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In conventional cropping systems (CS) of Southwest France based on short-term rotation of durum wheat - sunflower, a long bare soil period occurs. These CS strongly depend on chemical fertilizers and pesticides, leading to environmental contamination. The transitioning to agroecological CS needs novel agronomic integrative strategies such as crop diversification, incorporation of legumes, intercropping, and cover cropping of fallow periods.

Over six cropping seasons (2011-2016), three CS aiming at reducing fertilisers and pesticides were evaluated on experimental plots at the INRAE Toulouse station. The 6 CS tested were: (i) a Low Input system (LI) (with sunflower, wheat, and sorghum), (ii) a Very Low Input system (VLI) including a legume (faba bean) in the rotation and wheat cultivar mixture, and (iii) a system with legumes InterCropped (IC) (durum wheat-pea, soft wheat-faba bean, sunflower-soybean) in the 3-year rotation. Each plot was replicated three times, starting at each of the 3 crops in the rotation, with half of each plot managed either with bare soil (BS) or with a cover crop (CC), leading to 6 CS. Technical managements were adapted to each CS and were recorded in order to calculate Treatment Frequency Index (TFI) to assess pesticide pressure in the 6 CS tested. Lysimetric plates were installed at 1 m-depth in each plot for collecting drainage water. More than 500 samples were analysed for their concentration in active compounds from 2011 to 2016. All the molecules applied since 2004 were analysed in the drainage water, resulting in the analysis of 33 to 44 molecules applied, depending on the plot.

Differences in TFI were observed among the 6 CS with lower values for the LI system, followed by IC, and then VLI system. Cover crops did not affect TFI across all 6 CS. Cumulated mean drainage displayed a decreasing trend across systems, ranging from 380 mm in the LI system to 176 mm in the IC system, with the VLI system intermediate at 201 mm. Moreover, cover crops did not induced a significant reduction of water drainage. Cumulative mean pesticide loss during the 2011-2016 period ranged from 0.8 g/ha in the LI system with cover crops to 4.2 g/ha in the LI system without cover crops. Introducing cover crops consistently led to a reduction in pesticide losses across the various systems, with reductions of approximately 2-fold for IC, 2.7-fold for VLI, and 5.3-fold for LI.

The results highlight the crucial benefits of managing the fallow period using cover crops to reduce pesticide transfers, in addition to well-known ecosystem services. Additionally, the introduction of intercrops appears to also contribute to the reduction of pesticide transfers, mainly because of a reduced application frequency.