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Biofumigation Experiences in Argentina: Short Report

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Horticultural crops in Argentina are produced along a wide territory under very different climatic conditions. Biofumigation has been assayed mostly under protected cultivation where intensive use of soil originates high populations of nematodes and soil-borne pathogens. Positive experiences have been held in Jujuy, Salta, Corrientes, Entre Ríos, Tucumán, Mendoza, Córdoba, Río Negro, Neuquén, La Pampa, etc. These practices have been successfully implemented, allowing the disinfection of soils in a sustainable manner. Biofumigation has proved to be much more effective when combined with solarization. Solarization has been adopted especially by farmers in regions in the northeast and northwest of the country where hot conditions in summer (mainly during January) make it impossible to cultivate into the greenhouse. These farmers add manure to the soil prior to solarization, so they perform bio-solarization (solarization + biofumigation) treatment in most cases. In Corrientes, a subtropical province specialized in off-season production in more than 1700 has of greenhouses, incorporation of chicken and cattle manure into the greenhouse soil prior to solarization was effective against *Ralstonia solanacearum*, *Pythium aphanidermatum*, *Rhizoctonia solani*, and *Sclerotium rolfsii*. Other biofumigants essayed were pine tree fallen leaves, grass, cabbage and sorghum [1-5] (Figure **1**).

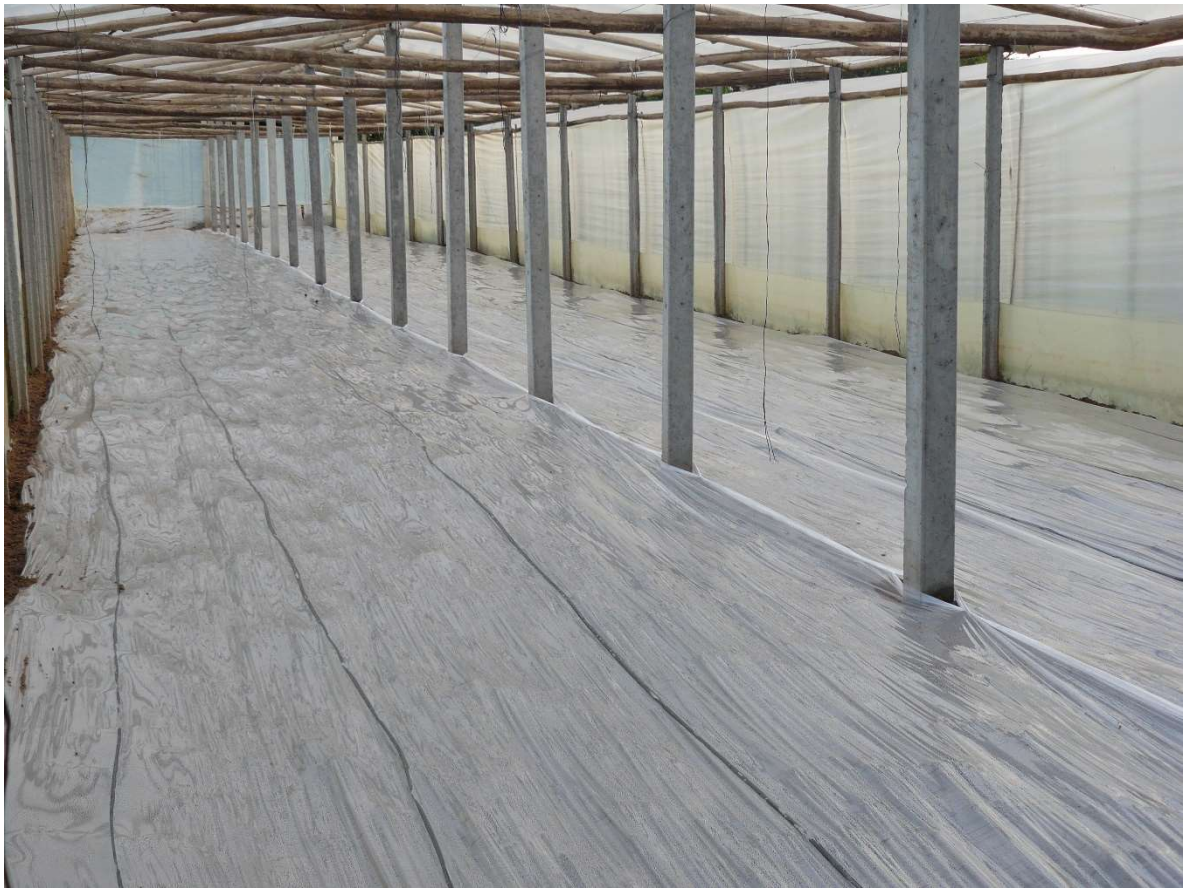

Figure 1: Bio-solarization in a greenhouse of Corrientes province.

In the center of Argentina, horticultural and ornamental crops are grown under mild winter climate in more than 6000 has of greenhouses located mainly near Buenos Aires, the capital city, and its surrounding areas. In La Plata (the south part of Buenos Aires green belt), bio-solarization in spring has been evaluated with good results for control of tomato soil-borne pathogens [6]. Reduced population of *Nacobbus aberrans* was obtained after treatments performed in summer [7], in both cases with broccoli application to the soil (Figure **2-3**). Biofumigation during the warmer season is easier to adopt by farmers specialized in vegetables like lettuce, because they can bio-solarizate soil during the summer and then cultivate during autumn and winter.

Figure 2: Chipping of broccoli residues in La Plata.

Figure 3: Broccoli residues distributed in a greenhouse of La Plata.

At INTA San Pedro, a site 240 km at north of La Plata in Buenos Aires province, a bio-solarization experience has been performed for 17 years with repeated solarization and bio-solarization treatments. Bio-solarization was assayed with two different strategies: a succession of organic amendments (chicken manure, broccoli, chicken manure, broccoli, tomato, and pepper crop debris, mustard, tomato crop debris) and another one based only on brassicas (rapeseed, broccoli, broccoli, mustard, mustard, mustard, *Brassica campestris*). Treatments have been carried out in spring [8-10] and in short periods during summer, so a late-season tomato crop can be grown after. Fungal pathogens controlled in these experiences were *Pyrenochaeta lycopersici*, *Fusarium solani*, *Sclerotium rolfsii*, and *Sclerotinia sclerotiorum*, as well as nematodes like *Nacobbus aberrans*, *Helycotylenchus*, and *Criconemella* [11-14]. Near San Pedro, at Zárate and Escobar, farmers have controlled nematodes and weeds by applying manure and cabbage residues in bio-solarization treatments performed in summer [15-18] (Figure **4-5**).

Figure 4: Tomato crop in bio-solarizated soil. Nestor Paolinelli farm in Zárate, Buenos Aires province, Argentina.

Figure 5: Spinach crop in bio-solarizated soil. Johny Valverde farm in Escobar, Buenos Aires province, Argentina.

In Córdoba, a province in the center of Argentina, bio-solarization using chicken manure, sorghum, and Brassicas was effective against weeds and damping-off pathogens affecting under protected cultivation nurseries [19]. At the west of the country, in Mendoza, a province with arid and continental weather near Los Andes mountain range, summer is hot, and good control of strawberry diseases caused by *Phytophthora*, *Rhizoctonia*, *Pythium*, *Verticillium*, *Macrophomina,* and nematodes such as *Meloidogyne* and *Ditylenchus* have been achieved using rapeseed as a fumigant in the greenhouse [20]. In Bahía Blanca, a city in the south of Buenos Aires province with cold weather, *Meloidogyne hapla* was controlled using cattle manure and cauliflower in spring and summer in the greenhouse [21]. Nematodes of the same genus were controlled in winter using *Melia azedarach* seeds as fumigant [22]. At the North of Patagonia, at the east of Neuquén province (Centenario), a semiarid region with hot summers but very cold winters, weeds in onion open field nurseries were controlled in summer using chicken manure and cabbage [23]. Similar results were obtained at the northwest of Rio Negro province, in Cipoletti, a city next to Centenario, where weeds were controlled using cabbage in spring for open-field tomato crops [24]. In the same province, *Fusarium oxysporum* in onion was controlled using cabbage in autumn and summer [25, 26]. "*In vitro*" successful trials were conducted using cabbage, garlic, *Sinapis alba*, *Brassica juncea*, *Diplotaxis tenuifolia*, rocket, etc. [27-33].

Biofumigation and bio-solarization have been fundamental to achieve the replacement of methyl bromide and comply with the Montreal Protocol, being one of the best alternatives in certain regions of Argentina.

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