Is durum wheat-winter pea intercropping efficient to reduce pests and diseases?

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Is Durum Wheat-Winter Pea Intercropping Efficient To Reduce Pests And Diseases?

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Intercropping (IC) is known as an agricultural practice which can improve the use of environmental resources (light, nutrients and water) resulting in yield advantages compared to sole cropping (SC) (Willey, 1979) particularly in low input systems. But, diseases ands pests can strongly affect both yield and grain quality in such systems. Now, numerous studies have shown significant reductions in harmful insects and on diseases in IC compared to SC of the same species (Vandermeer, 1989; Kinane and Lyngkjaer, 2002) even if others studies did not confirmed these foundings. The aim of our study was to evaluate the assumption that IC can reduce pea pests (green aphids and weevils), pea ascochyta and main durum wheat diseases (mildew, brown rust, fusarium and septoria).

Methodology

An experiment was carried out in Auzeville (SW France) in 2006-2007. Three main treatments were compared: *i)* durum wheat (cv. Neodur) sown at 280 plants.m^{-2} (W-SC), *ii)* winter pea (cv. Lucy) sown at 60 plants.m^{-2} (P-SC), *iii)* durum wheat-winter pea IC, each specie sown at half of normal density (IC). Two fungi managements have been evaluated: i) no fungicide treatment (NT) and ii) two applications (T) of metconazole fungicide (90 g.ha^{-1}). Two fertiliser-N sub-treatments were applied on W-SC and IC as following: *i)* no fertilizer (N0), *ii)* moderate fertilization (N1) splitted in 2 applications of 80 kg N.ha^{-1} at wheat tillering and 60 kg N.ha^{-1} at stage 'flag leaf visible'. P-SC was only evaluated without fertilization. The two species were sown in row-intercropping on Nov. 9, 2006. The experiment was a two replicates split-split-plot. Each sub-plot (21 m²) consisted of 11 rows of length 12 m spaced 14.5 cm. Pea aphids have been counted every week on 10 plants. During pea flowering, the number of nodules of 5 plants has been evaluated considering five classes (1 to 5) from no nodules to more than 20 nodules per plant. Pea ascochyta has been quantified separately for stem, leaves and pods, considering a note of attack (0 to 100), respectively from 'no symptom' to more than 80% of the surface covered by the disease. For each wheat diseases (mildew, brown rust, fusarium and septoria), 10 plants have been observed and the percentage of attack has been calculated considering the percentage of plants attacked multiplied by the percentage of the surface covered by each of the four diseases. The note was divided by 4 in order to represent a pondered mean effect. Analyses of variance were performed and means were compared using the LSD test at the 0.05 probability level.

Results

As hypothesised, the number of green aphids per pea plant was significantly higher in SC than in IC (Figure 1). Moreover, no difference was observed between N0 and N1. The number of green aphids increased from the beginning of March to the middle of May and then decreased until the beginning of June. Focusing on weevils (Figure 2), the percentage of nodules drilled was higher than 85% and we did not observed any difference between IC and SC neither between N0 and N1. Moreover, the number of nodules seems not to be different between IC and SC and thus even if the amount of nitrogen coming from N_2 fixation was higher in SC compared to IC (97 kg N.ha^{-1} and 61 kg N.ha^{-1} respectively corresponding to 56% and 89% of all the N acquired by pea).

Figure 1: Number of aphids per plant of pea at different sampling dates for sole crop (SC) and Intercrop (IC). Values are the means (n=2).

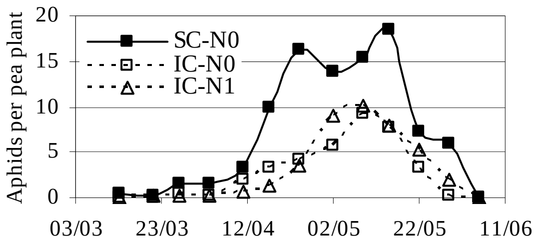
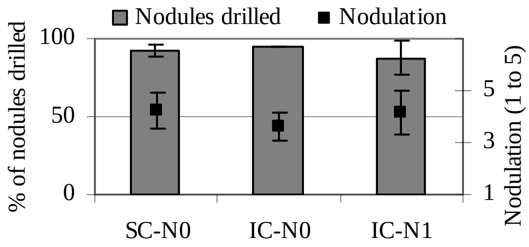


Figure 2: Note of nodulation on pea roots (scale 1 to 5) and percentage of nodules drilled. Values are the means (n=2 ± S.E).



For all treatments, pea ascochyta notes (Figure 3) were higher on stems and leaves compared to pods. The fungicide protection (T) allowed a significant reduction of ascochyta in IC but not in SC. Nevertheless, the levels of attack were similar in IC and SC for NT but ascochyta was slightly reduced in IC with fungicide application. Considering wheat diseases, no difference was observed between IC and SC and higher values were found for N1 compared to N0. Moreover, the increase of Fusarium and Brown rust with fertilization was greater than for Septoria. The fungicide application has been very efficient for both IC and SC reducing total diseases by 88% and 47% for N0 and N1 respectively.

Figure 3: Pea Ascochyta notes in IC and SC for stems, leaves and pods and for the different treatments. Values are the means (n=2 ± S.E).

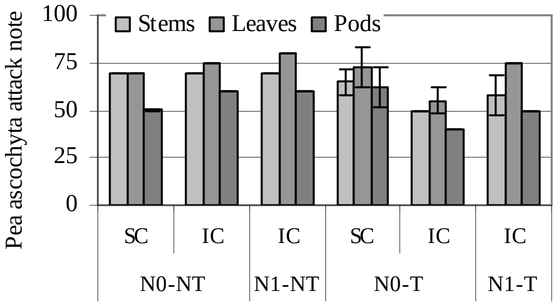
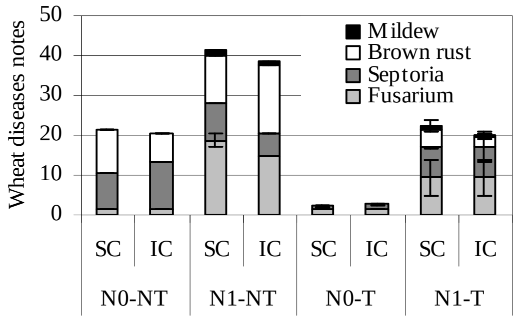


Figure 4: Wheat diseases notes in IC and SC for Fusarium, Septoria, Brown rust and Mildew. Values are the means (n=2 ± S.E).



Conclusions

Our results showed that IC seems not very efficient to reduce wheat and pea diseases, excepted for pea ascochyta which has been significantly reduced in IC with fungicide application. However, we observed than some diseases were reduced in IC while others were increased indicating that fungi diseases were specifically dependant on interactions between plant architecture, disease dispersion and farming practices. Concerning pests, the effect of IC on the reduction of pea aphids but not weevils can be attributed to the greatest mobility of weevils. Moreover, it can be suggested that the effect of IC depends on plant environmental conditions (resources dilution, physical barrier, microclimate, chemical…). As a consequence, because IC involves functional complementary groups of plants, such systems could be optimized in order to reduce the use of pesticides but this needs further studies in order to better understand interactions between plants, diseases, pests and farming practices in IC.

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