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Impact of the cannabis cultivation on the physico-chemical degradation and hydrodynamic behaviour of soils in the wadi Sra Catchment, (Central Rif, Morocco)

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KEYWORDS

Central Rif
Cannabiculture
Soil degradation
Surface conditions
Infiltration

INTRODUCTION

The Oued Sra basin is part of the Central Rif in northern Morocco; It constitutes a fragile environment where soil degradation is spectacular. The objective of the present work is to study the impacts of *cannabis* cultivation on the physicochemical properties of soils, their surface characteristics, as well as their hydrodynamic behaviors during different seasons.

METHODOLOGY

The methodology adopted is based on the analyzes of the physico-chemical properties of the surface horizons soil (0-25 cm). Two soil samples were taken from the 0-25 cm layer on adjacent sites, in order to determine the loss of soil fertility and texture degradation by of the physico-chemical soil analyzes. The first sample was taken from a plot under forest. The second was taken from a plot that had been cleared and put

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into cannabis cultivation for 10 yrs. Among the tests carried out : Chemical analysis of organic matter using the Walkley and Blak method, phosphorus is determined by extraction with sodium bicarbonate. In addition, the Texture (sand, silt, clay %) is determined using the international Robinson Pipette method.

Before each simulation, the states of the surfaces inside each plot (1 m^2) were checked and recorded in the field in different seasons using the quadrat point method described. It is a question of determining by two diagonal transects inside the plot at every 10 cm the rate of covered or bare surfaces and closed or open surfaces. Therefore, the sum of covered and bare surfaces equals 100%. Likewise, the sum of closed and open areas equals 100%. And Before each rainfall simulation, two soil samples were taken for all plots and during each season using a cylinder to determine soil moisture, bulk density (Bd, g/cm^3) and total soil porosity. These samples were weighed before and after drying in an oven at 105 °C for 24 hours to evaluate the ratio of water weight to dry soil weight. The hydrodynamic behavior of soils and detachability were based on rain simulation. The experimental device used is a mini-rain simulator with a ramp (a simple manual irrigator), which allows simulating rainfall on an artificially plot delimited by a rectangular metal frame of one m^2, sunk in soil to concentrate water and runoff in the concerned plot. This device is equipped at the bottom of the plot with a tank to receive runoff water; it also includes a 50 cm wide watering ramp with a line of 0.5 mm diameter separated by a distance of 1 cm and connected by a conventional ten-liter watering can. The simulated rain intensity is 80 mm/h^{-1} for 35 to 50 min for each test.

RESULTS

The obtained results show that the soils reach very advanced levels of degradation; marked by a significant reduction in fertility. In fact, chemical analyzes of surface soil horizons clearly show a reduction in soil fertility after forest clearance. A comparison between the control plot (under forest) and the cleared plot followed by cannabis cultivation shows that clearing the land followed by cannabis cultivation contributes significantly to the reduction in soil fertility. For example, the highest value of organic matter was recorded under the control plot (3.64%), compared with a low value of (3.01%) under the cleared plot followed by cannabis cultivation. Likewise, organic carbon showed values of 2.11% and 1.74% respectively for the two plots. Assimilable phosphorus and potassium concentrations were recorded after clearing. The comparison shows a significant change in soil texture. The control plot under forest had 49.86% sand and 45.12% silt, whereas the cleared plot followed by cannabis cultivation for 10 years had a high proportion of sand (80.45%) and a very low proportion of silt (10.22%).

The results obtained on the characteristics of the soil surface show an apparent fluctuation between cannabis growing lands and that used for cereal growing land; the latter has the highest proportion of surface covered (80%), particularly during the winter and spring seasons, due to the development of weeds, litter, crop residues and mulch during the summer season. Cannabis cultivation, on the other hand, is characterised by the predominance of bare surfaces for most of the agricultural year, with values in excess of 89%. The latter depends essentially on earthing-up and weeding, which are carried out in April, with the aim of aeration and higher yields. Harvesting this type of crop in August continues until October, leaving no residue, because after the cannabis has been harvested, the plants are taken out of the plots to cut off the parasitic leaves so that the plants can dry out. The effects of cannabis cultivation on the surface of the soil are also exacerbated by the harvesting of cannabis plants, which in most plots involves complete removal, including the roots, leaving the surface bare. These procedures, which are practised for a large part of the year - from sowing to harvesting - together with the considerable expansion of cannabiculture over the last few decades towards steep slopes, can contribute to an increase in bare surface rates and hydric erosion rates. The rate of closed surface conditions was recorded in the cannabiculture plots, with values in excess of 80%, due to the successive and cumulative passage of farmers through the plots over the course of the year. In fact, this phenomenon is very common in the study area during the spring for the purpose of purifying herbs, as well as during the periods when cannabis is irrigated by suction and drip irrigation in the summer season and during the harvest period. This contributes to the degradation of roughness and favours compaction of the soil

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surface and disruption of pore volume, resulting in very high runoff coefficients and consequently erosion and soil losses in land intended for cannabiculture. Likewise, the simulation tests result in maximum final infiltration values recorded on cereal growing land (67.20 mm/h); while land intended for cannabis cultivation recorded low values (43.12 mm/h). Consequently, the maximum averages of solid transport are recorded in the cannabis growing lands (98.87 g/l) but the cereal growing lands are marked by low values (26.64 g/l).

CONCLUSIONS

Based on measurements taken in the field, we were able to conclude that soil degradation is increasing in the mountains of the Central Rif as a result of deforestation followed by the spread of cannabiculture. The results obtained from the physico-chemical analyses show that the clearing carried out on site not only reflects the regression of forest areas, but also leads to an accentuated degradation of the soils, resulting in a reduction in their fertility and stability. The reduction in soil fertility in this environment, if we take into account the dominance of soils of a less advanced type, leads to the subsequent abandonment of cultivated land, a phenomenon that results in the acceleration of erosive processes and the installation of dense networks of linear incisions. The excessive expansion of the area under cannabiculture in the region over the last few decades, for financial gain, is a recent phenomenon that has had a major impact on soil stability and resistance to erosion. The over-exploitation of cleared forest land, fuelled by a rapidly growing population, explains the extension of cannabis cultivation to steeply sloping areas, with the corollary of accelerating the rate of erosion in this fragile environment. Many plots of land, both bare and under cultivation, are affected by deep erosion gullies whose rapid evolution produces huge quantities of sediment every year, in the absence of maintenance and basic protection work. This alarming state of deterioration calls for immediate action, which must be taken as part of an overall development policy for the region that aims to be compatible with the physical and socio-economic conditions of this vulnerable environment.

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