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A soil-specific agro-ecological strategy for sustainable production in Argentina farm fields

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The continuous increment of frequencies and doses of pesticides, glyphosate and fertilizers, the deterioration of the structure, biotic balance and fertility of soils and the ground water pollution are characteristics of the current Argentinian agricultural model. In this context, agro-ecological innovations are needed to develop a real sustainable agriculture, enhancing the food supply. Precision agriculture technologies can strengthen the expansion of agro-ecological farming in experimental farm fields. The aim of this study was to propose a soil-specific agro-ecological strategy for sustainable production at field scale focused on the use of soil sensors and digital soil mapping techniques. This strategy has been developed in 15 hectares transition agro-ecological farm field, located at Barrow Experimental Station (Lat:-38.322844, Lon:-60.25572) Argentina. The strategy included five steps: (i) to measure apparent electrical conductivity (ECa) and elevation within agro-ecological farm field; (ii) to apply a clustering method using MULTISPATI-PCA algorithm to delimitate three soil-specific zones (Z1, Z2 and Z3); (iii) to determine three soil sampling points by zone, using conditioned Latin hypercube method, in addition to elevation and ECa as auxiliary information; (iv) to collect soil samples at 2-10 cm depth in each point and to determine in laboratory: total organic carbon content (TOC), cation-exchange capacity (CEC), pH and phosphorus availability (P-Bray). In addition, soil bulk density (SBD) was measured at 0-20 cm depth. Finally, (v) according to each soil-specific zone, a management strategy was recommended. Important differences in soil properties among zones could suggest that the strategy developed was able to apply an agro ecological soil-specific practice management. pH and P-Bray were significantly ($p<0.05$) higher in Z1 than in Z2 and Z3. TOC did not show significant difference among zones, but it was higher in Z2. CEC was significantly ($p<0.05$) lower in Z3 than in the other ones. SBD did not show significant difference among zones; however it had a higher content in Z1. From these results, we propose an agro ecology strategy which involves a continuous nutrient cycling. During the first two years, P-Bray levels will be adjusted among zones, by using different external phosphorous sources. Only in Z3, this strategy will be achieved adding P fertilizer and also rotating plots with high stocking rate. The aim is to increase soil organic matter content and CEC. Furthermore, P content will be supplied through manure because the animal nutrition will include wheat husk, in order to achieve similar P levels among zones. The proposed strategy demonstrated that the agro-ecology soil-specific management allows a sustainable scheme in Argentinian agro-productive systems.