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# Co-designing crop diversification solutions from farm to agri-food chain to manage root-knot nematodes in Mediterranean market gardening systems

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**European Conference on Crop Diversification, September 18-21 September 2019, Budapest, Hungary**

**Topic:** Actor-oriented approaches that could foster crop diversification and accompany actors in their transition towards sustainable agri-food chains

**Title:**

Co-designing crop diversification solutions from farm to agri-food chain to manage root-knot nematodes in Mediterranean market gardening systems

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**Abstract:**

Root-knot nematodes (RKN) are causing major yield losses in Mediterranean sheltered market gardening systems on the dominant crops (e.g. tomatoes, melon, lettuce). Climate change and crop specialization are the main causes of increased RKN damages. After the ban of most synthetic nematicides due to their toxicity, no directly effective solution exists anymore. Crop diversification has been identified as a central alternative solution, by introducing in crop successions non-host, trap or allelopathic crops for commercial and non-commercial purposes. Crop diversification is known to provide other agronomic benefits such as reduction of weed, pest and disease pressures. However, scientific literature (Meynard et al. 2013; Magrini et al. 2016) has shown that lock-ins hinder the implementation of crop diversification. We studied how to accompany the market-gardening agri-food chain to unlock crop diversification in the “Rhône-Durance-Vaucluse” territory, South East France.

Based on Geels’ studies (Geels, 2002, 2004), we define the RKN management socio-technical regime (STR) as the interrelation between the actors that influence cropping practices impacting RKN damage risk (wholesalers, extension services). We identified the key actors of the STR, the different crop diversification techniques for RKN management and the main lock-ins preventing their adoption by market gardeners, in a STR analysis, based on the interview of 33 actors including the analysis of 11 organic and conventional farming systems, grey literature review, and participative observation in key meetings of the STR actors. Lock-ins to crop diversification in sheltered market gardening systems exist at multiple levels. This calls for simultaneous and organized actions of multiple STR actors (Meynard et al., 2018). First we realized a “multi-level innovation tracking” to find and characterize existing actions to unlock crop diversification, with the interview of stakeholders, literature review and key meeting focused on these actions. Then, to foster multi-actors action, we organized a collective innovative design process with key STR actors to find solutions to unlock crop diversification in sheltered market-gardening systems. “KCP methodology” (Le Masson et al., 2009) offered a 3 phases methodological framework to make STR actors take distance with their current situation and find ways to unlock or bypass lock-ins. The Knowledge-phase consisted on providing fundamental knowledge to participants to tackle the problem and quirky knowledge to lead them to think “out-of-the-box” (e.g. nomad melon farmers). The Concept-phase was an oriented exploration of new solutions based on starter concepts proposed by the facilitators (Berthet et al., 2019). The

Project-phase will occur later in our research. Knowledge-phase and Concept-phase were prepared based on the knowledge gathered with the STR analysis and the multi-level innovation tracking.

In “Rhône-Durance-Vaucluse” territory, among the main lock-ins found for crop diversification were, from plot to agri-food chain level: unsuitable soils (e.g. too much stone for root crops), investment in shelter infrastructure conditioning the crop species needed to write the investment off, poor cooperation between farmers (e.g. for sharing machinery) and lack of local outlet for minor crops. The organic market-gardening sector appeared to have more leeway than the conventional one. For instance, a much wider range of crops could find outlets with organic wholesaler compared to conventional ones. Key stakeholders of the STR, besides the market gardeners themselves, were the vegetable brokers such as wholesalers and retailers, consumers, input-suppliers (seedlings, seeds), breeders, extension services (advisers, applied research stations), farmer cooperatives and agri-food chain coordinators. Solutions found by actors ranged from moving the shelter to another spot (plot-level) to negotiating species exchange for a season with a market-gardener selling to the same broker (agri-food chain level).

To conclude, we engaged market-gardeners and other key STR actors from “Rhône-Durance-Vaucluse” territory in a common effort to explore both farm and agri-food chain innovations to unlock crop diversification. Crop diversification is only one lever for RKN management in vegetable-gardening system, though a major one. In order to favor the transition toward a low-RKN risk agri-food chain of RKN, crop diversification needs to be combined within global sustainable RKN management strategies based on other technical levers (e.g. soil life stimulation) and solutions to overcome lock-ins. Designing and evaluating *ex-ante* those strategies are part of the KCP Project-phase we will conduct with STR stakeholders.