *Fusarium* | 3.6 | 2.3 | 1.6 | 2.0 | 1.5 | 7.5 | 9.8 | 11.0 | 5.3 | 11.2 | 5.6 |
| *Drechslera sorokiniana* | 0.8 | 4.0 | 3.5 | 0.8 | 0.7 | 5.8 | 5.2 | 4.4 | 2.0 | 1.4 | 2.7 |
| *Drechslera gramineum/D. teres* | 0.2 | 0.3 | 0.1 | 0.2 | 1.4 | 0.2 | 5.1 | 3.4 | 14.4 | 3.1 | 2.8 |

Correlation and regression between seed infection and root discoloration.

| Pathogen | Year | Number of samples | Average percentage | | Regression coefficient | | Correlation coefficient |
|---|---|---|---|---|---|---|---|
| | | | infected seed ($\bar{x}$) | discoloured rootlets ($\bar{y}$) | b* | a* | r |
| *Fusarium nivale* | 1972 | 92 | 4.74 | 5.30 | 0.71 | 1.96 | 0.78 |
| *Fusarium nivale* | 1973 | 23 | 11.04 | 14.83 | 1.10 | 2.75 | 0.91 |
| *Drechslera sorokiniana* | 1977 | 94 | 20.01 | 9.66 | 0.53 | –0.88 | 0.89 |
| *Drechslera sorokiniana* | 1978 | 109 | 25.22 | 15.29 | 0.50 | 2.77 | 0.85 |
| *Drechslera sorokiniana* | 1979 | 76 | 19.36 | 11.11 | 0.41 | 3.08 | 0.82 |

*Regression: $y = bx + a$

The effect on grain yield of fungicidal treatment of seed with different degrees of infection determined by the Doyer filter paper method (calculated from Lindegaard and Christensen, 1971). Seed treatment: 100 ml organic mercury fungicide containing about 1.2% mercury.

| Percentage infection | Number of experiments | Average increase in grain yield due to seed treatment kg/ha |
|---|---|---|
| 0 | 148 | $-19.1^{+}$ |
| 1– 5 | 271 | $-22.6^{++}$ |
| 6–15 | 176 | $-10.9^{NS}$ |
| 16–40 | 48 | $29.5^{++}$ |
| 41–70 | 18 | $50.6^{NS}$ |

$^{+}$ Significantly different from zero at the 94% level
$^{++}$ Significantly different from zero at the 99% level
$^{NS}$ Not significantly different from zero

Inoculum thresholds and crop losses.

| Crop | Pathogen | No. of affected seeds/ seedlings causing economic loss |
|---|---|---|
| Lettuce | Lettuce mosaic virus | 1/30,000 |
| Bean | *Pseudomonas syringae* pv. *phaseolicola* | 1/10,000 to 1/16,000 |
| Cabbage | *Leptosphaeria maculans* | 1/10,000 |
| Celery | *Septoria apiicola* | 1/7000 |
| Onion | *Botrytis allii* | 1/100 |
| Peas | *Ascochyta pisi* | > 5/100 |
| Field bean | *Didymella fabae* | > 2/100 |

Standards for seedborne pathogens in UK seeds regulations (from Rennie, 1993).

| Regulations | Crop | Pathogen | Seed category | Standard* |
|---|---|---|---|---|
| Fodder | Field beans | *Ascochyta fabae* | Pre-basic | 1 infected seed in 1000 |
| | | | Basic | 2 infected seeds in 1000 |
| | | | C1 | 2 infected seeds in 500 |
| | | | C2 | 1%† |
| | Peas | *Pseudomonas syringae* pv. *pisi* | Multiplication categories | Nil in 1 kg |
| Vegetables | Brassicas | *Phoma lingam* | Basic | Nil in 1000 seeds‡ |
| | Red beet | *Phoma betae* | Basic | Nil in 200 seeds‡ |
| | Celery | *Septoria apiicola* | Basic and certified | Nil in 400 seeds‡ |
| | Celery | *Phoma apiicola* | Basic and certified | Nil in 400 seeds‡ |
| | Peas | *Ascochyta* spp. | Basic | Nil in 200 seeds§ |
| | | | Certified | 20 seeds max. in 200§ |
| | Lettuce | Lettuce mosaic virus | Basic and certified | Nil in 5000 seeds |
| | Phaseolus bean | *Colletotrichum lindemuthianum* | Basic | Nil in 600 seeds |
| | Phaseolus bean | *Pseudomonas syringae* pv. *phaseolicola* | Basic | Nil in 5000 seeds |
| | Vicia bean | *Ascochyta fabae* | Basic | Nil in 600 seeds |

# Plant Quarantine

Phytosanitary Certificate for hybrid seeds produced by contracted must be free from following organisms:

| Host | Pathogen | |
|---|---|---|
| Tomato | *Clavibacter michiganensis* sub sp.*michiganensis* | *Phoma destructiva* |
| | *Xanthomonas campestris* pv. *vesicatoria* | *Colletotrichum phomoides* |
| | *Pseudomonas syringae* pv. t*omato* (*P. punctulans* ) | Tomato Black Ring Virus |
| | *Psedomonas corrugata* | Tomato Bushy Stunt Virus |
| | *Pseudomonas solanocearum* | Tomato Ring Spot Virus |
| | *Didymella lycopersici* | Tobacco Mosaic Virus |
| | *Fusarium oxysporum* | Potato Spindle Tuber Viriod |
| | or *F. oxysporum* f. sp. l*ycopersici* | (Tomato Bunchy Top Virus) |
| | or *F. oxysporum* f. sp. l*ycopersici* race III | |
| | *Verticilium albo-atrum* | Tomato Big Bud (MLO) |
| | *V. dahliae* | |

Phytosanitary Certificate for hybrid seeds produced by contracted must be free from following organisms

| Host | Pathogen |
|---|---|
| Watermelon | *Pseudomonas syringae* pv. *lachrymans* |
| | *Xanthomonas cucurbitae* |
| | *Fusarium oxysporum* f. sp. *niveum* |
| | *Mycosphaerella melonis* |
| | *Physalospora rhodina* |
| | *Colletotrichum lagenarium* |
| | Musk Melon Necrotic Spot Virus |
| | Squash Mosaic Virus |
| | Prunus Necrotic Ring Spot Virus |

# Chemical seed treatment

# Purposes of Seed Treatment

- Eradicate seedborne pathogens


Loose smut fungus in seed embryo

# Purposes of Chemical Seed Treatment

- Protect seeds and seedlings

Soybean seed decay and seedling blight

# Alternatives and Supplements

- Broadcast sprays
- Certified seed
- Crop rotation
- Planting date
- Variety resistance
- Volunteer control

# Advantages

- Seedborne pathogens are vulnerable
- Precision targeting
- Optimum timing
- Low dose
- Relatively easy to apply

# Disadvantages

- Accidental poisoning
- Cropping restrictions
- Limited dose capacity
- Limited duration of protection
- Limited shelf life of treated seed
- Worker exposure
- Possible phytotoxicity

# When to use a seed treatment

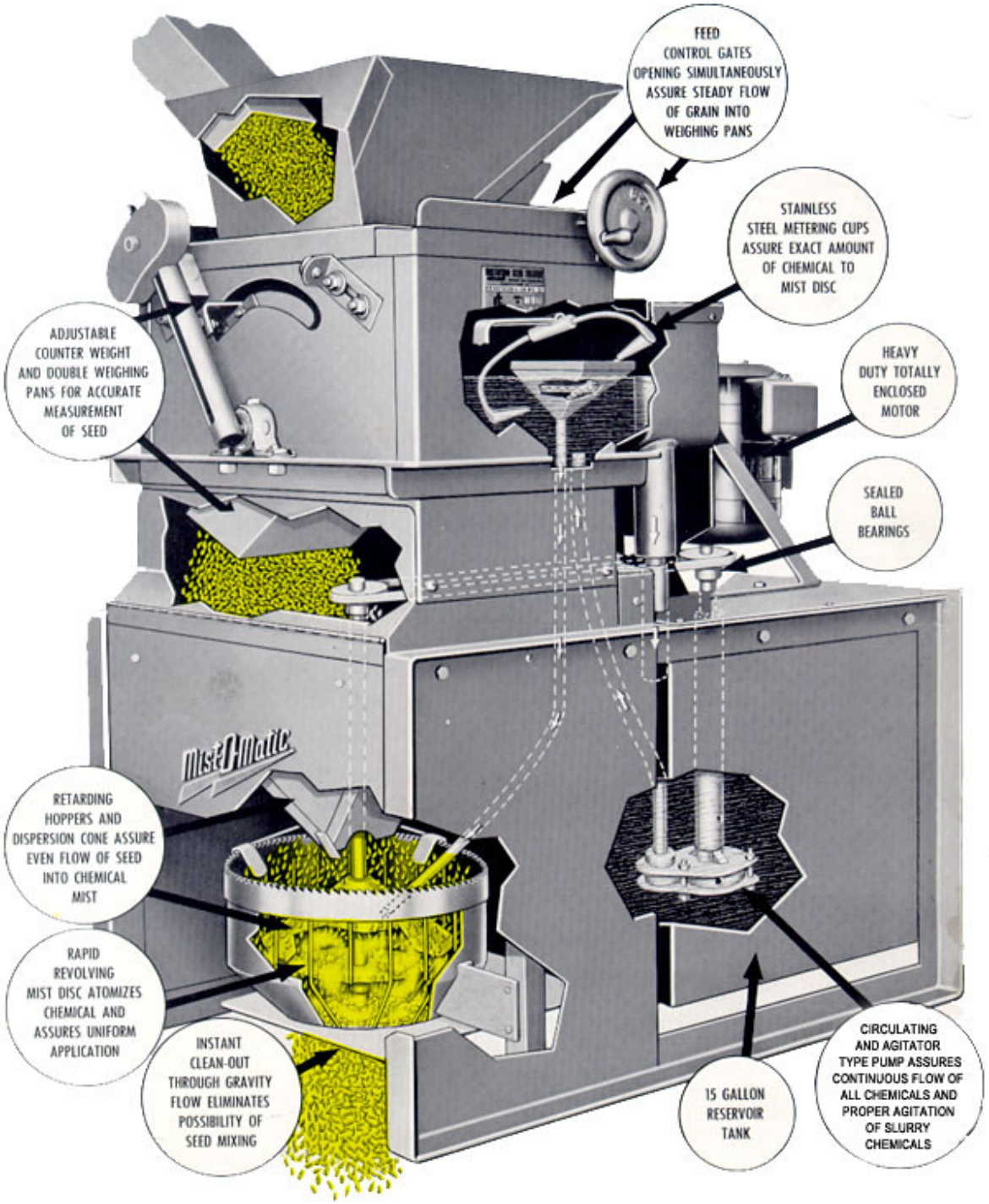
- When planting for seed production
- When using low test weight or older seed
- When planting in unfavorable conditions
- In fields with a history of stand problems
- When replanting is not feasible
- When seed-borne pathogens may be present
- When yield potential is high or seed is expensive

Classification of non-systemic and systemic organic fungicides used as seed treatments in the UK (from Hassal, 1990; Soper, 1991; Tomlin, 1994; Whitehead, 1995).

| Type | Family/action | Group | Used in seed treatment |
|---|---|---|---|
| Non-systemic | Organosulphurs | Dithiocarbamates | Thiram |
| | | Phthalimides | Captan |
| | Chlorinated aromatics | Chlorinated nitro compounds | (Quintozene) |
| | | Chlorinated quinones | (Dichlone, chloranil) |
| | | Benzotriazines | Triazoxide |
| Non-systemic or weakly systemic | | Cyanopyrroles | Fenpiclonil |
| | | Guanadines | Guazatine |
| | | Azoles | Imazalil, prochloraz, bitertanol |
| | | Dicarboximides | Iprodione, vinclozolin |
| Systemic | | Benzimidazoles | Benomyl, thiabendazole carbendazim, fuberidazole |
| | | Phenylamides | Carboxin |
| | Steroid inhibitors | | |
| | Reduction | Morpholines | Fenpropimorph |
| | Demethylation | Azoles | Triadimenol, flutriafol tebuconazole |
| | | Isoxazoles | Hymexazol |
| | | Pyrimidines | Ethirimol |
| | | Acylalanines | Metalaxyl |
| | | Oxazole ketones | Oxadixyl |
| | Miscellaneous groups | Ethyl phosphonates | Fosetyl aluminium |

Advantages and disadvantages of the major types of seed treatment formulation (from Godwin *et al.*, 1988).

| Formulation | Advantage | Disadvantage |
|---|---|---|
| DS (powder for dry seed treatment) | 'On farm' application possible | Reduced adhesion<br>Reduced efficacy |
| WS (water dispersable powder for slurry treatment) | 'On farm' application possible | Efficacy not maximized |
| FS (flowable concentrate) | Accurate loading<br>Good adhesion<br>Excellent efficacy<br>Application machinery can be washed out<br>No organic solvents used | Specialist machinery needed for application |
| LS (solution) | Accurate loading<br>Excellent adhesion<br>Efficacy maximized | Organic solvents present can be phytotoxic<br>Specialist machinery needed for application |
| FC (formulated products applied in polymer film coats) | Accurate loading<br>Excellent adhesion<br>Efficacy maximized<br>No phytotoxicity<br>No hazards to health or environment | Specialist machinery needed for application |


FEED CONTROL GATES OPENING SIMULTANEOUSLY ASSURE STEADY FLOW OF GRAIN INTO WEIGHING PANS
STAINLESS STEEL METERING CUPS ASSURE EXACT AMOUNT OF CHEMICAL TO MIST DISC
HEAVY DUTY TOTALLY ENCLOSED MOTOR
SEALED BALL BEARINGS
ADJUSTABLE COUNTER WEIGHT AND DOUBLE WEIGHING PANS FOR ACCURATE MEASUREMENT OF SEED
Mist-O-Matic
RETARDING HOPPERS AND DISPERSION CONE ASSURE EVEN FLOW OF SEED INTO CHEMICAL MIST
RAPID REVOLVING MIST DISC ATOMIZES CHEMICAL AND ASSURES UNIFORM APPLICATION
INSTANT CLEAN-OUT THROUGH GRAVITY FLOW ELIMINATES POSSIBILITY OF SEED MIXING
15 GALLON RESERVOIR TANK
CIRCULATING AND AGITATOR TYPE PUMP ASSURES CONTINUOUS FLOW OF ALL CHEMICALS AND PROPER AGITATION OF SLURRY CHEMICALS


untreated


propiconazole