



The University of Vermont

Preliminary characterization of organic phosphorus species in soils along the Missisquoi River (Vermont, USA)

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INTRODUCTION



Algae blooms have become a worldwide issue in lakes and fresh water bodies, affecting drinking water and recreational activities. In Lake Champlain, their growth is limited by the concentration of phosphorus (P) and nitrogen in its waters.

Due to the prominent contribution of streambank erosion from lands adjacent to the streams and rivers that flow into Lake Champlain, it is important to characterize the different species of P present in one of the most affected areas of the Lake Champlain Basin: the Missisquoi River watershed (Fig. 1a).

Land use can influence significantly the amount of P that can be discharged into nearby streams: the use of fertilizers and manure in crops incorporates high amounts of P into the soil, while other land uses, such as forests or wetlands, only have natural inputs.

METHODS

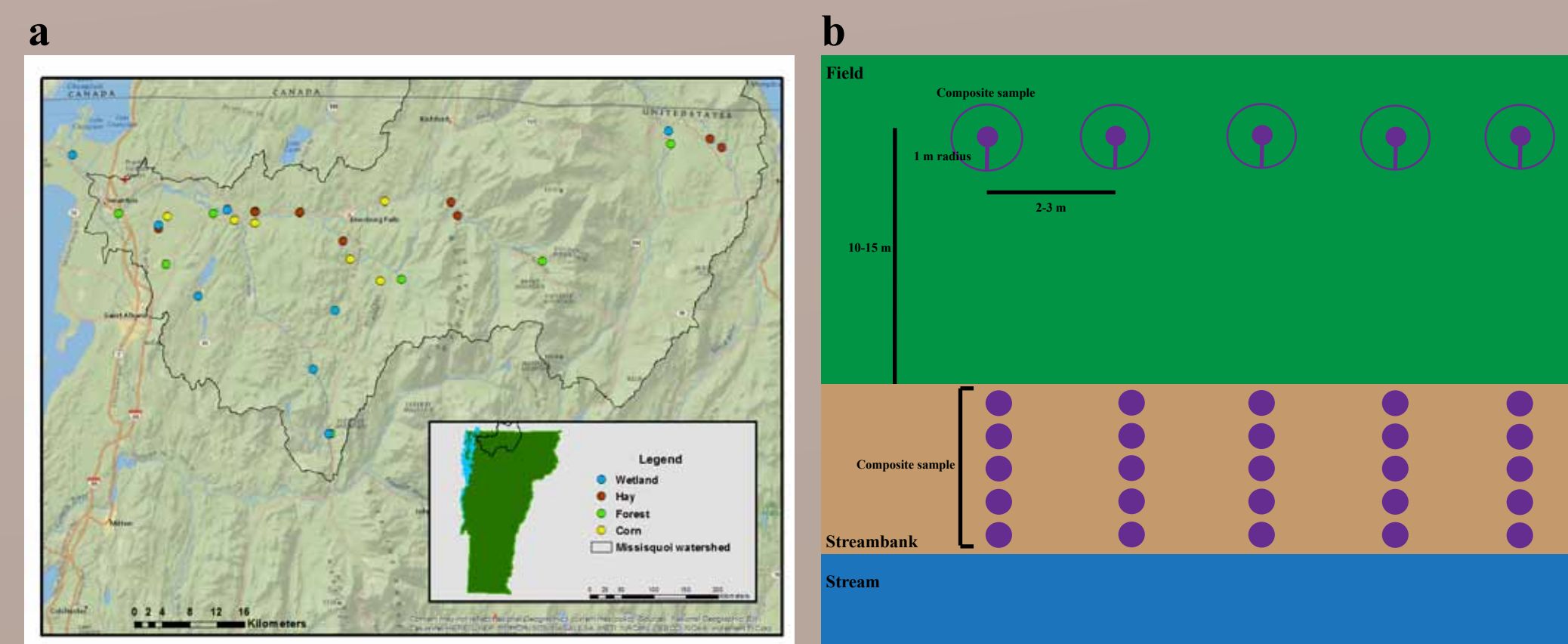


Figure 1. (a) Distribution of sampling sites in the Summer 2015 in the Missisquoi River Watershed. Forested sites are depicted in green, corn fields in yellow, hay fields in red and wetlands in light blue. (b) In each site, 10 soil samples (10-cm deep) were taken, 5 corresponding to the field and 5 to the streambank. Field samples were taken in a straight transect parallel to the stream, separated from the streambank 10-15 m. Each sample consisted of a composite between a central point and 4 random points located in a 1m radius. Streambank samples consisted of a composite of 5 points along the vertical profile.

- **Sampling:**
 - + Four land uses were studied: Forests, Corn fields, Hay fields and Wetlands
 - + 32 sites distributed along the Missisquoi River (northern Vermont, USA) and its tributaries were sampled in the period of June-August 2015 (Fig.1a); 8 sites per corresponding land use. Sampling design is shown in Fig. 1b.
- Particle Size Analysis was determined with hydrometer method (Ashworth et al., 2001).
- Total P was measured with Inductively Coupled Plasma (ICP-OES) after microwave assisted nitric acid digestion (Method 3051a; USEPA 2007).
- Total Organic P was obtained by extraction with NaOH-EDTA (0.25 M NaOH + 0.05 M EDTA) for 16h (Turner et al., 2005).
- Total P_{NaOH-EDTA} with the ICP-OES.
- Inorganic P_{NaOH-EDTA} with Murphy Riley colorimetric method (Murphy and Riley, 1962).

$$\text{Total Organic P} = \text{Total P}_{\text{NaOH-EDTA}} - \text{Inorganic P}_{\text{NaOH-EDTA}}$$

- Total Inorganic P = Total P - Total Organic P.
- Plant available P was determined with a modified Morgan extraction (pH 4.8 ammonium acetate buffer in a 1:5 ratio, McIntosh 1969) and the Murphy-Riley colorimetric method.

GOAL

We present here a preliminary characterization of the different P species in fields and streambanks along the Missisquoi River and its tributaries, looking at four different land uses: forest, wetlands, hay fields and cornfields.

RESULTS

CONCLUSIONS



- Total P, Total Inorganic and Total Organic P in the fields of wetlands are high, comparable to the hay and/or corn fields, where fertilizers had been incorporated.

- There are significant differences between the field and the streambank for Total P, Total Inorganic P and Total Organic P for cornfields, wetlands and hay fields, while for plant available P the differences between field and streambank may be affected by the addition of fertilizers to the fields.

- Forests have no statistical differences in any of the different P species between their fields and streambank.

- The type of fertilizer (inorganic vs. different methods of manure application) might be affecting the species of P present in the field but with no effect on the streambanks.

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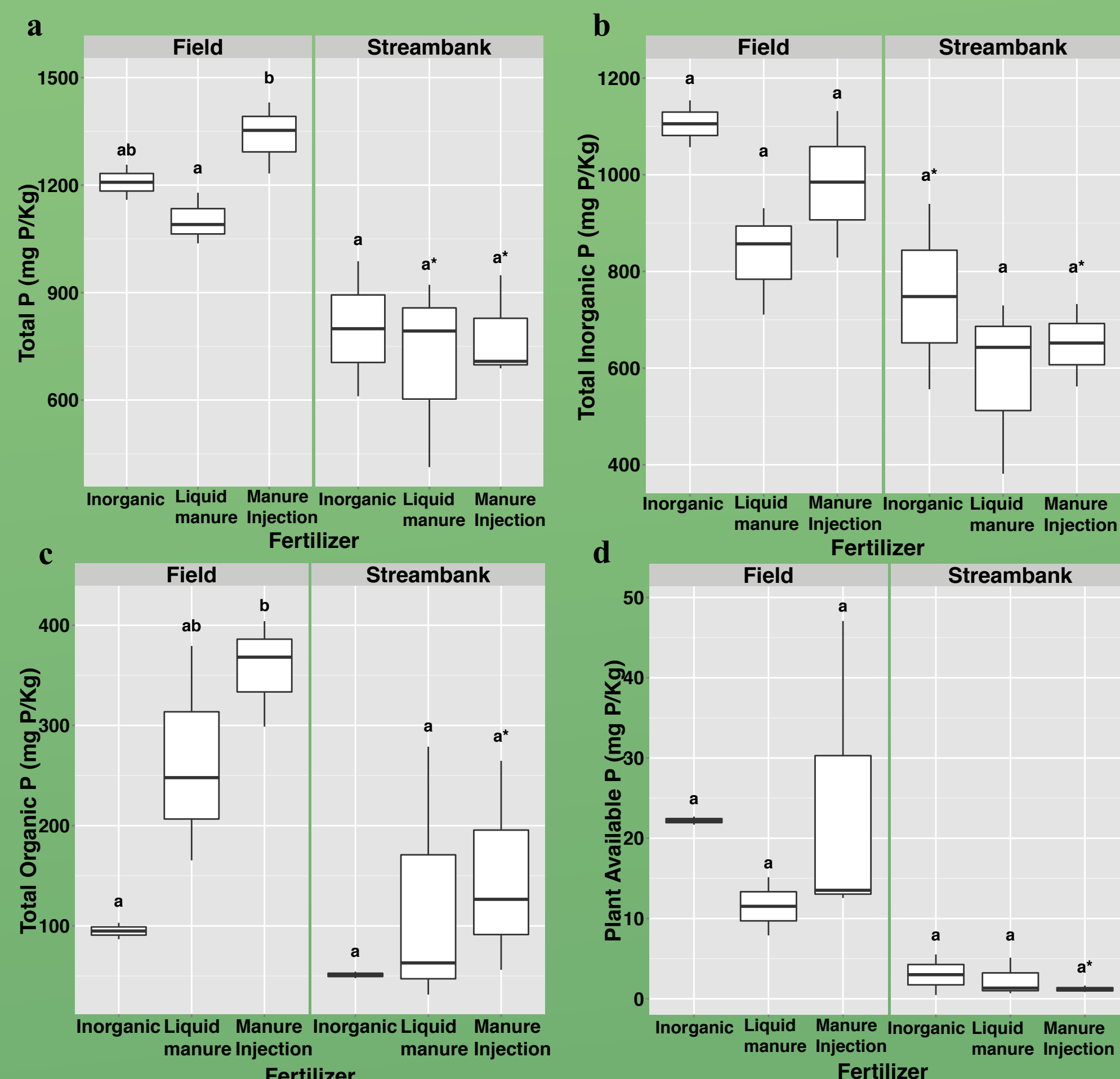


Figure 3. Differences in (a) Total P, (b) Total Inorganic P, (c) Total Organic P and (d) Plant Available P in the Field and Streambank in Cornfields utilizing different types of fertilizers. Statistical significant similarities among different fertilizers in each location are denoted by the use of the same letters, while statistical significant differences between the field and streambank are denoted with an asterisk (p<0.05).

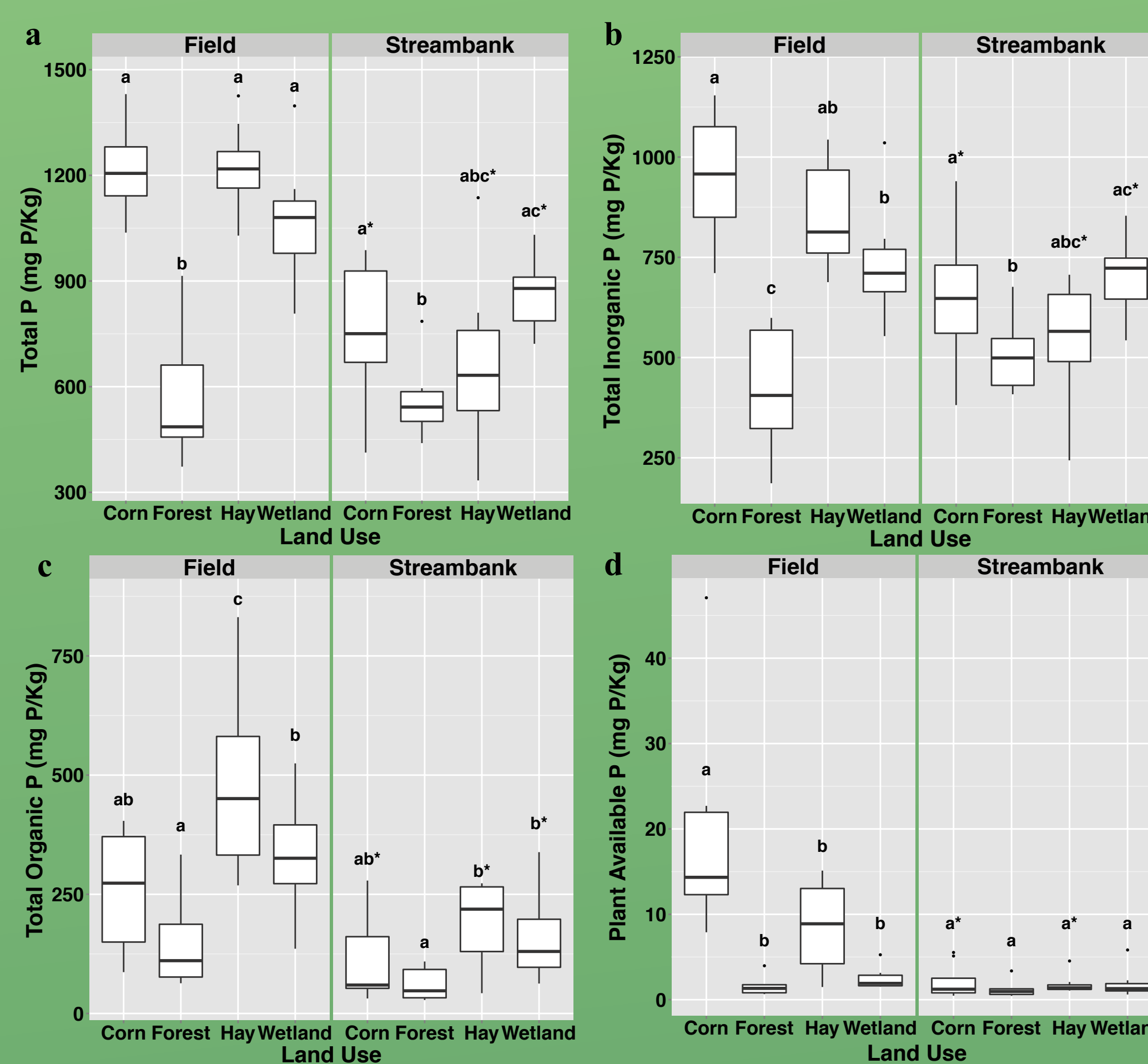


Figure 2. Differences in (a) Total P, (b) Total Inorganic P, (c) Total Organic P and (d) Plant Available P between the different land uses studied and between their location in the sites (Field or Streambank). Statistical significant similarities among different land uses in each location are denoted by the use of the same letters, while statistical significant differences between the field and streambank are denoted with an asterisk (p<0.05).

