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Dissolved N-P-K losses and their relation to the magnitude of rainfall event in a rural catchment

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Chemical elements transported to the streams may originate from anthropogenic activities including agriculture through the supply of fertilizers and agrochemicals or from natural sources, as the result of weathering and leaching in the soil profile. The amount of nutrients that is transported from the soil to the rivers varies according to the characteristics of the rainfall events in the different seasons of the year. The aim of this study was to evaluate the characteristics of the rainfall event that may explain the transport of N-P-K nutrients. The study site is located in Arvorezinha catchment (1.23 km^2) in southern Brazil. The land use comprises forests (36.5%), tobacco (19.6%), soybean (18.7%), pasture (12.8%), yerba mate (4.9%), corn (4.7%) and others (7.9%). The soil management of cropfields is characterized by conservationist tillage (no-till system) (59%) and or conventional tillage (41%) system. The rainfall is measured by rain gauges and discharge by pressure sensor installed in a Parshall flume. Samples were taken during seven rainfall-runoff events occurred along 2018 (winter, spring and summer 2018/2019) and the elements analysed were total N and dissolved P and K. Water + sediment samples were collected during rising, peak and falling limb of the hydrograph. In the laboratory, they were filtered through a 0.45 µm filter to separate the dissolved fraction. The concentrations of N, P and K were determined by the methods proposed by Kjeldahl (1883), Murphy and Riley (1962) and Tedesco et al. (1995), respectively. A simple regression analysis between the maximum N-P-K concentrations with the maximum discharge (Q_{peak}), precipitation depth (PPT) and maximum intensity in 30 min (I_{30}) was performed. In addition, total nutrients (kg) was calculated. The PPT varies from 21 to 103 mm triggered discharges between 55 to 3,366 L s^{-1}. The total losses of N, P and K varied from 1.7 to 195; 0.02 to 2.34; and 7.2 to 399 kg, respectively. The losses were more significant in the event of 11/23/2018, which presented Q_{peak}= 905 L s^{-1} with an average rainfall intensity of 5.3 mm h^{-1} and PPT of 91 mm. The regression analysis showed that PPT does not explain the variations of N, P and K concentration, where the highest R^2 was 0.05 for P. Although, I_{30} was able to explain 75% of the total N variation between the events. Q_{peak} was the hydrological variable which best explained the variations of N, P and K concentrations, i.e., R^2 = 0.43, 0.50 and 0.71 for P, K and N, respectively. In 2018 there was a significant change in land use in the catchment. Many areas with Eucalyptus plantation were replaced by soybean and tobacco cultivated using inverting tillage system. These changes may have affected the large losses of these elements, mainly N (594 kg) and K (1220 kg), since P (7.1 kg) is preferably transported in particulate form. Thus, even evaluating a small number

of events it is possible to verify the impact of these losses on agricultural production, in addition to the environmental impact they may cause in aquatic environments.