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Soil fertility levels in the process of recovery of degraded pasture by iCL in the western Brazilian Amazon

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Introduction:
Pasture degradation is one of the environmental problems of the Amazon region, with about 60% of pasture areas in the Amazon in some degree of degradation. Thus, there are losses not only to the environment but also the sustainability of livestock, since livestock production in degraded pasture is lower than in recovered or in good condition pastures. The low soil fertility levels are one of the main reasons of the degradation. Integrated systems as iCL are considered the most economically and technically viable way to proceed the recovery of soil fertility. Thus, this study aimed to compare the soil fertility levels in degraded pastures and in the recovery process with iCL.

Materials and methods:
The work was conducted at the Experimental Station of Embrapa Western Amazon, located at km 54 of BR 174 highway. The soil is a Xanthic Ferralsol (FAO, 1990) with clayey texture. The object of the study was a system implemented in 1991, made up of six paddocks of 3000 m^2 each, with pasture associated with Mahogany (*Swietenia macrophylla*), arranged in two central lines. That pasture was reformed through corn cultivation associated with *Brachiaria brizantha* CV Xaraés. Three paddocks were cultivated with corn only in the first year (Cult1) and the other three were cultivated for two years in a row (Cult2). After de corn harvest, the pasture was grazed by sheeps. In the first year it was applied 3Mg/ha of limestone to raise the sum of bases to 40%. In each planting were applied, in the groove, the equivalent to 350 kg/ha of 4-28-20 formula, plus 100 kg/h of urea and 75 kg/ha of KCl for cover. After de second year six soil samples were collected at a depth of 0–20 cm in each paddock to analyze pH in water, organic matter (OM), available phosphorus (P) and potassium (K), sum of the bases (SB) and base saturation (V%) according to the Embrapa Methods Manual (2011). The variance analysis was performed and means were compared using the Tukey test.

Results:
OM levels increased gradually among treatments ($P < 0.0021$) going from 28,1g/kg in degraded pasture (DP), to 35,3g/kg in Cult1 and 41,5g/kg in Cult2, demonstrating the benefits of corn cultivation can bring soil fertility. In relation to P ($P < 0.0129$) and K ($P < 0.0688$) a similar trend occur, but whit the levels at DP lower than Cult2, being respectively 3.6 and 14.2 mg/dm^3 of P and 17.5 and 21.7 mg/dm^3 of K, but with the Cult1, not differing from any of the two treatments (7.7 mg/dm^3 of P and 20.2 mg/dm^3 of K). For the SB ($p < 0.0005$), the response was the opposite, since only the DP values were low; 0.48 cmolc/dm^3. In Cult1 or Cult2, the values have stabilized in the range of 1.55 cmolc/dm^3. The V% ($P < 0.0007$) showed a gradual increase, going from 8.5% in DP, to 17.1% in Cult1 and 23.1% in Cult2.

Conclusions:
In general, the introduction of maize crop in successive years by iCL, was an effective way to restore fertility levels of the degraded pasture soil, since all fertility parameters increased with the crops sequence.