

DISEASE INTERACTION BETWEEN CRUCIFEROUS CROPS IN EUROPE, AND THE NEED FOR RESISTANCE BREEDING IN WINTERRAPE

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1. INTRODUCTION

The name oilseed rape covers four types of crops in two species in the genus Brassica: B.napus and B.campestris, respectively winter- and summer-rape, and winter- and summer turnip rape. The crops are part of the exceptionally large range of cultivated plants in the family Cruciferae: horticultural and agricultural. The other agricultural crops grown in Europe are Stubble turnips, "Perko", Fodderrape, Rutabagas (swedes) Marrow stem and Thousand headed kale and Fodderradish for fodder, and the greenmanure crops: Summerrape, Oilradish and White mustard (Sinapis alba) which is also known as an oilseed crop. Except for Rutabagas and the kales these crops are "stubble crops" i.e. are sown in the period between the middle of July and the middle of August and harvested or grazed from late autumn (after which in cases a late small grain crop is still sown) into winter. For this reason these crops are little known and indeed obscure to most crop oriented researchers who are largely ignorant about farming. The aforementioned crops do occupy substantial niches in various widely used farming systems in Europe.

Special about winterrape is, that the crop "overwinters". Sown in late August the crop goes through the winter as a green field, to bolt in spring, flower, seed, and to be harvested in July, depending on locality. As will be explained in the following, winterrape acts as a "time bridge" to foliar pathogens, it is the only crop with this cropping system.

2. DOMESTICATION OF CROPS AND HOST-PARASITE SYSTEMS

Europe is one of the world's main centres of domestication of Cruciferous crops, which are therefor firmly rooted and well known in farming communities, the crops are an integral part of Europe's cultural heritage.

Equally firmly established must be the attendant pathogens, and presumably host resistance and pathogen virulence (in the wide sense) systems will have evolved to certain levels, different in each case. There will be immunity as well as all types of resistance and escape mechanisms in operation, largely unknown and indeed unsuspected to grower and researcher. In any case all known pathogens of Cruciferous crops are presumably potentially virulent on all crops.

Changes in the host parasite relation through genetic recombination of the host as a consequence of breeding work, and changes in crops and areas cultivated will affect the disease status of all related crops in a

region or country.

The development of Cruciferous crops in Great Britain (UK) in the 1970's is a very interesting and illustrative case in fact that deserves further study.

3. CRUCIFEROUS (AGRICULTURAL) CROPS IN GREAT BRITAIN

Cruciferous (agricultural) crops in Great Britain are being grown on a much larger scale these days as compared to five or six years ago. Since 1972 the area sown to Stubble turnips (the crop is sown densely to prevent bulbing so that it is still firmly rooted in November - December when grazed by sheep) increased from 20.000 to 100.000 ha, in fact this crop was unknown in the UK prior to 1970. The area of winterrape went from 6.000 ha in 1972 to 70.000 ha, this crop was more or less reintroduced in the country.

4. THE IMPORTANT DISEASES OF CRUCIFEROUS CROPS IN THE UK

The important diseases of Cruciferous crops in the UK are at present:

4.1. Light leaf spot, Pyrenopeziza brassicae (perfect stage), Gloeosporium concentricum (imperfect) which is seen first as a crumbling and curling of the leaves which often have a frosted appearance around the periphery. Sporulation appears as concentric rings of white acervuli up to 5 cm in diameter. Individual acervuli are about pin head size. Foliar distortion increases with chlorosis and eventually leaves have a burnt appearance, this stage looks rather like herbicide damage. The disease spreads to the stems causing girdling brown cankers. In spring the expanding pedicels are attacked and total abortion of the flowers may take place, additionally the disease spreads to the pods. The UK Advisory Service have found active sporulation on pods and there is reasonable evidence for seed transmission.

All variety fields in England are scored for the disease. Assessments of susceptibility are made on the basis of the percentage leaf affected. It has been possible to keep very susceptible cultivars off the UK market. Current ratings are shown in Table 1. Originally the disease was of local significance on horticultural Brassicas in SW England. The disease was picked up on the (new) oilrape crop, grew with it and moved from Dorset (S England) to Yorkshire (N England) in one season. From winterrape the disease has begun to affect: Turnips, Rutabagas (swedes) Kales, Forage rape and it has become a threat to all other cruciferous crops, rape has acted as a bridge crop for this disease.

4.2. Downy mildew, Peronospora parasitica, ubiquitous parasite of all Brassica crops including winterrape, especially in the recent succession of mild winters in the UK.

Symptoms are white areas of diffuse sporulation bounded by the veins on the upper surface of the leaf.

The disease is likely to do its worst damage in the winter period when the plants are at the rosette stage. The fungus destroys leaf tissue when the plant is in the delicate physiological stage of just producing enough photosynthates to keep going. Downy mildew would set plants back and delay regrowth in early spring, it is often confused with herbicide damage. Current ratings of susceptibility in variety trials are shown in Table 1 on the basis of observations of field trials.

Again rape acts as a bridge crop and provides a host in winter when few other Brassicas are about.

TABLE 1

DISEASE FIELD RATING OF WINTERRAPE CULTIVARS IN THE UK FOR SUSCEPTIBILITY TO RESP. LIGHT LEAF SPOT AND DOWNY MILDEW

0-9 SCALE: 0 = SUSCEPTIBLE, 9 = RESISTANT

Brinke	6	3	Lesira	7	6	Rapora	6	6	Quinta	8	5
Erra	8	5	Primor	7	6	Magnus	7	6	Rapol	6	3

4.3. Canker - Leptosphaeria maculans (perfect stage), Phoma lingam (imperfect) important disease world wide of Brassica crops. In the autumn ascospores spread from old winterrape stubble on the newly emergent crop causing distinct foliar lesions. These are circular, 2-3 cm in diameter with a papery necrotic centre covered in black pycnidia. Rain splash moves the pathogen as pycno spores about in the crop. It attacks the stems especially near soil level leading to girdling and subsequent lodging. The disease is left behind and survives in thrash and stubble eventually to infect the next host crop. It is also seed transmitted.

The foliar stage was really unknown until winterrape come along as a wide scale host. The disease was previously unimportant because of strict seed sanitation which was not applied rigorously enough in the case of winterrape. Tests of seed batches by the official seed testing station showed all to be infected, with in some cases up to 6 % seeds diseased.

Now the pathogen can live the year round on one crop, can move to other crops in the vicinity and in any case survives in thrash in the stubble to invade the next rape crop to be sown. No disease rating is done yet.

4.4. Clubroot - Plasmodiophora brassicae, obligate parasite of Cruciferae causes greatly distorted roots (galls) to develop.

Fungus resting spores in the soil are initiated by the developing root-system of the host crop, and produce primary zoospores that penetrate root-hairs, grow into a zoosporangium that in turn issues a generation of secondary zoospores, capable of invading the root's cortex. As myxamoeba the pathogen works its way through the cortex and transforms into the plasmodial stage in the parenchyma tissue cells. Here the growth regulator mechanism of the plant is changed, resulting in wild cell division. In time, this process forms the clubroot galls and when these disintegrate resting spores are formed.

Early growth of plants is slowed down, if not entirely frustrated. The water transport system breaks down, wilting occurs during sunny weather and crop growth is reduced.

For agricultural crops there will never be a chemical cure, resistance is the only means of crop protection. Sources of resistance and mass screening methods are available and used in clubroot breeding of other crops. Dutch Stubble turnip varieties are the result of clubroot breeding programs and have high levels of resistance. All rape crops and cultivars are very susceptible and are boosting up levels of inoculum. In the UK, areas are now being cropped for 2nd and 3rd times in the rotation.

P.brassicae will begin to become a problem especially in areas like Bedfordshire which has a history of intensive horticultural Brassica production with clubroot as a well known phenomenon. S. Scotland used to have a crop rotation of Rutabagas once in six-eight years and a (stubble) crop of Fodderrape to which the Stubble turnips were recently added, resulting in a rotation with a Brassica crop once in 3-4 years. Winterrape has now been introduced large scale into this farming system. Clubroot is a very well known and wide spread phenomenon in this area of old. It could be that a disaster is just around the corner.

5. CONCLUSION

Plant breeding activities interact strongly with the diseases problem of crops. Authors believe that the breeders of winterrape in Europe are insufficiently aware of the position of this crop to its relatives in farming practices. Too much attention is focussed on reaching the single objective of transferring "double zero" from summerrape into winterrape. Summerrape was domesticated in a different ecological niche and is therefor (by defenition) adapted to a different pathogen complex. On this general consideration, the introduction of germplasm from summerrape into winterrape is a hazarderus undertaking. Crossing the two must have changed the latter's host status considerably and consequently upset its host-parasite systems. Strong disease resistance components should be features of such breeding programmes.