# Disease risk associated with subsidiary crops in different cropping systems and tillage strategies

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## Introduction and objectives

The existing reduced soil tillage systems are mainly based on simplified rotations and large increases in agrochemical inputs like herbicides and fertilizers that decrease soil quality and biodiversity. The use of subsidiary crops grown as cover crops preceding or following the main crops or as living mulches together with the main crops can provide ecological and agronomical benefits. These benefits can include protecting soils from erosion, improving soil fertility (especially nitrogen availability), increasing microbial diversity and suppressing weeds. However, the benefits of the subsidiary crop can only become effective if they are healthy. Some species of subsidiary crops may serve as alternative hosts for important pathogens on the main crop. The objectives of this study is to assess diseases affecting legumes used as subsidiary crops in different cropping systems established in experiments under two climatic conditions in Morocco.

## Material and Methods

Experiments were conducted in two different climatic regions in Morocco; in sub-humid (Sidi Allal Tazi) and semi-arid (Sidi El Aidi) regions. Three cropping systems were installed; (1)Conventional: wheat only, (2)LM: intercropped wheat with berseem clover (*Trifolium alexandrinum)* as a living mulch and (3) CC: pure wheat followed by a cover crop of sub clover (*T. subterraneum*). Experimental design was split-split Plot with four replications where the main factor (9 x 14 m plot size) had three levels representing the cropping systems and the split-split factor (4.5 x 7 m plot size) included two levels of nitrogen fertilizer (50 kg/ha; 100 kg/ha). In each site, experiments were conducted two times. Soft wheat was used as a main crop during the first-year cycle and Maize was planted as a test crop during the second year in Till or No- Till system (Fig 1).

On clover species, foliar, foot and root diseases were assessed, just before planting the test crop. Twenty-five plants were collected from each plot. The severity of tissue damage was assessed according to the modified assessment key of Flett (1994) with the scale from 0 to 5 (score 0 = no visible symptoms; score 5 = dead plant). Pathogen identification associated to these species was done according to the method of Leslie and Summerell (2006). The incidence of each pathogen species was calculated for the total samples evaluated for each crop (150 plants).

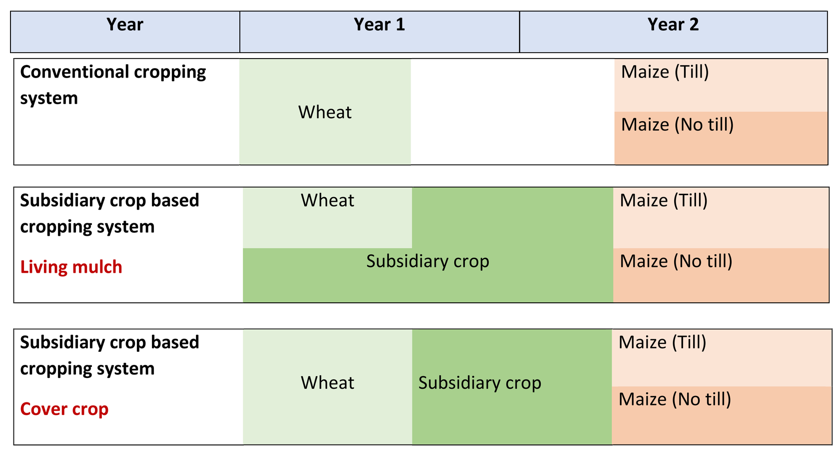


*Fig 1: Structure of three cropping systems testes in these experiments*

**Cover crop: Berseem clover (*Trifolium alexandrinum*)**

**Living mulch: Sub clover (*T. subterraneum*)**

## Results and discussion

Foot and root diseases were the most important disease identified on legume clovers. They were more expressed in sub-humid conditions on both clover species more than in semi-arid conditions (Fig. 1). Lesions observed on foots and roots appeared generally black with low severity from 2 to 3. There were no statistically significant effects of N rate factor (at *P<0.001*) on foot disease severity in both sites. Overall, disease severity on clover species was low in all systems tested and did not increase diseases of main crops (cereal and maize).

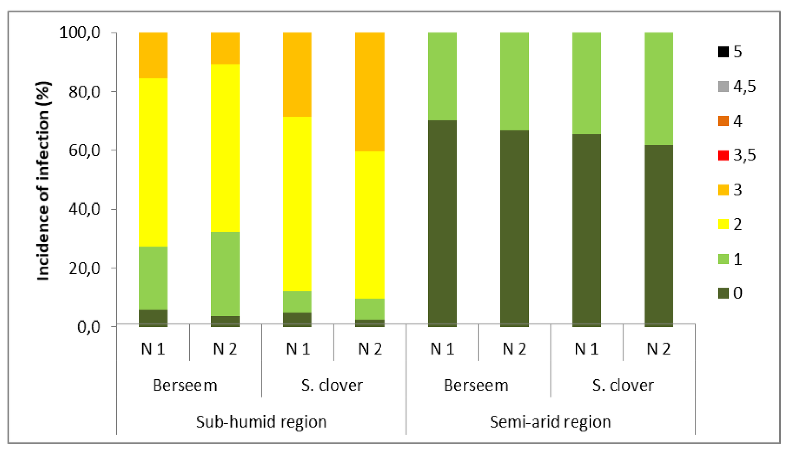


*Fig. 2: : Incidence of root and foot lesion scores on subclover and berseem clover at different sites*

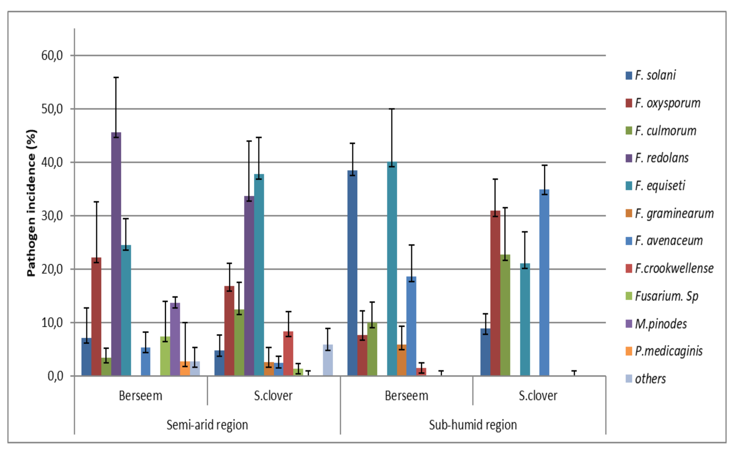


*Fig 3: Incidence of pathogen species associated to subclover and berseem clover at different sites.*

*Vertical bars indicate standard errors of the means*

Dominating pathogens isolated were *Fusarium* species and only 5% of the isolated species belonged to the Ascochyta complex (*Mycosphaerella pinodes* and *Phoma medicaginis*) (Fig. 3). Several species of *Fusarium* could be identified from each crop. In the semi-arid experiment site, *F. redolens* and *F. culmorum* dominated in both species and in the sub-humid experimental site, *F. equiseti, F. culmorum* and *F. avenaceum* dominated. The presence of some of these *Fusarium* species (e.g. *F. culmorum, F. avenaceum. F. graminearum*) in legume clovers in different cropping systems has to be carefully considered. These pathogens can be also pathogenic on cereals and maize where they can produce several carcinogenic mycotoxins (Hollaway and al., 2013, Zhoo et al., 2018). Therefore the pathogenicity of isolates found in these subsidiary crops against the main crops has to be confirmed.

## Conclusions

In conclusion, foot and root rot on the of sub clover and berseem clover as cover crops or living mulch was low and depended more on the weather and site conditions and did not increase foot diseases of main crop. Therefore, the use of these legumes as subsidiary crops can be encouraged. However, to take full advantage of these legume species in any cropping system, their potential as hosts as well as their epidemiological role need to be fully understood.

**Acknowledgment**

This work was supported by EU Project OSCAR (Optimizing Subsidiary Crop Application in Rotation)