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*Carpinus* )

*Quercus castaneifolia* ) (*betulus* L.

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(*Fagus orientalis* Lipsky) (C.A.Mey.

(*Alnus subcordata*) (*Acer velutinum* Boiss.)

- McDonald

- Soil compaction

- Bulk density

- Macroporosity

- Froehlich and McNabb

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(Timberjack 450C)

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- Upslope and downslope tracks
  - Wheel-track section
  - Steel soil core
  - Complete randomized factorial design

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- Rubber-tired skidder
  - Pre-planned skid trail
  - Skid trail with transversal slope
  - Flat skid trail
  - Senyk and Craigdallie

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- Kolmogorov-Smirnov test
  - Two-way analysis of variance
  - Levene test
  - Duncan
  - Kruskal-Wallis
  - Mann-Whitney U

/  $Mg.m^{-3}$

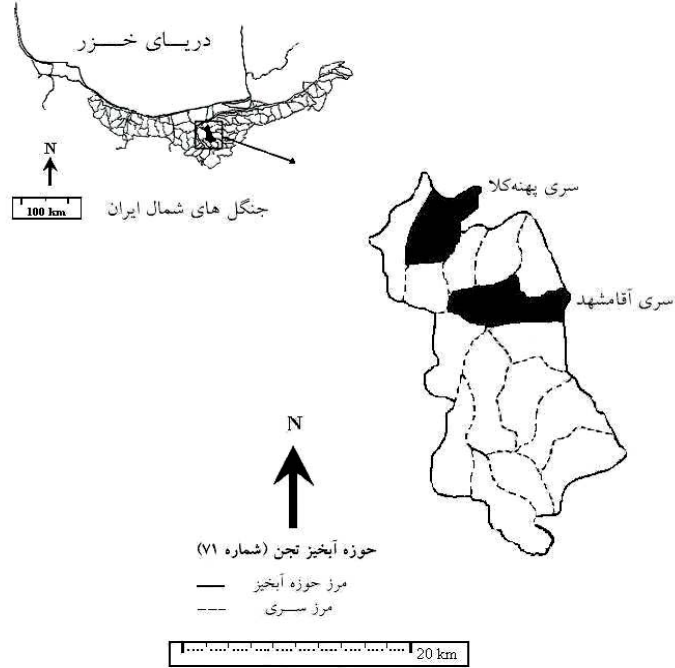
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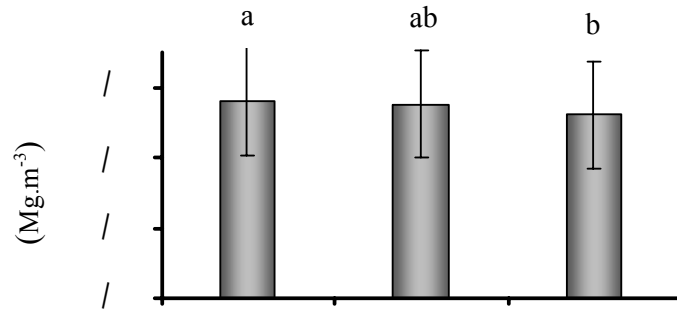
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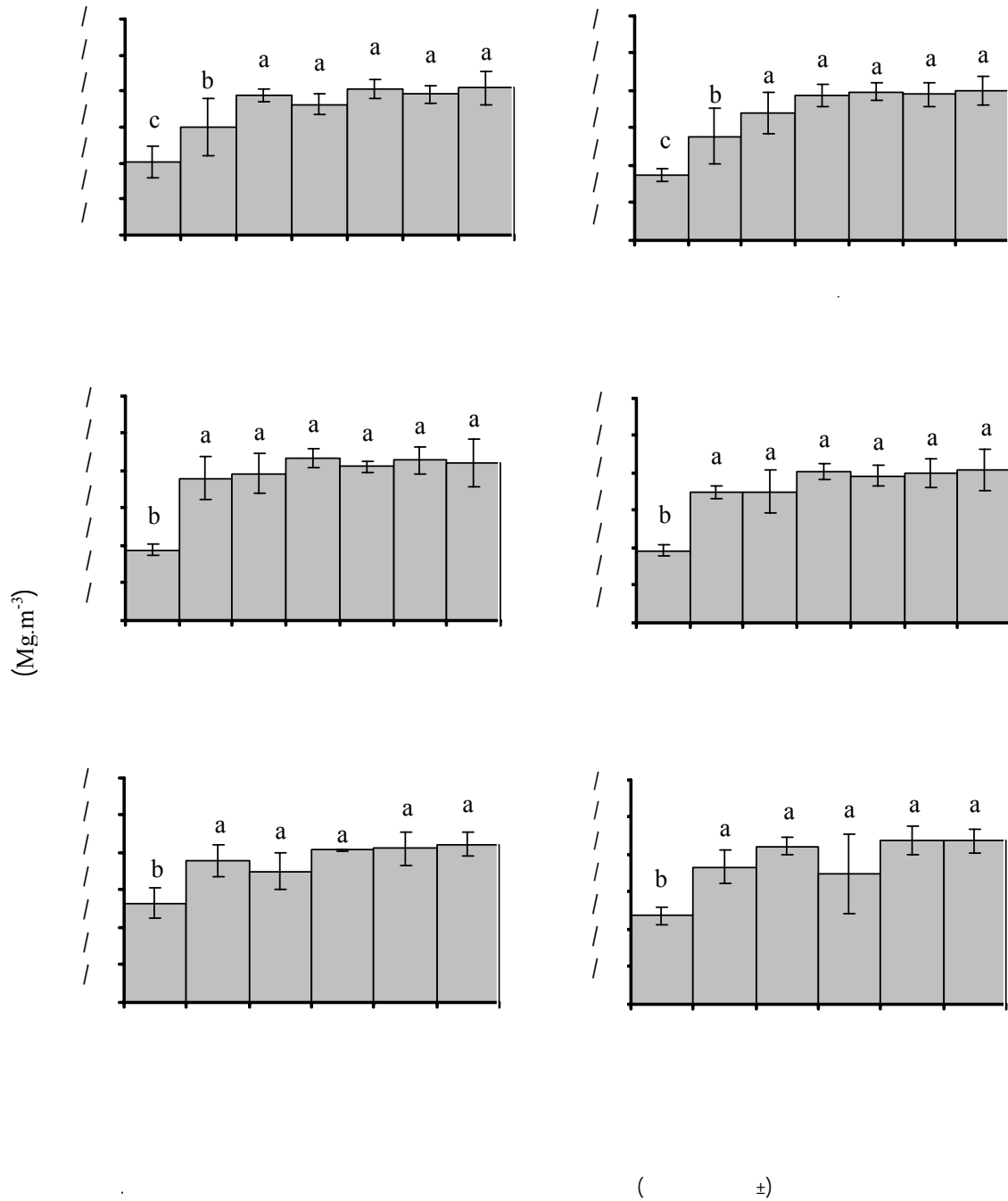
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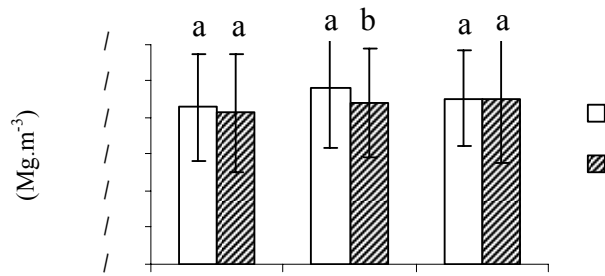
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- Lateral wheel-slip or lateral slippage
  - Between track

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- Microporosity
  - Shear stress
  - Machinery vibration

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## Effects of ground-based skidding on soil compaction of skid trails in different slope and gradient positions

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### Abstract

This study was done to evaluate the changes in bulk density ( $D_b$ ) of the 0-10 cm surface soil of skid trails in the Hyrcanian hardwood forests, Iran. The treatment involved running a rubber-tired skidder in three skid trails: Flat Skid Trail (STF), Skid Trail with Transversal Slope (STTS), and Skid Trail with Longitudinal Slope (STLS). Pre- and post-skidding activities, soil cores were collected at random points of upslope and downslope tracks of each skid trails to measure soil bulk density and moisture content. In general, mean bulk density of compacted soil in skid trails was significantly greater than that of undisturbed soil. A significant increase ( $P < 0.01$ ) in soil bulk density occurred during first six skidding cycles at the STTS and STLS, when the soil moisture content was about 30% and 35%, respectively. But on STF, the increase in bulk density was greatest during first twelve skidding cycles. Additional cycles, up to 6 (on the STTS and STLS) and 12 (on the STF) cycles, did not cause significant increase in bulk density. The severe soil compaction was concentrated on the STTS.

**Keywords:** Soil compaction, Ground-based skidding, Bulk density, Skid trail.