

gefördert durch



Abschlussbericht zum Projekt:

Entscheidungsstützungssystem zum Nährstoffentzug im Rahmen der Holzernte

Teil 2: Anhang

Nährstoffbilanzen wichtiger Waldstandorte in Bayern und Rheinland-Pfalz

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- Auftragnehmer:** Lehrstuhl für Waldwachstumskunde, Department für Ökosystem- und Landschaftsmanagement der Technischen Universität München
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Antragstitel **Entscheidungsunterstützungssystem zum Nährstoffentzug im Rahmen der Holzernte**

Stichworte Biomasse; Nährstoffentzug; Stoffhaushalt, Holzernte, Modellierung

Laufzeit Projektbeginn Projektende

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Zielsetzung und Anlass des Vorhabens

Die verstärkte Nutzung von Holz als nachwachsendem Rohstoff und Energieträger führt zu höheren Entzügen von Biomasse und Nährstoffen aus dem Wald, die auf manchen Standorten zu negativen Nährstoffbilanzen führen können. Ziel des Projektes war es, für definierte Standorte die Zusammenhänge von Biomassenutzung und Nährstoffentzügen quantitativ darzustellen. Grundlage dafür sind die im Rahmen des Projektes neu entwickelten Biomasse- und Nährstoffmodelle. Durch die Datenerhebung anhand von fünf Baumarten und über eine breite Standortsamplitude haben die Modelle auch eine überregionale Gültigkeit und schaffen so zukünftig eine neue Entscheidungsgrundlage für Wissenschaft und Forstpraxis.

Darstellung der Arbeitsschritte und der angewandten Methoden

In Rheinland-Pfalz und Bayern wurden auf ausgewählten, flächenmäßig bedeutsamen Waldstandorten Bäume der Baumarten Fichte, Kiefer, Douglasie, Buche und Eiche gefällt und kompartimentsweise (oberirdisch) zur Bestimmung der Biomassen vermessen. Dabei wurden in der Regel pro Standort aus den Altersbereichen „jung“, „mittel“ und „alt“ immer fünf Stämme beprobt. Zusätzlich zu den Aufnahmen vor Ort wurden auch Messungen, insbesondere Gewichtsbestimmungen im frischen und darrtrocknen Zustand, im Labor durchgeführt. Neben den Biomassen wurden die Nährelementgehalte kompartimentsweise bestimmt. Auf Grundlage der in diesem Projekt erhobenen Daten in Verbindung mit Daten aus anderen Projekten, welche nach dem gleichem Beprobungsschema erhoben worden sind, wurden Modelle zur Berechnung der Biomassen und Nährelementgehalte der einzelnen Kompartimente der Baumarten in Abhängigkeit von Baumdimensionen (Bhd, Höhe, Kronenlänge, Kronendurchmesser) sowie der Standorte erstellt. Anhand von repräsentativen, virtuellen Bestände, die mit dem Wachstumsmodell SILVA generiert worden sind, konnten so unterschiedliche Holznutzungsszenarien und die damit verbundenen Nährstoffentzüge auf Basis einzelner Stämme und ihrer Kompartimente berechnet werden. Um eine vollständige Input-Output-Bilanz darstellen zu können, wurden Schätzgrößen für die atmogene Deposition, die Mineralverwitterung in den Böden und den Nährstoffaustrag mit dem Sickerwasser entwickelt. Hierfür wurde u.a das Modell PROFILE verwendet. Die Nährstoffentzüge mit der Holzernte und die Bilanzen wurden über Vergleiche mit den Nährstoffvorräten im Boden bewertet. Anhand von Szenarioanalysen konnten Empfehlungen und Hinweise für die forstliche Praxis bezüglich möglicher Gefahren einer hinsichtlich der Nährstoffvorräte/-versorgung bei bestimmten Baumarten-Standortskombinationen nicht nachhaltigen Bewirtschaftung abgeleitet werden.

Ergebnisse und Diskussion

Mit über 850 Bäumen der Baumarten Fichte, Kiefer, Douglasie und Kiefer, zu denen detaillierte Biomasse- und Nährstoffdaten zusammengefasst in einer Datenbank vorliegen, steht ein wertvoller Datensatz zur Verfügung, dessen wissenschaftliches Potenzial im Rahmen dieses Projektes sicher bei weitem noch nicht ausgeschöpft wurde. Es ist davon auszugehen, dass die über ein weites Alters-/Dimensions- und Standortspektrum erstellten kompartimentsweisen Biomasse- und Nährelementgehaltsmodelle für sehr große Bereiche zutreffende Schätzungen liefern und damit vielfältig einsetzbar sind.

Die Beprobung von fünf Baumarten über verschiedene, flächenmäßig bedeutsame Standorte in zwei Bundesländern ermöglicht jetzt einen breiten Vergleich von Nährstoffentzügen in Abhängigkeit von Baumart, Altersphase, Standort und Nutzungsszenario. Das letztendlich entscheidende sind die abschließenden Nährstoffbilanzen der unterschiedlichen Szenarien. Diese wurden im Rahmen des Projektes berechnet und liefern wichtige Hinweise auf bezüglich der Nährstoffnachhaltigkeit kritische Standorts-Baumarten-Nutzungs-kombinationen. Die dafür notwendigen Herleitungen des Eintrags über die atmogene Deposition, des Nährstoffaustrags mit dem Sickerwasser und der Freisetzung pflanzenverfügbarer Nährstoffe durch Mineralverwitterung sind beim aktuellen Kenntnisstand und der derzeitigen Datenlage jedoch immer noch mit Unsicherheiten behaftet. Dennoch reichen die vorliegenden Befunde aus, um schon jetzt Empfehlungen für die forstliche Praxis erstellen zu können.

Öffentlichkeitsarbeit und Präsentation

Bereits im laufenden Projekt wurden im Rahmen von Workshops sowie Posterpräsentationen und Vorträgen auf Tagungen sowohl die Methoden als auch Teilergebnisse mit anderen Wissenschaftlern und Vertretern aus der Forstpraxis intensiv diskutiert. Zudem sind verschiedene wissenschaftliche Publikationen aus dem Projekt heraus entstanden. Die Ergebnisse finden schon jetzt Verwendung bei der Erstellung aktueller Richtlinie zur Sicherung der Nährstoffnachhaltigkeit im Rahmen der Waldbewirtschaftung.

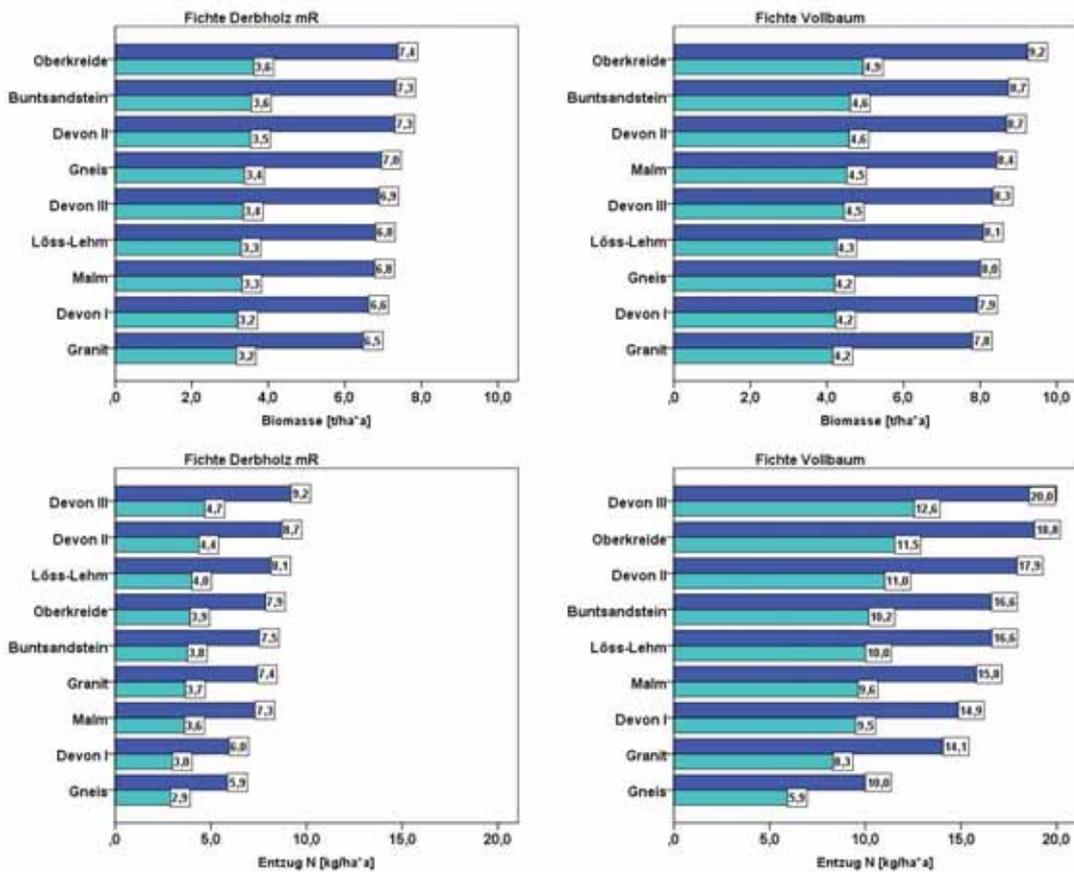
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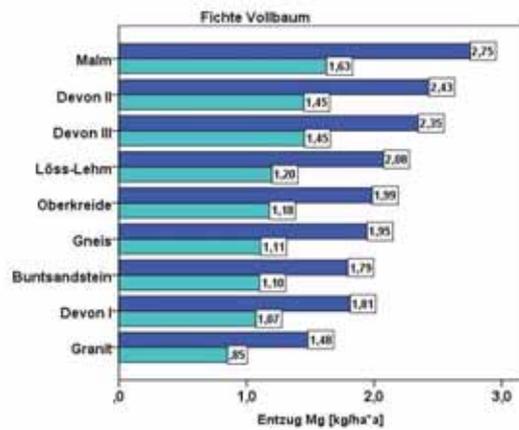
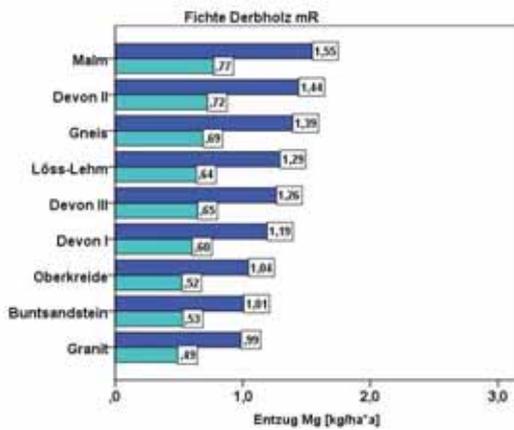
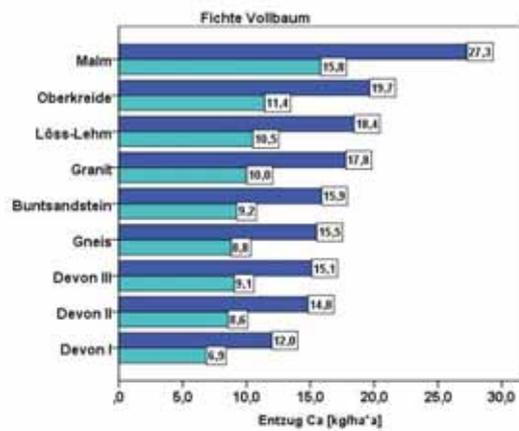
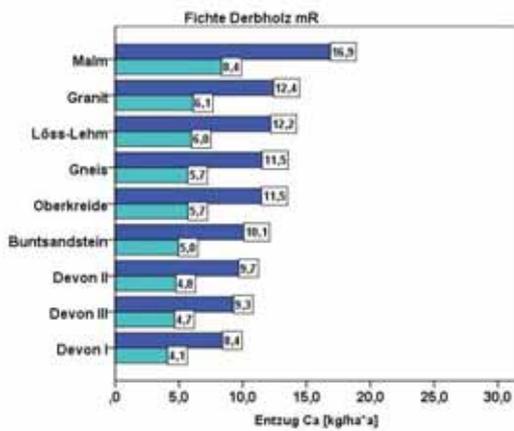
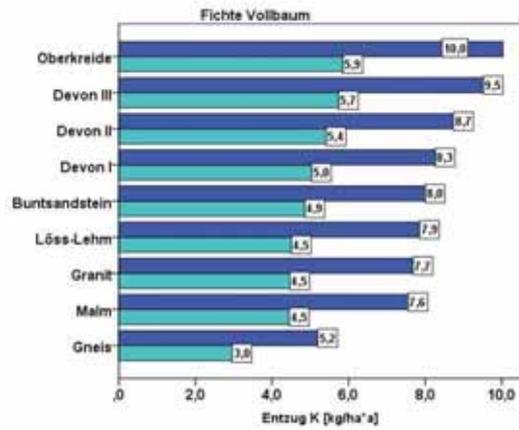
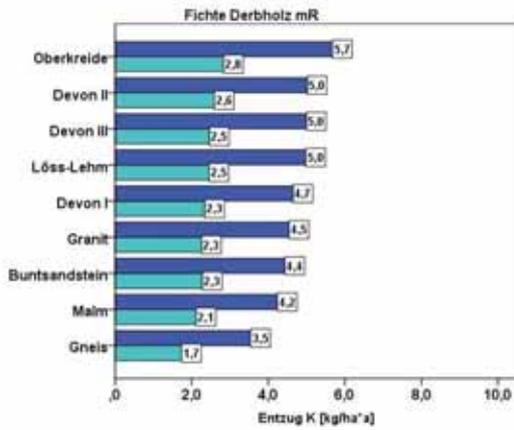
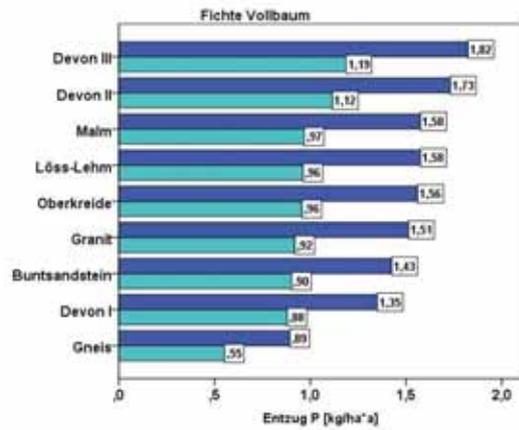
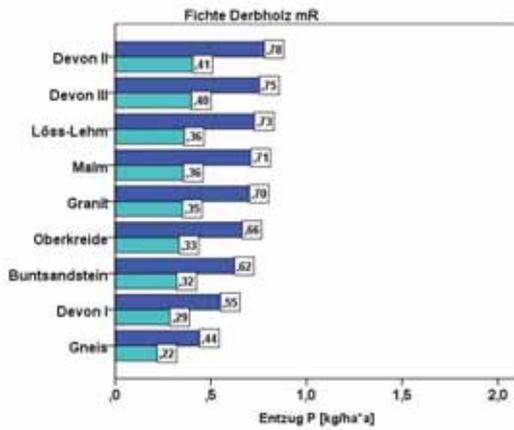
Die Projektziele waren sehr ehrgeizig gewählt und konnten nicht alle in vollem Umfang erfüllt werden. Insbesondere die Beprobung der Bäume im Wald und die daran anschließenden Analysen im Labor waren sehr zeitaufwendig und komplex. Doch der entstandene Datenpool und die daraus entwickelten Modelle zur Schätzung von Biomassen und der darin enthaltenen Nährelementmengen für die Baumarten Fichte, Kiefer, Douglasie, Buche und Eiche sind im Hinblick auf das breite Standortsspektrum und die große Probebaumanzahl einzigartig und setzen neue Qualitätsstandards für die Quantifizierung von Nährstoffentzügen aus unseren Wäldern. Für eine verlässlichere Bilanzierung des Nährstoffhaushaltes in unseren Wäldern besteht vor allem noch Forschungsbedarf bezüglich der Quantifizierung der Austräge mit dem Sickerwasser und der Freisetzung über Mineralverwitterung, vor allem für das Element Phosphor.

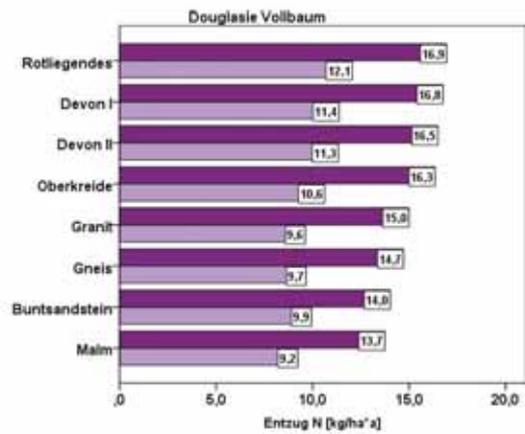
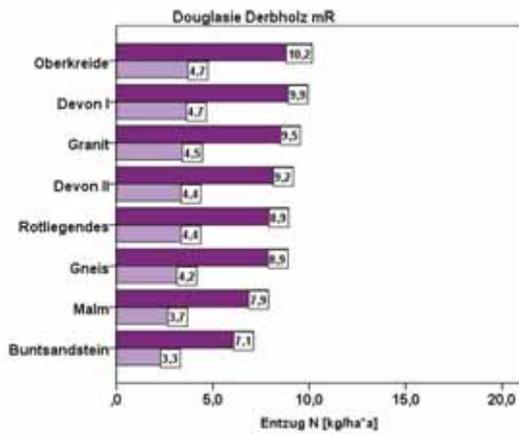
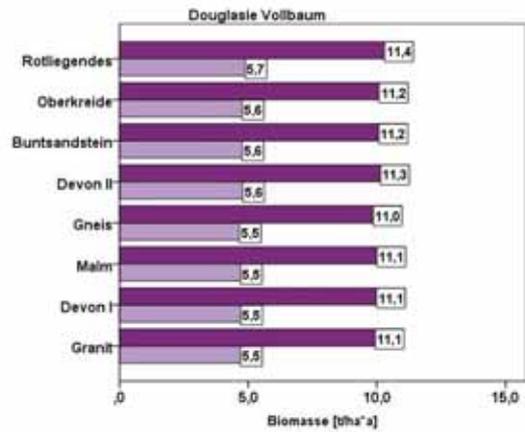
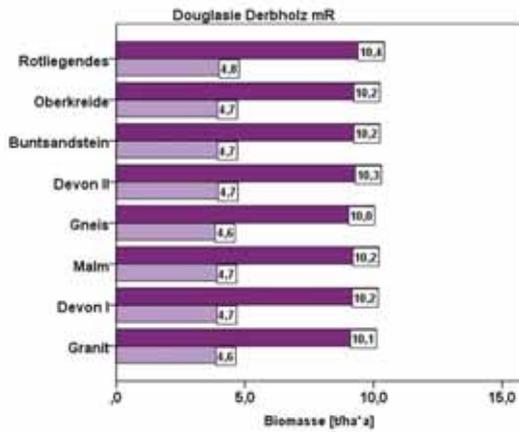
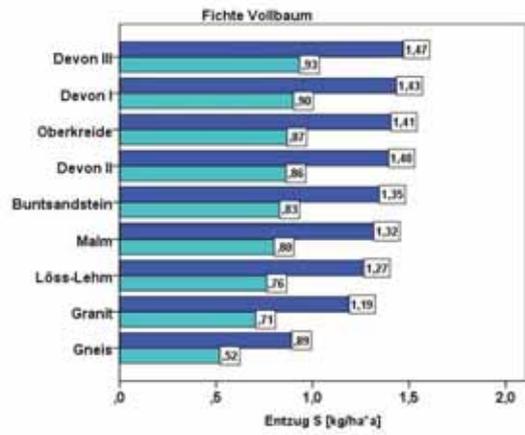
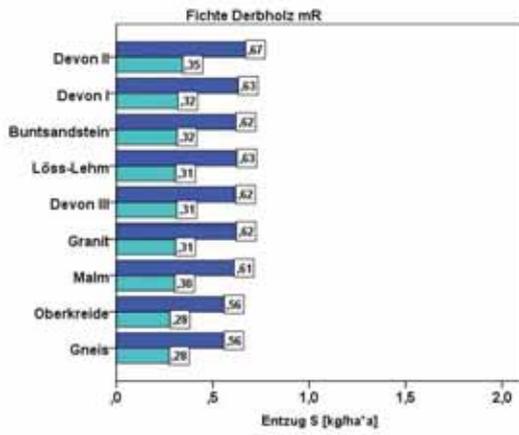
7 ANHANG

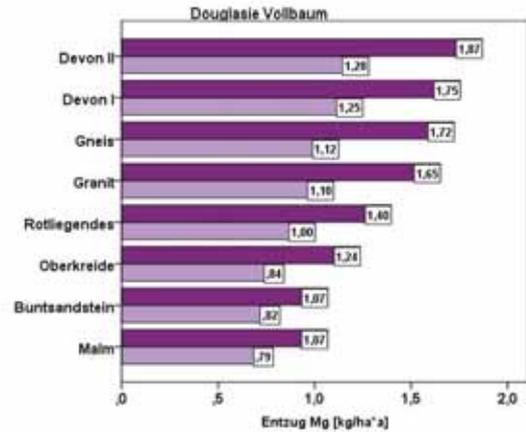
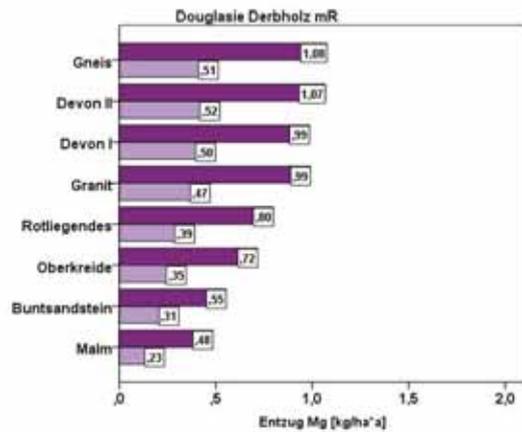
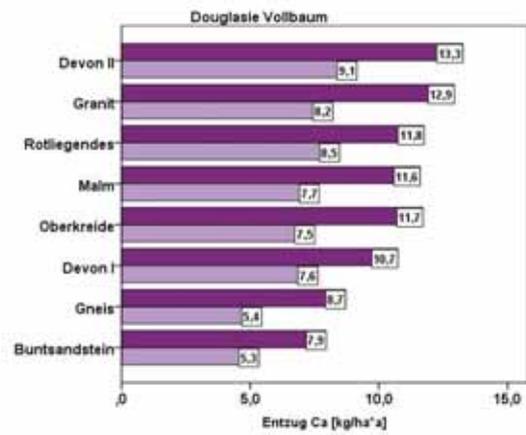
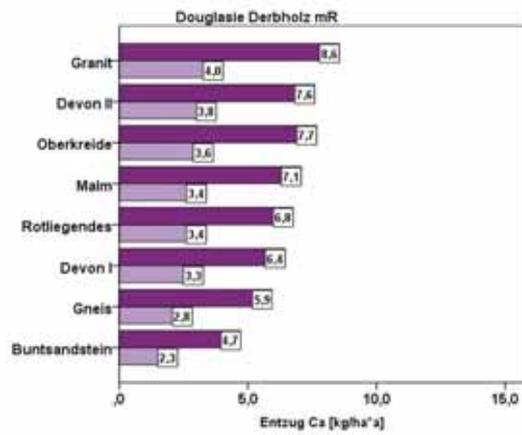
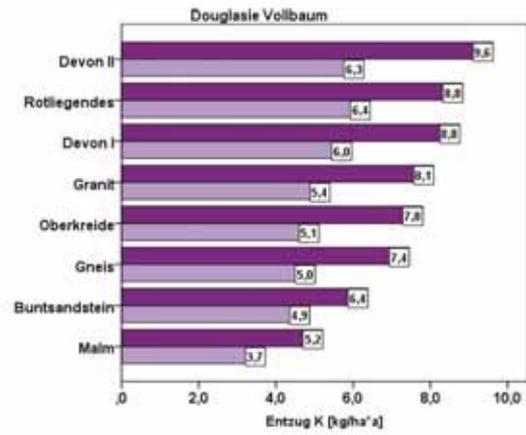
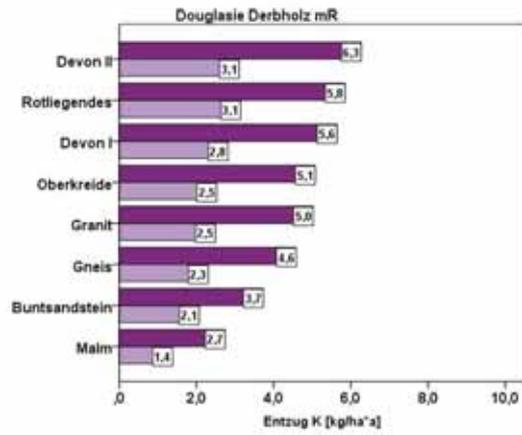
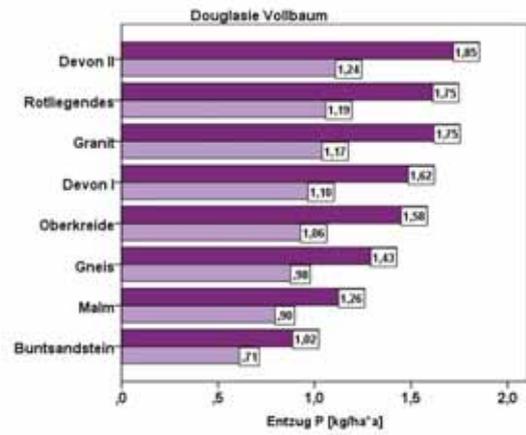
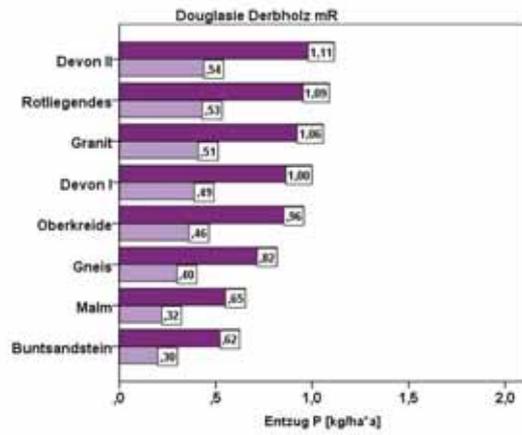
Anhang 1: Ergebnisgrafiken zu Biomasse- und Nährstoffentzügen nach Bodensubstraten

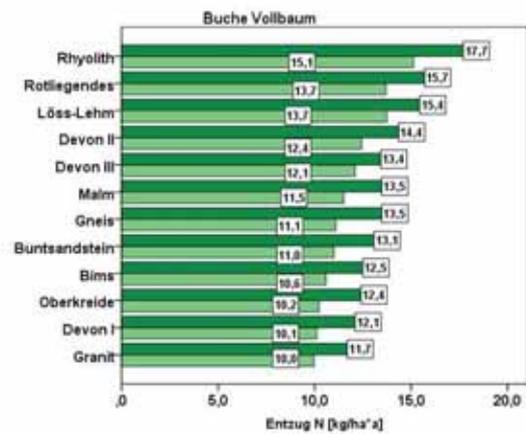
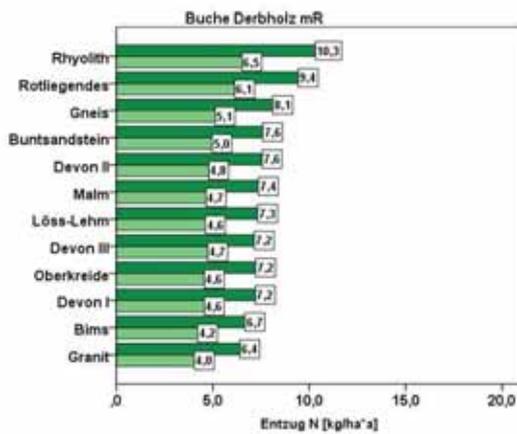
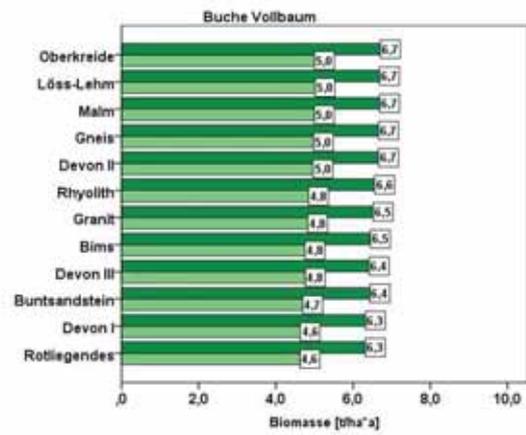
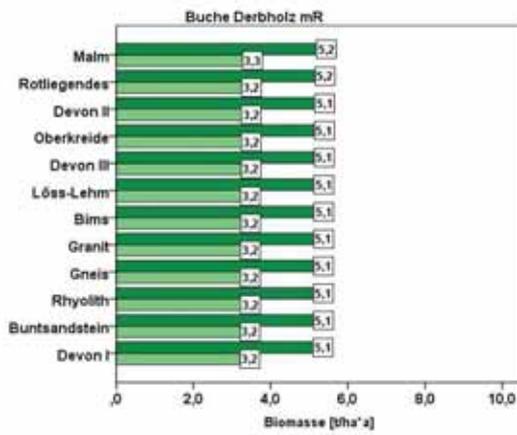
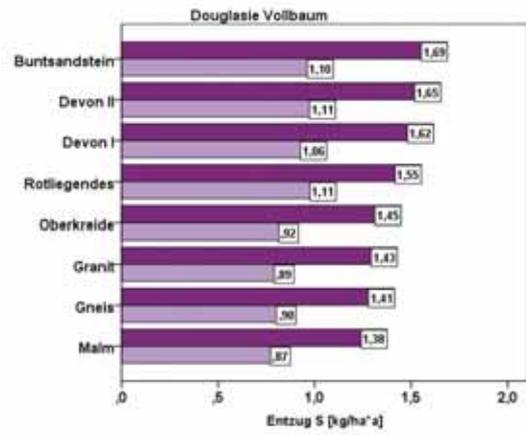
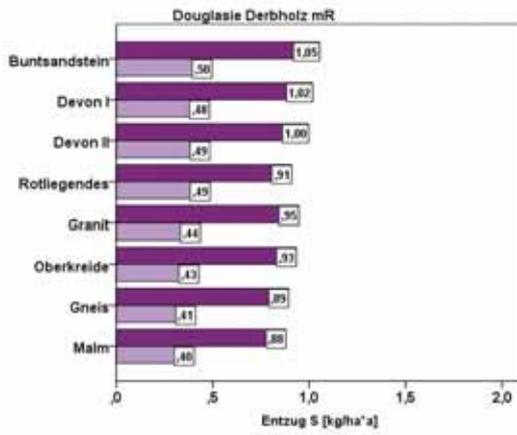
Biomasse- und Nährstoffentzüge für die untersuchten Bodensubstrate in Bayern und Rheinland-Pfalz differenziert nach Baumart, Derbholznutzung (mit Rinde) – Vollbaumnutzung, bessere Wuchsleistung (WL) – schwächere Wuchsleistung; Die Kalkulationen beziehen sich bei allen Baumarten auf Reinbestände und einen Kalkulationszeitraum von jeweils 100 Jahren (Entzüge bei Durchforstungen bis Alter 100 zuzüglich virtueller Nutzung des 100-jährigen Bestandes).

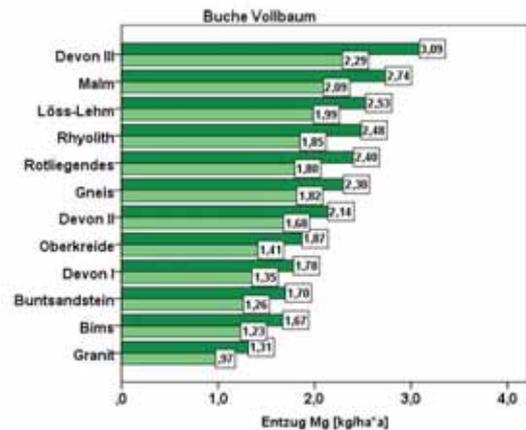
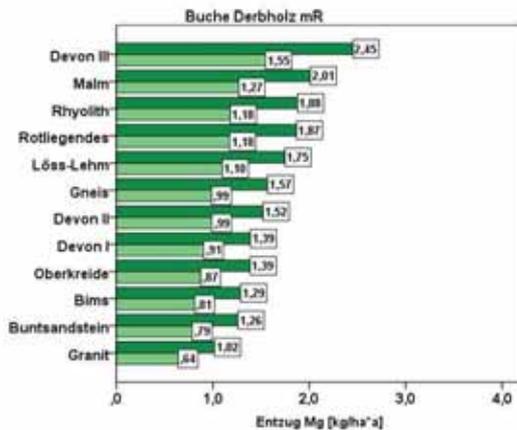
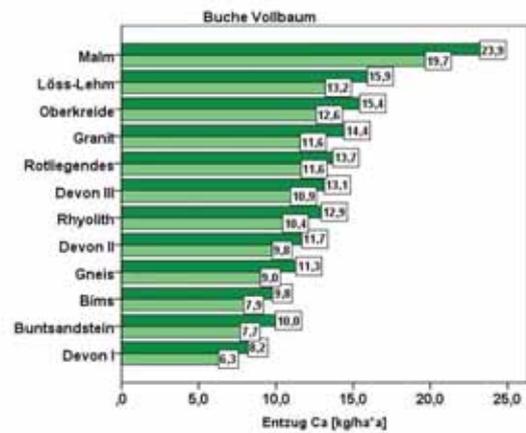
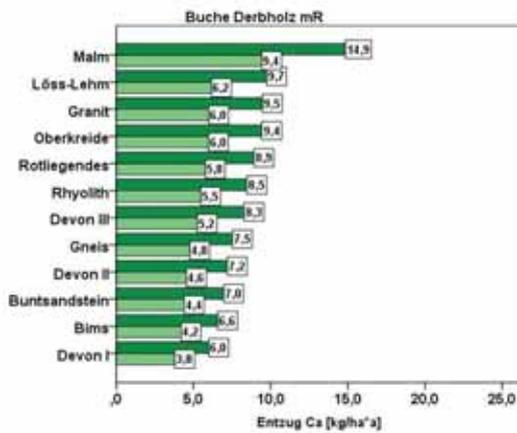
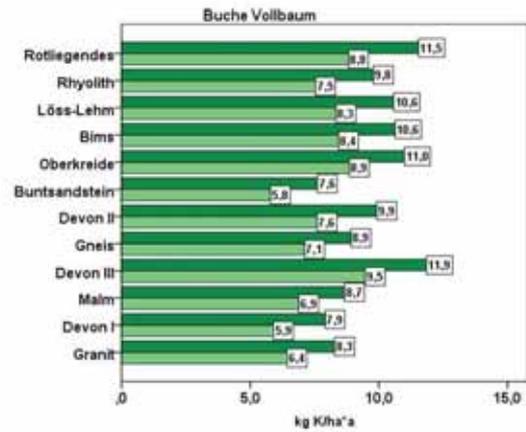
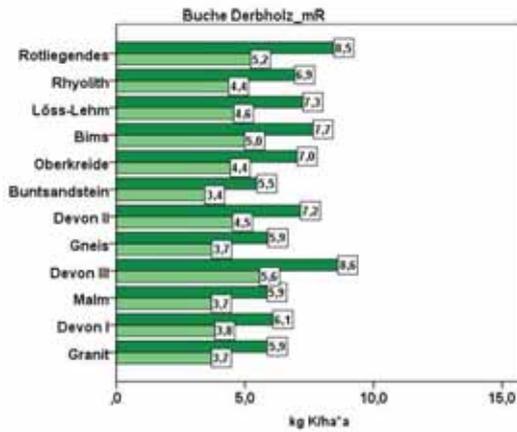
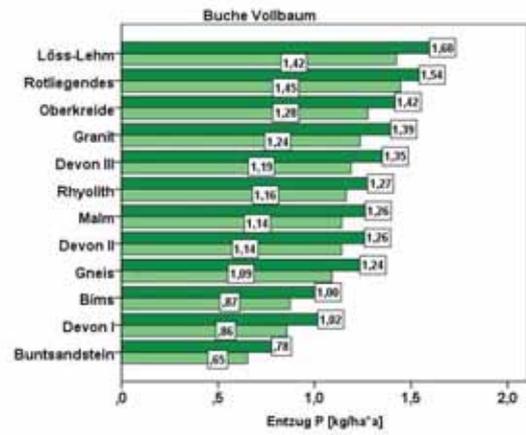
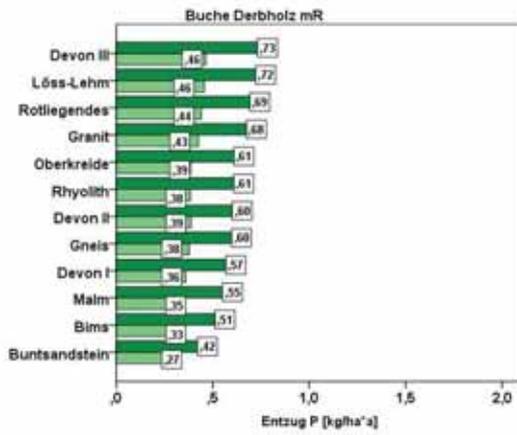


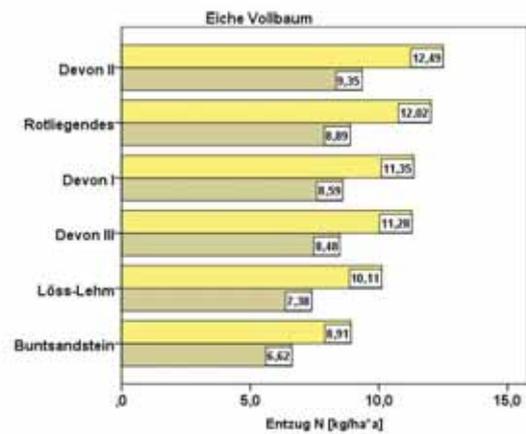
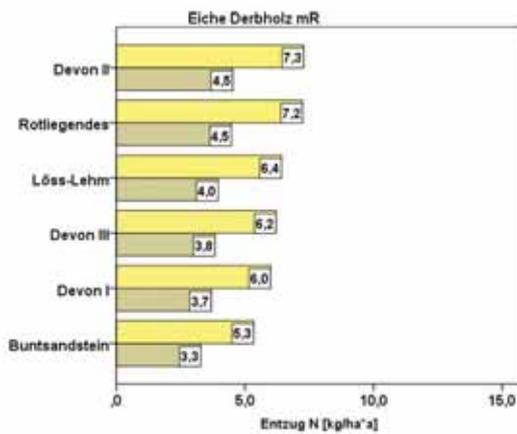
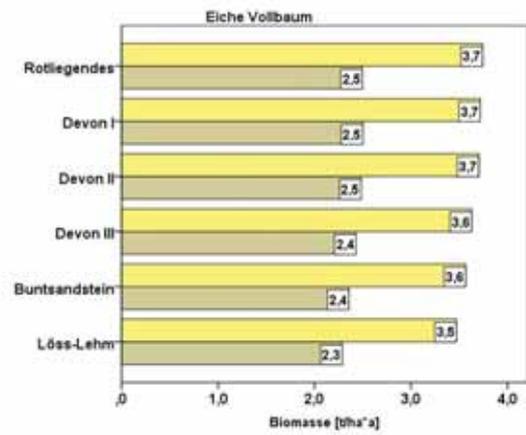
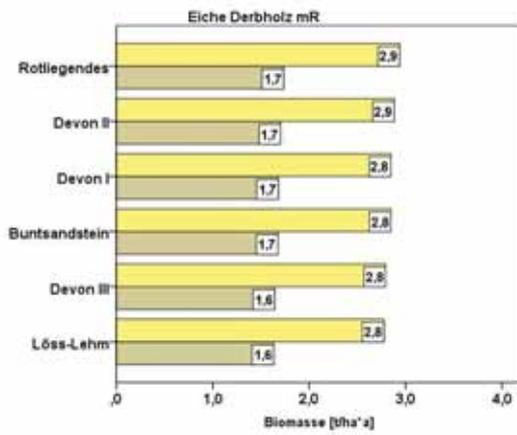
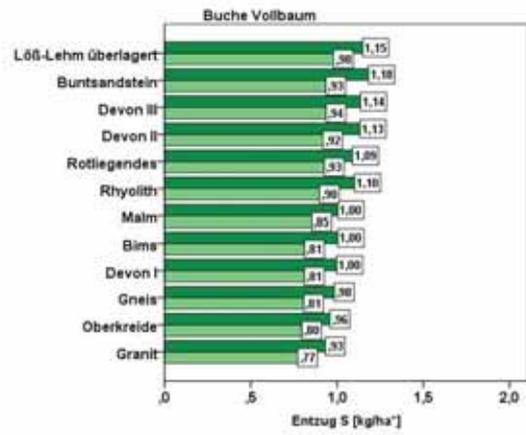
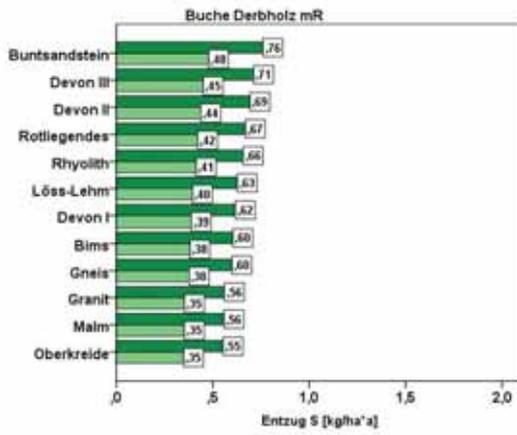


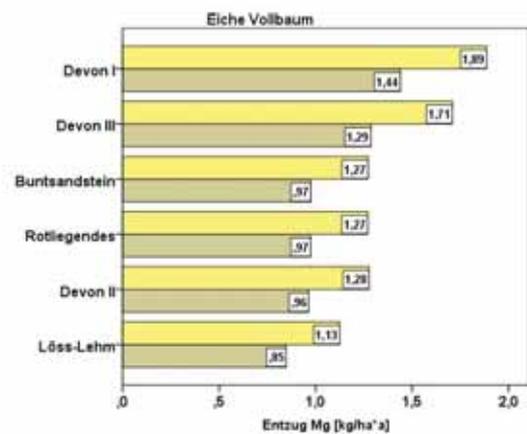
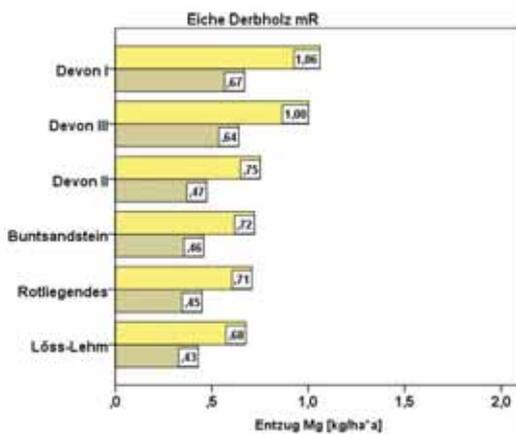
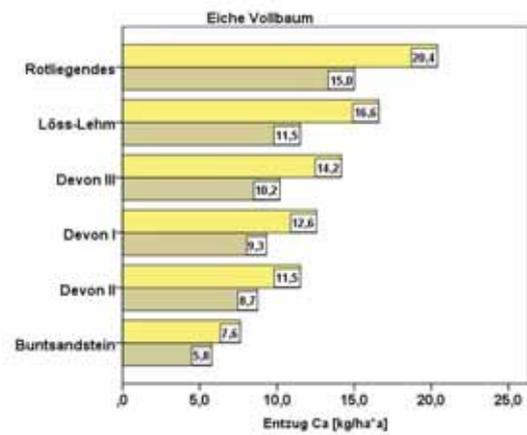
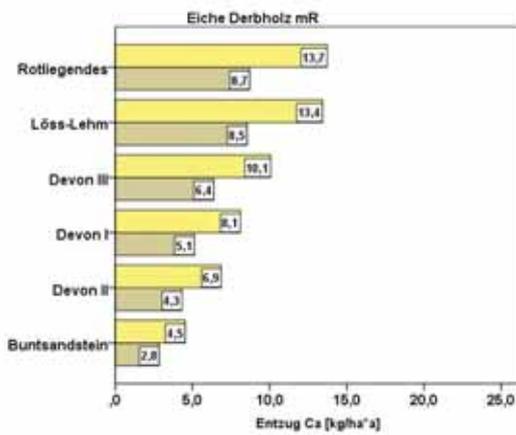
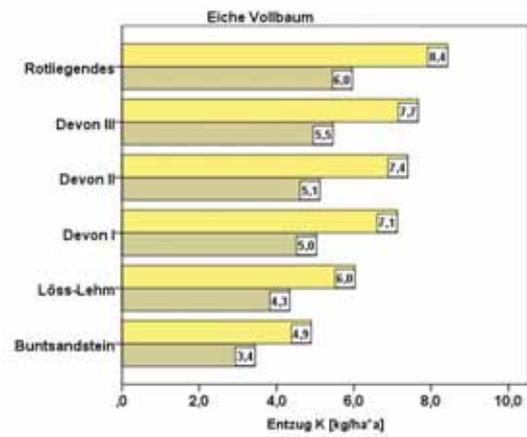
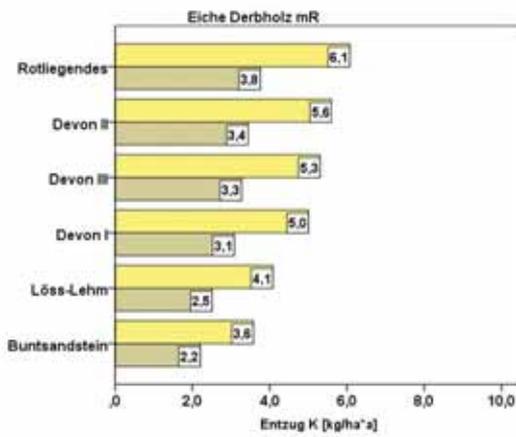
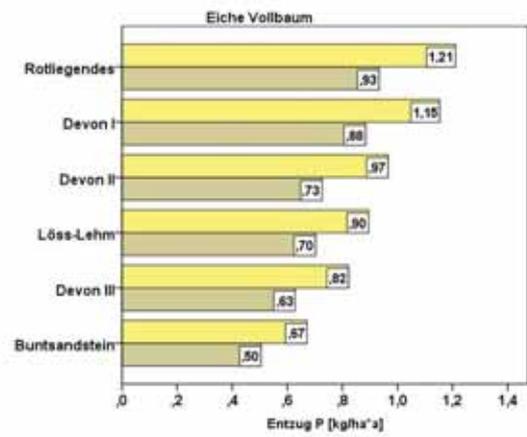
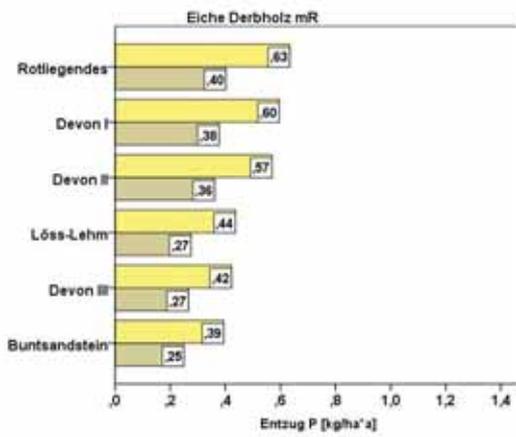


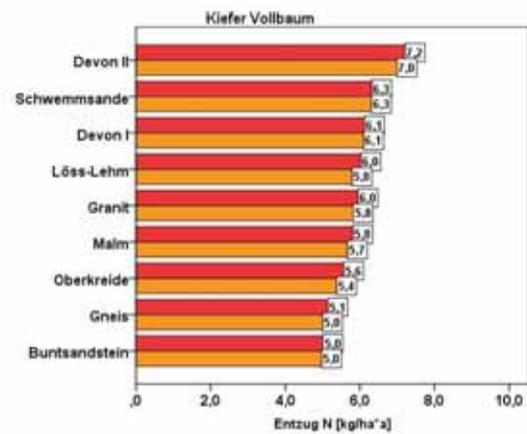
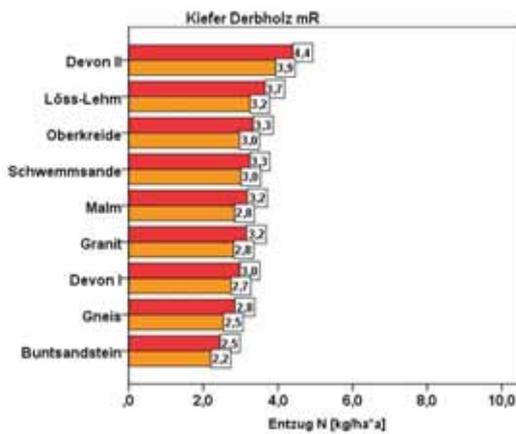
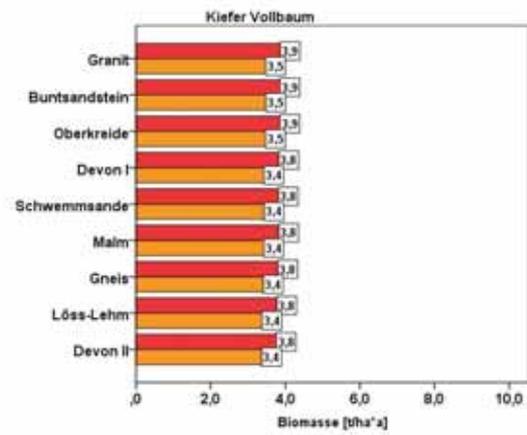
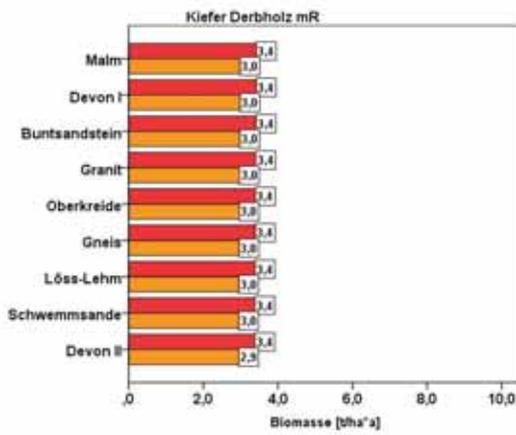
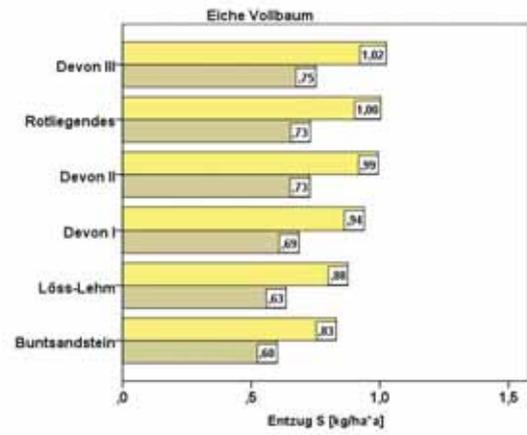
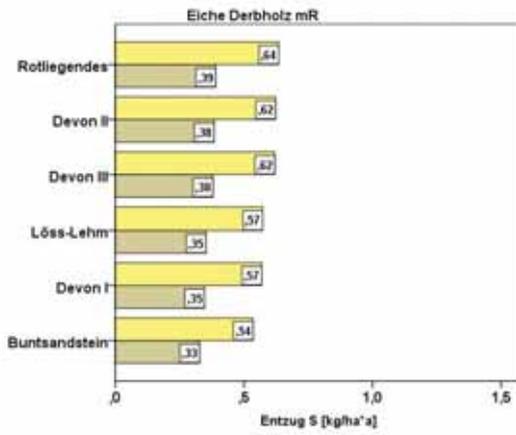


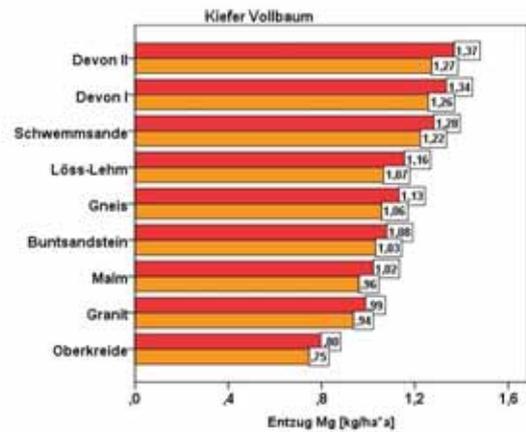
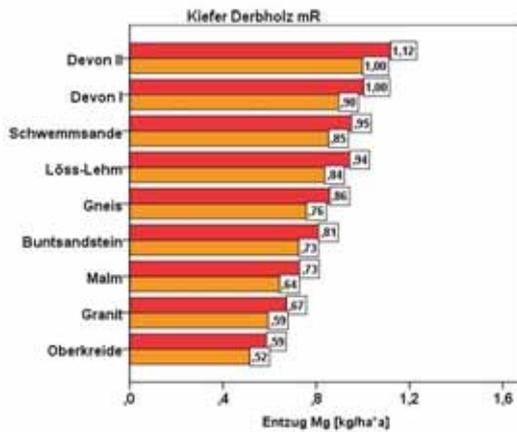
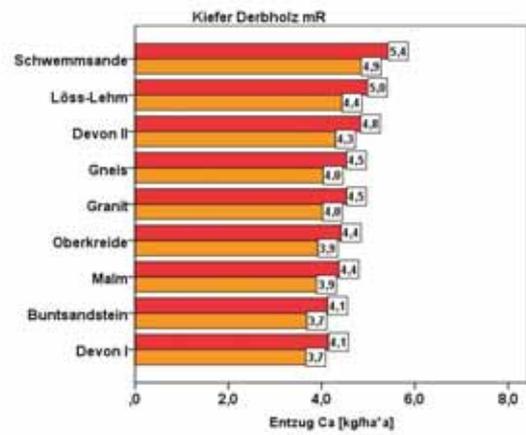
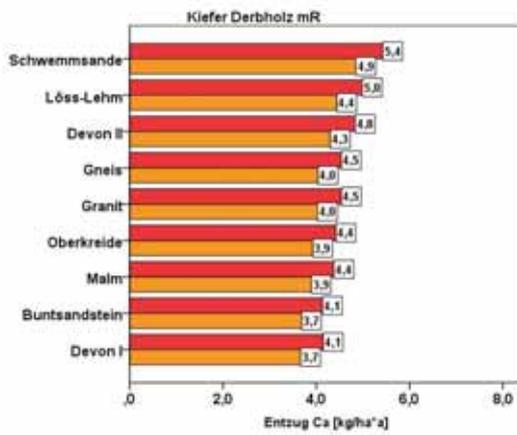
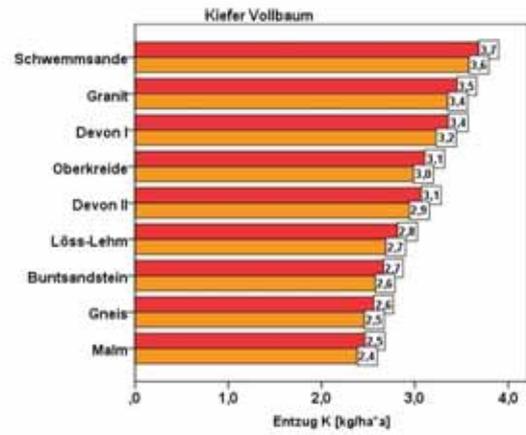
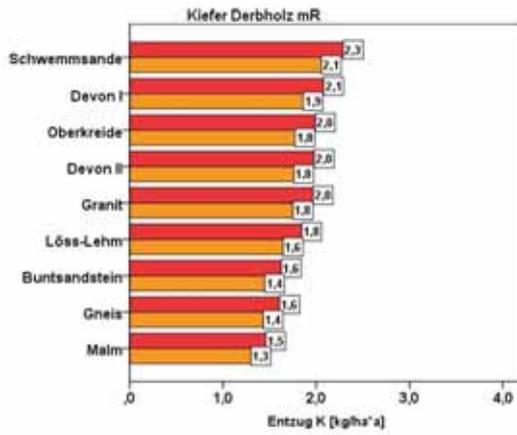
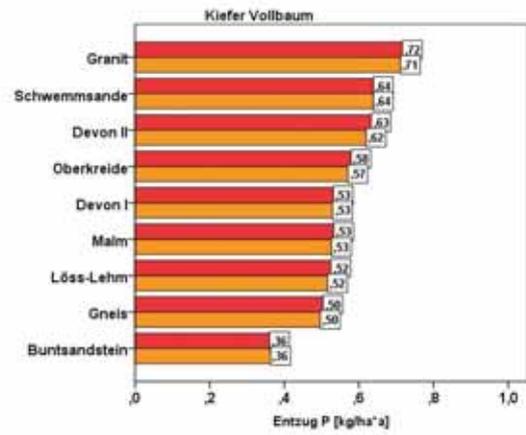
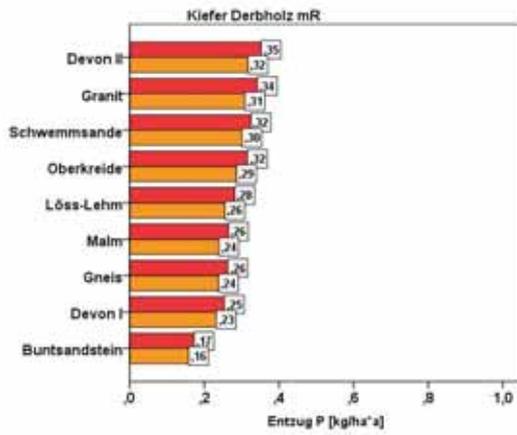


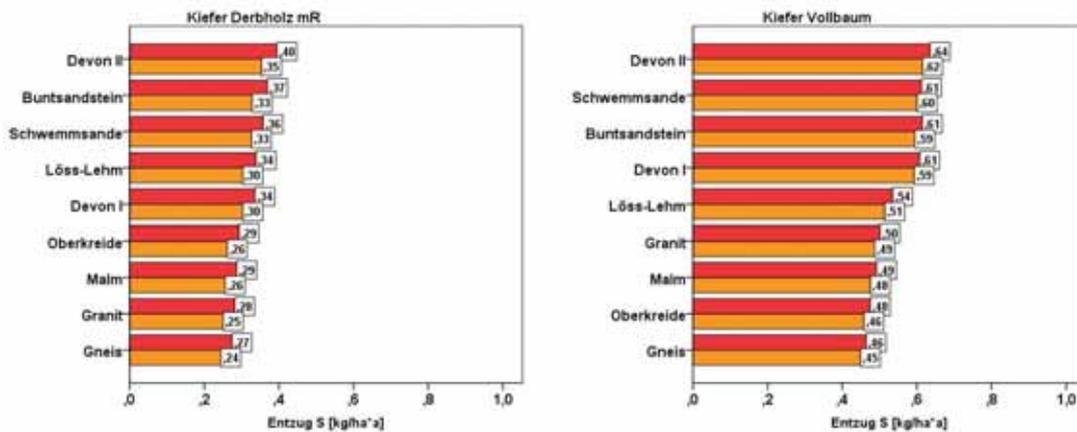






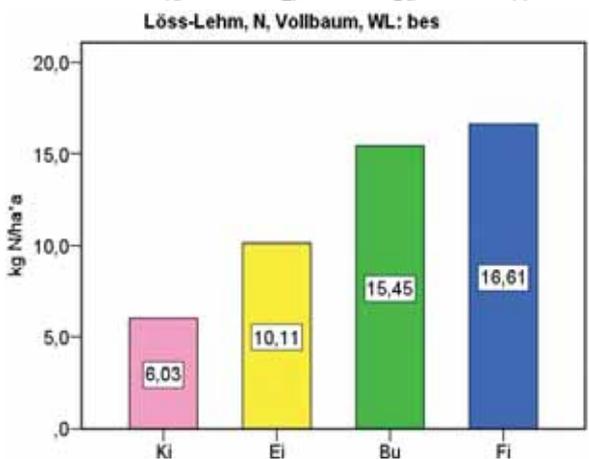
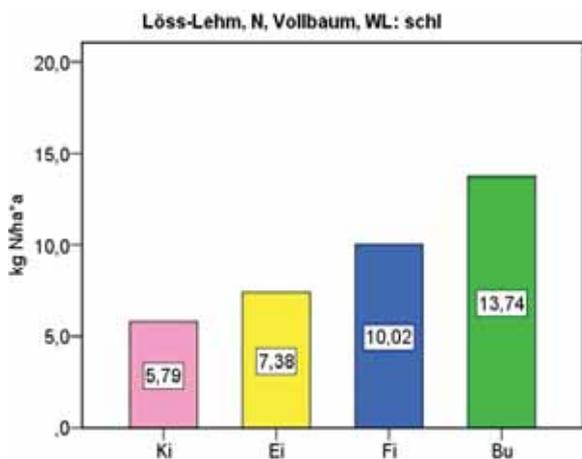
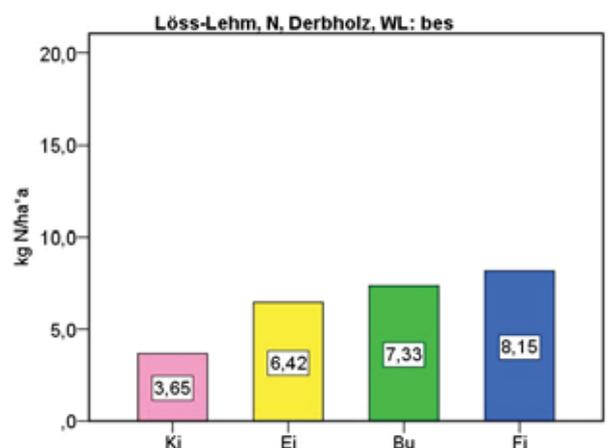
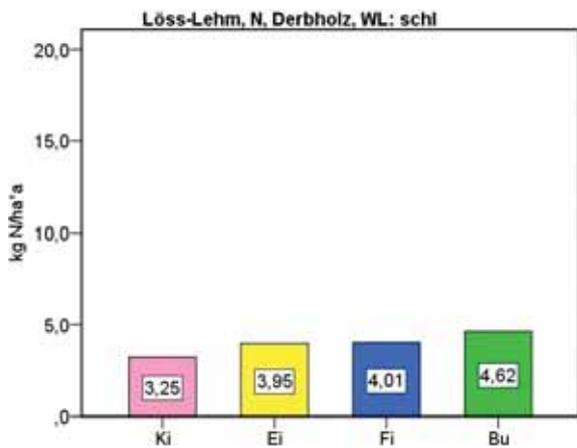
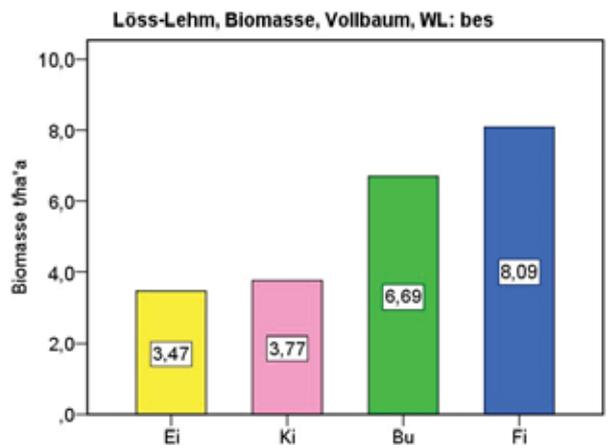
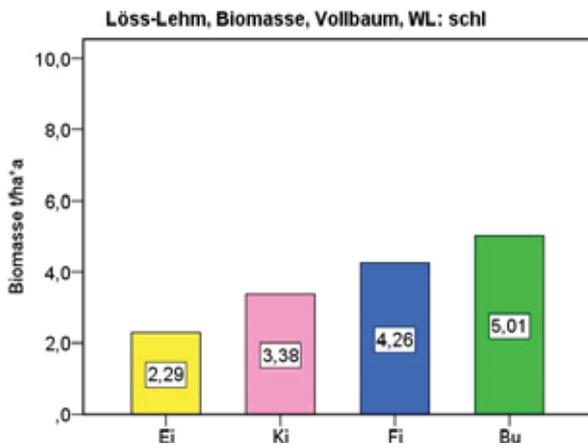
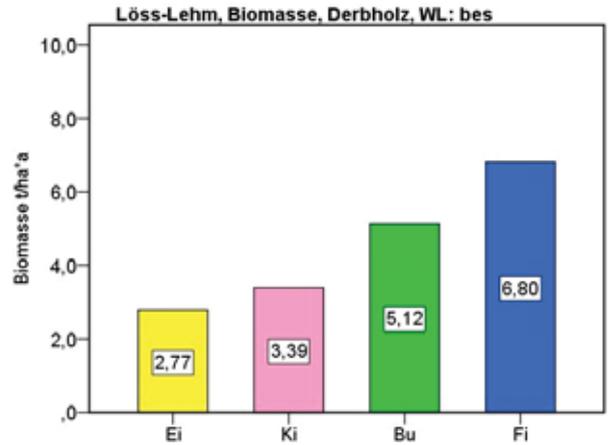
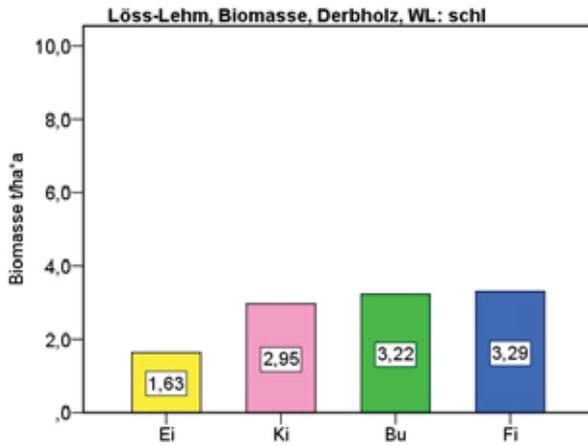


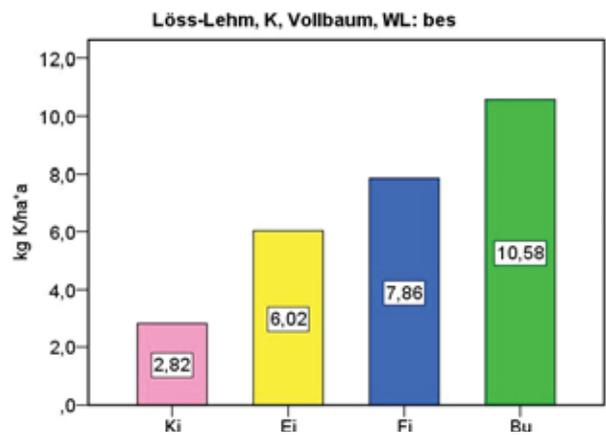
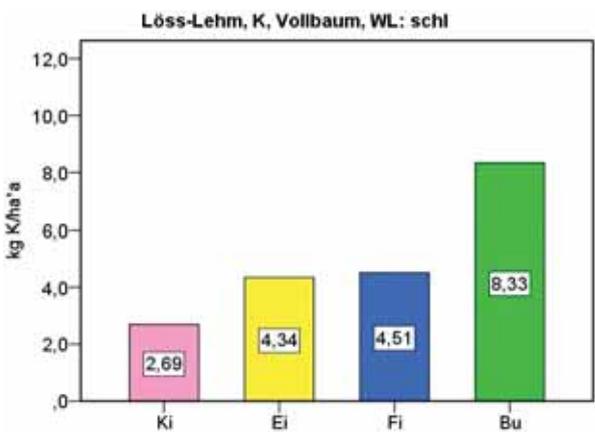
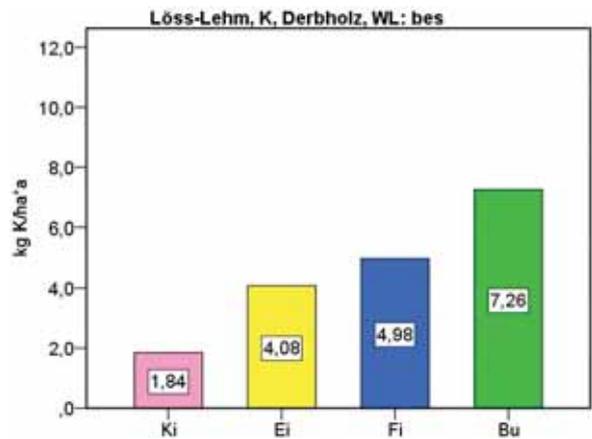
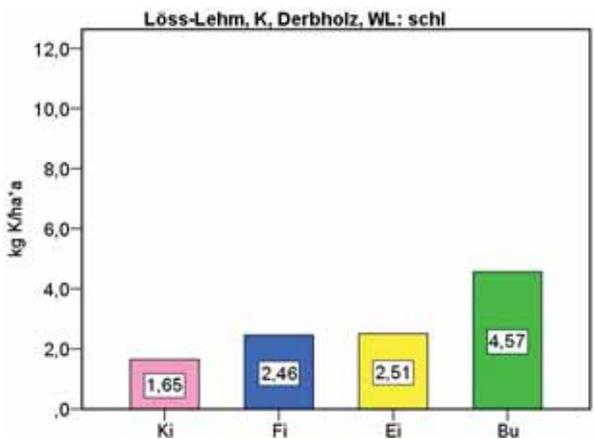
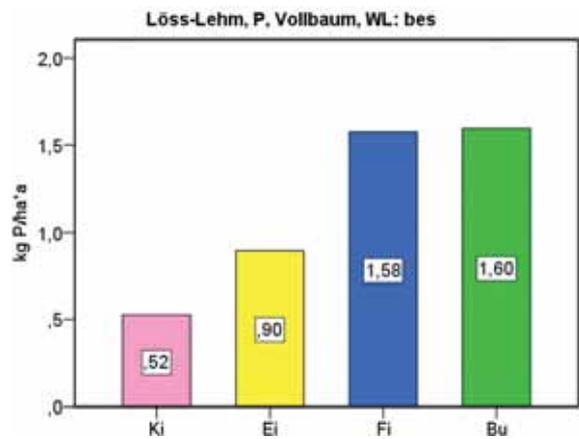
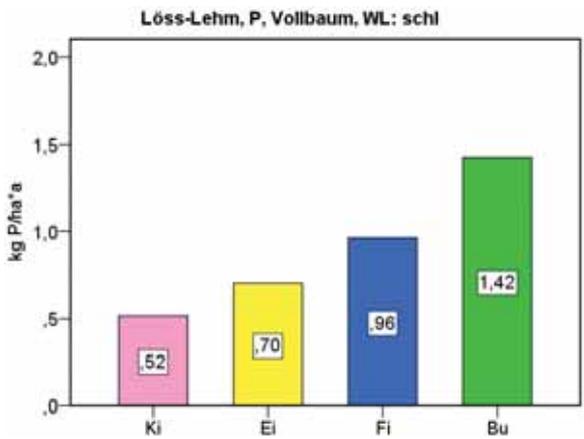
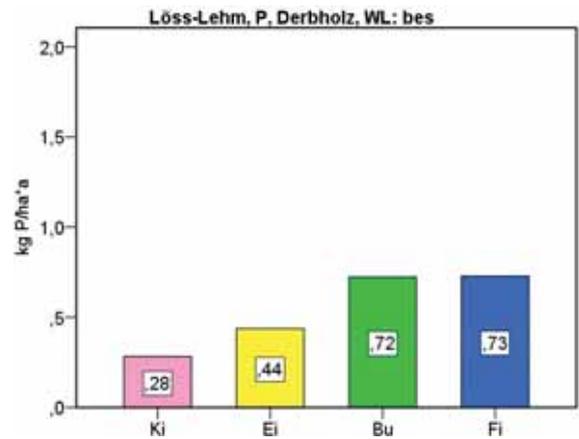
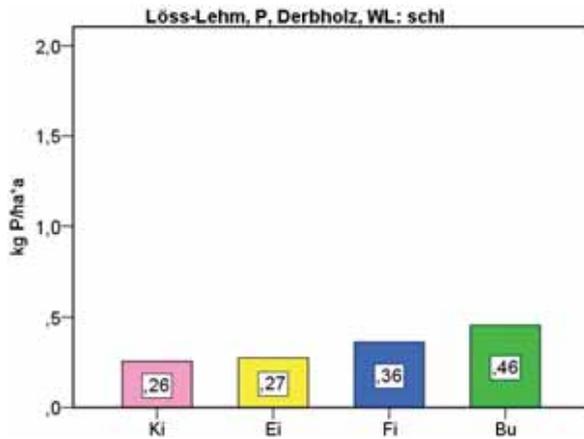


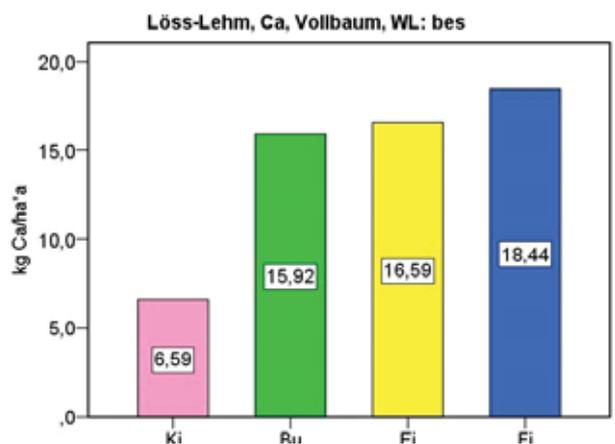
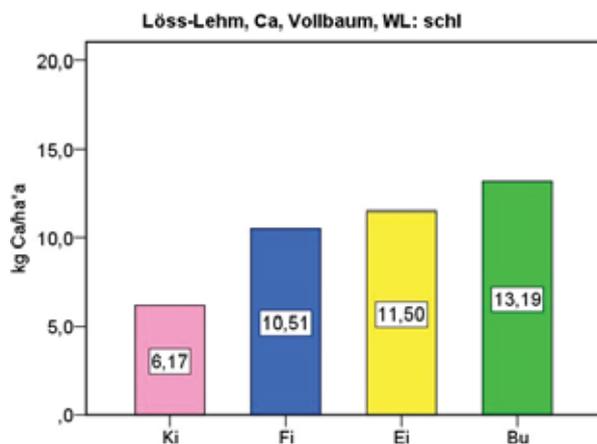
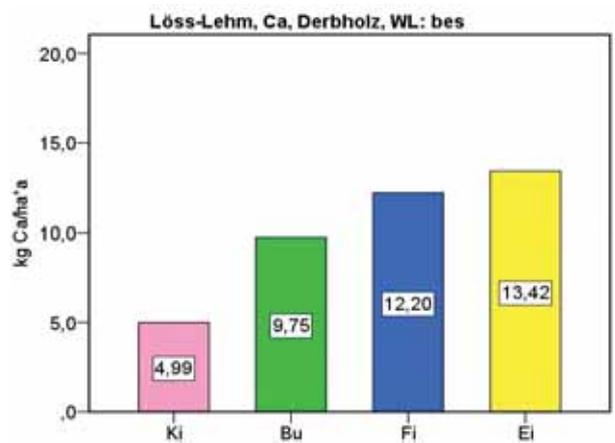
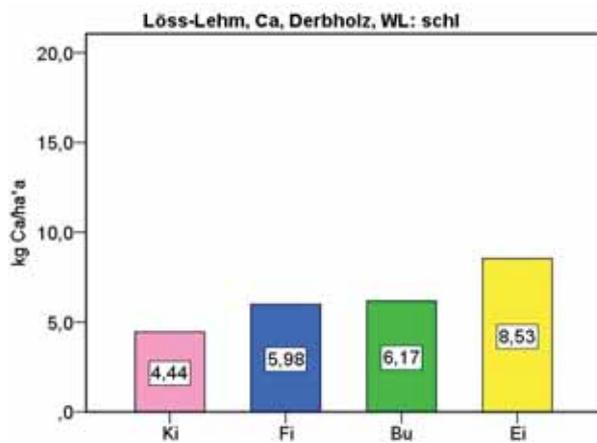
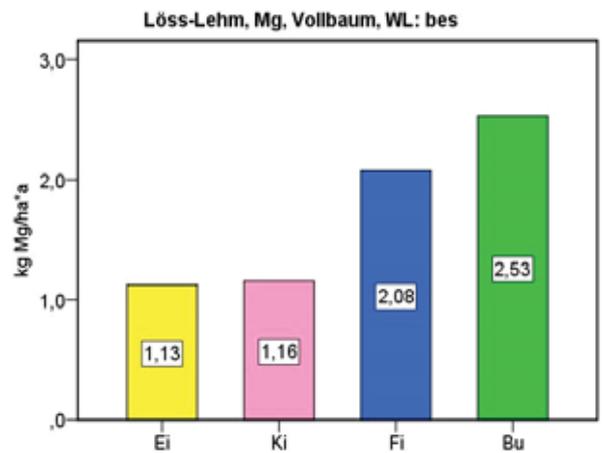
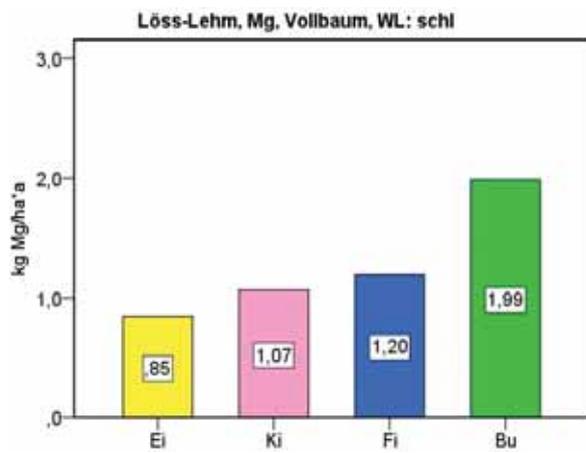
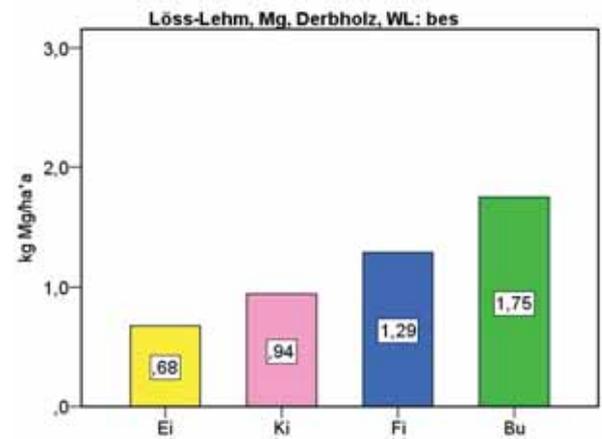
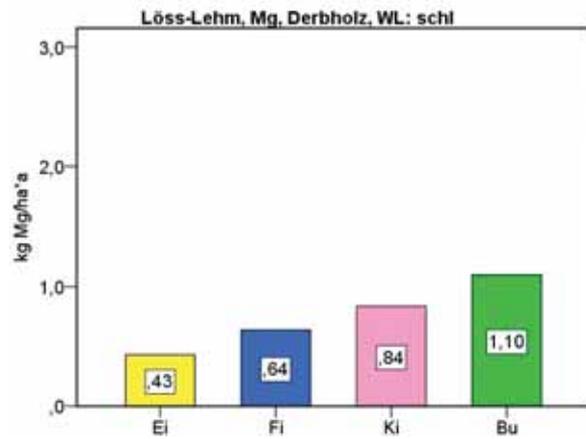


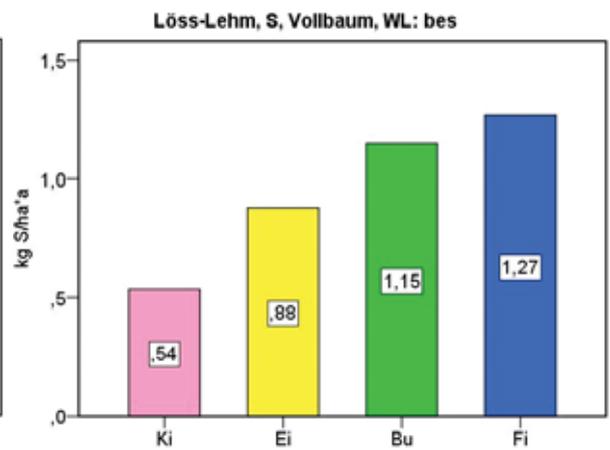
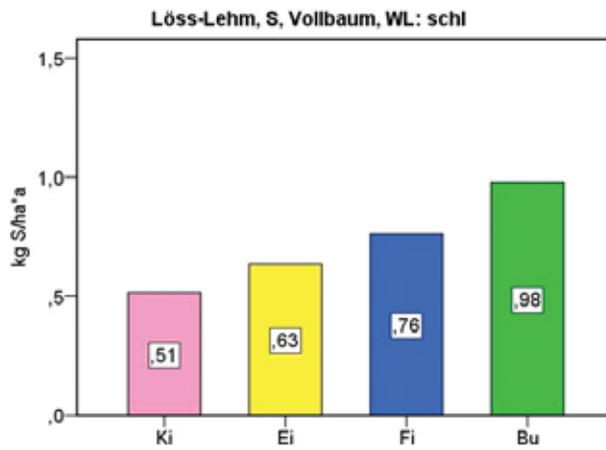
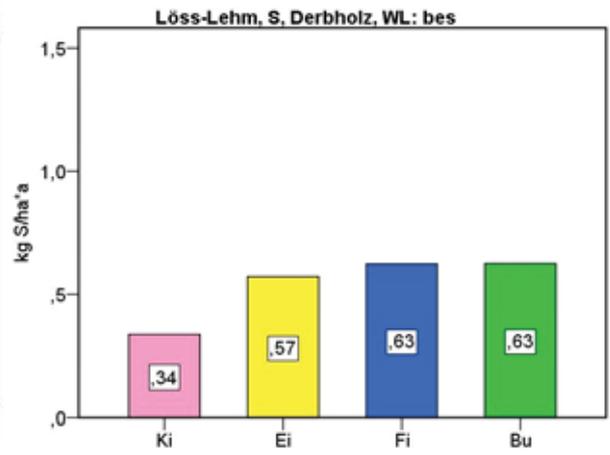
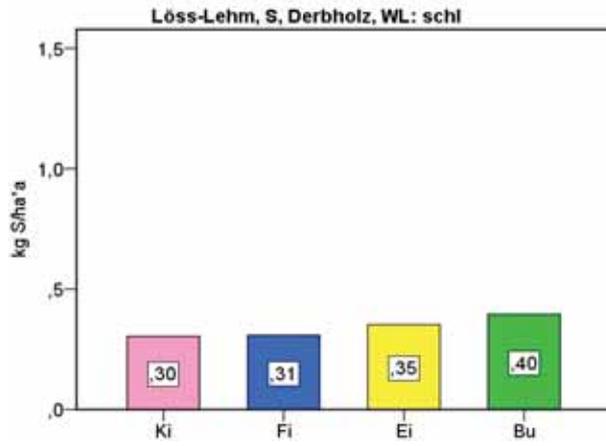
Anhang 2: Ergebnisgrafiken zu Biomasse- und Nährstoffentzügen nach Bestandestypen

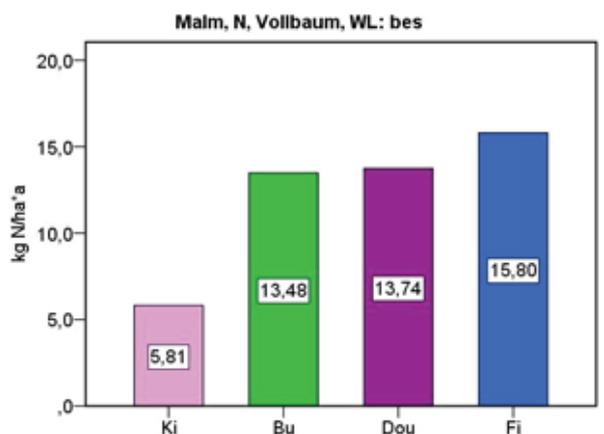
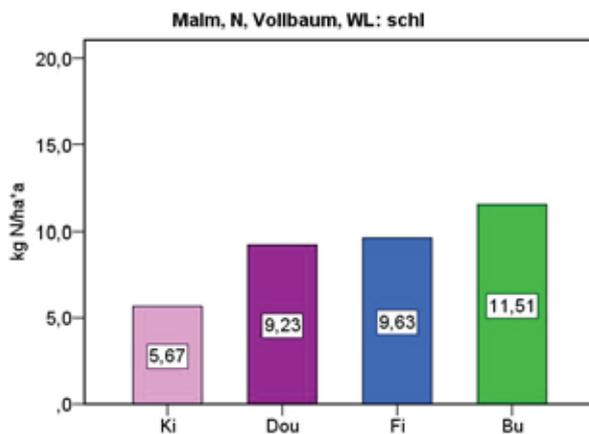
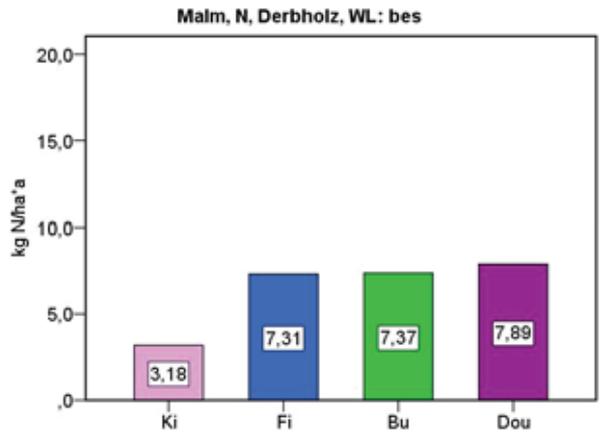
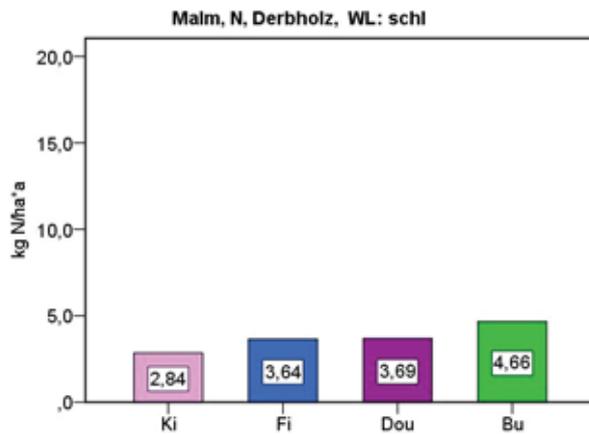
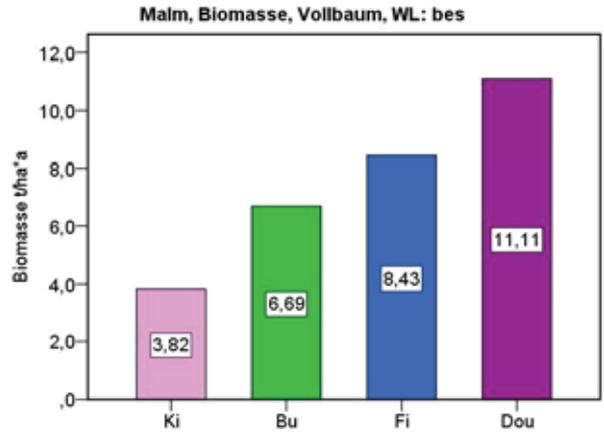
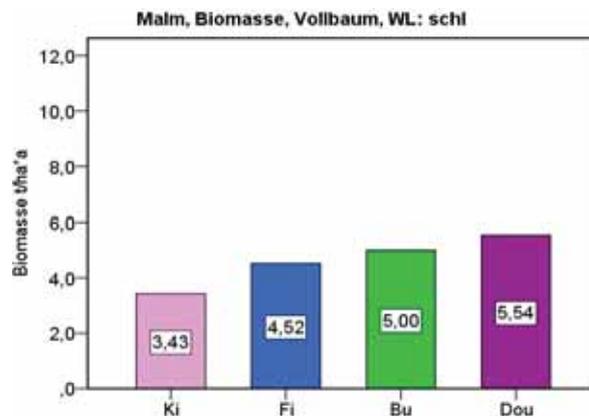
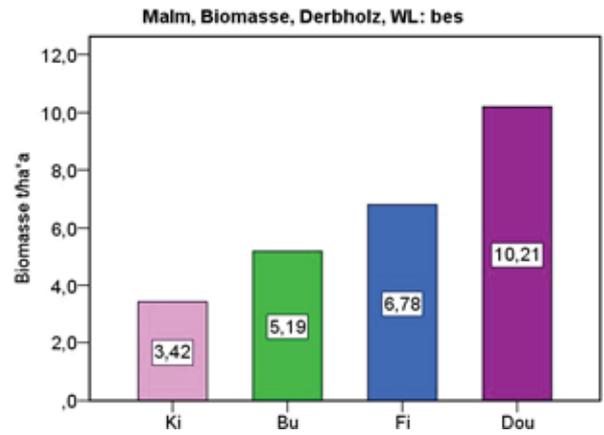
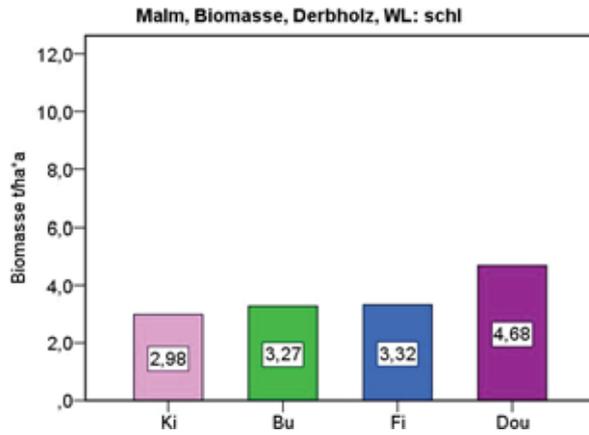
Biomasse- und Nährstoffentzüge bei unterschiedlicher Bestockung auf den jeweils untersuchten Substraten in Bayern und Rheinland-Pfalz differenziert nach Derbholznutzung (mit Rinde) - Vollbaumnutzung sowie bessere Wuchsleistung (WL: bes) - schwächere Wuchsleistung (WL: schl); Die Kalkulationen beziehen sich bei allen Baumarten auf Reinbestände und einen Kalkulationszeitraum von jeweils 100 Jahren (Entzüge bei Durchforstungen bis Alter 100 zuzüglich virtueller Nutzung des 100-jährigen Bestandes).

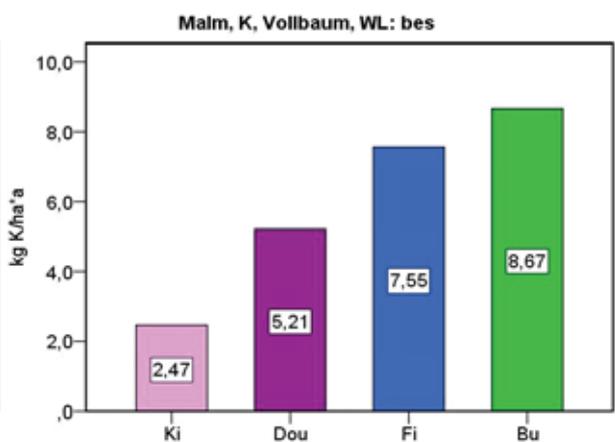
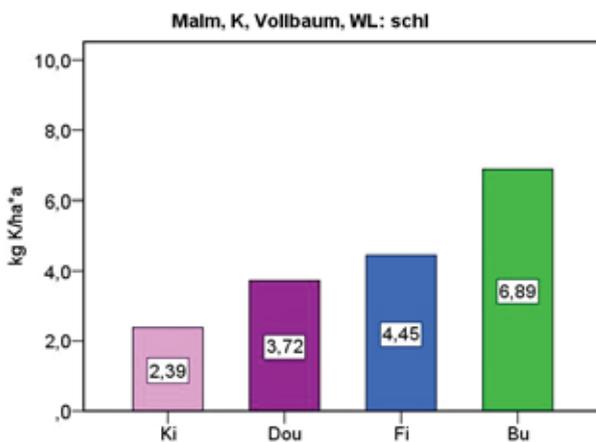
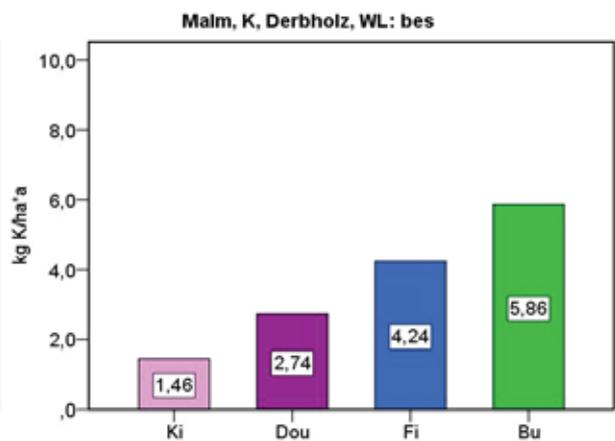
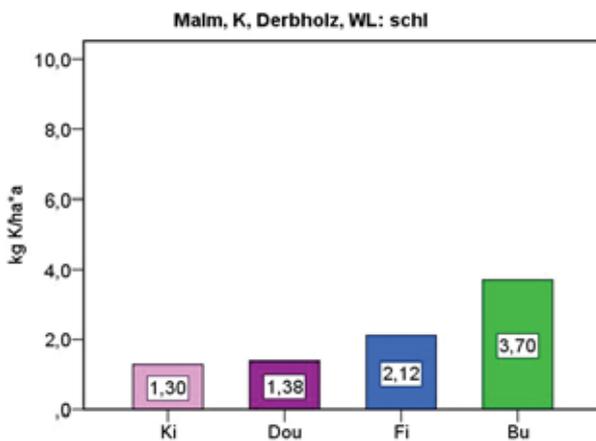
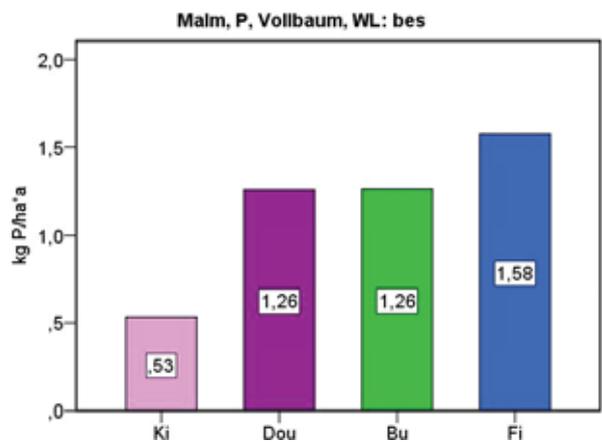
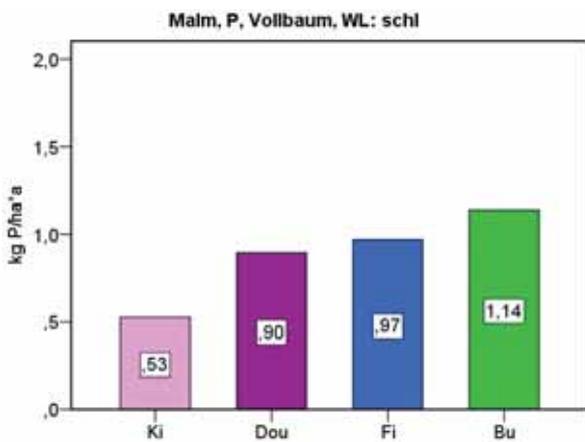
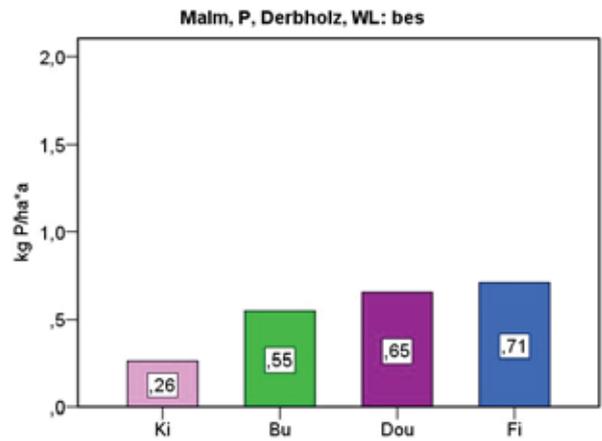
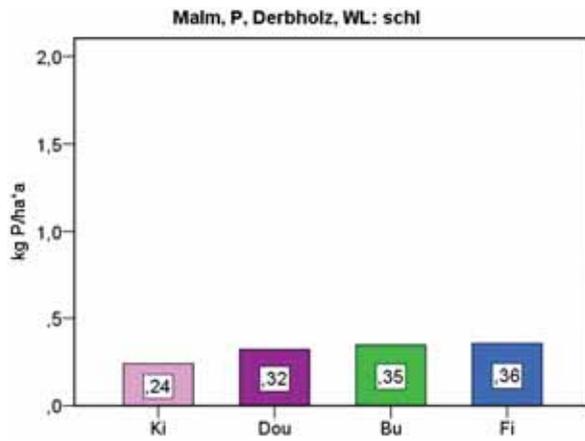


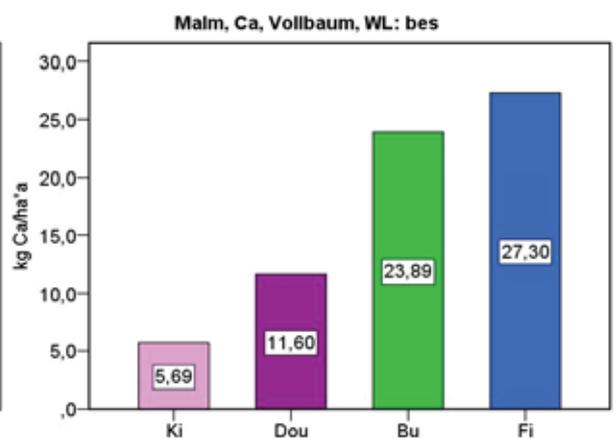
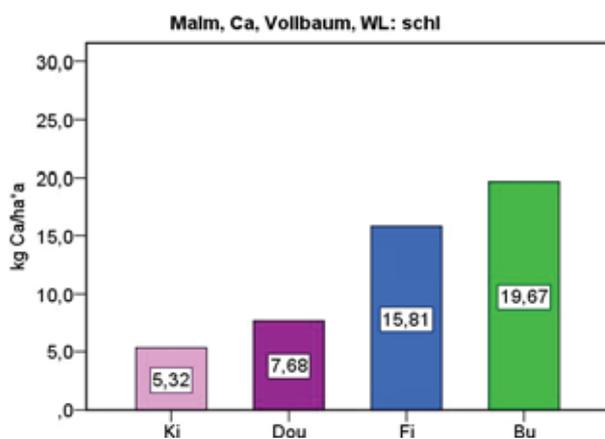
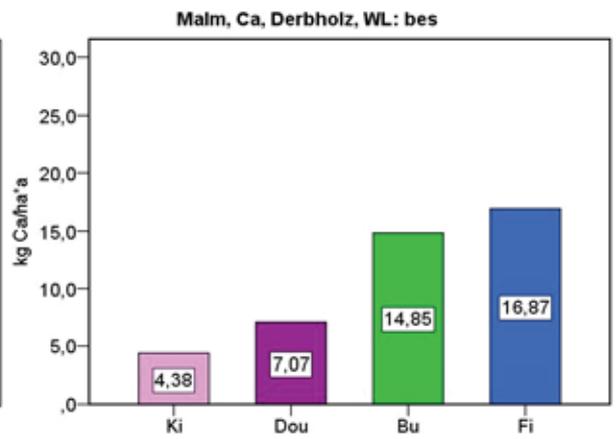
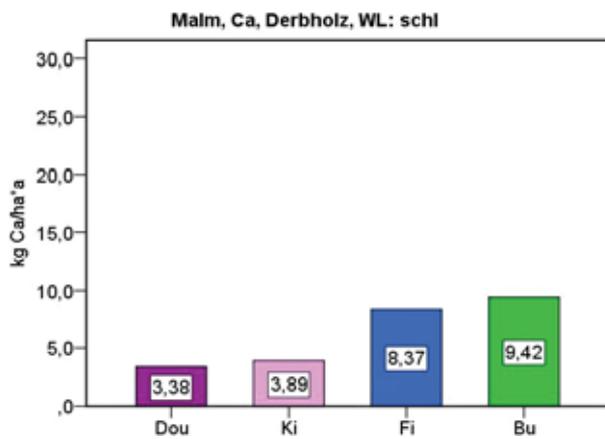
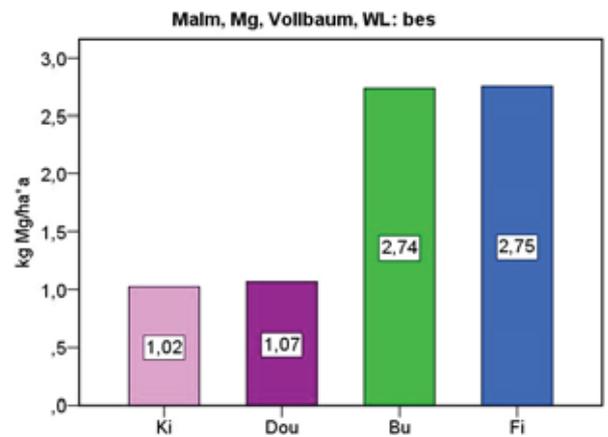
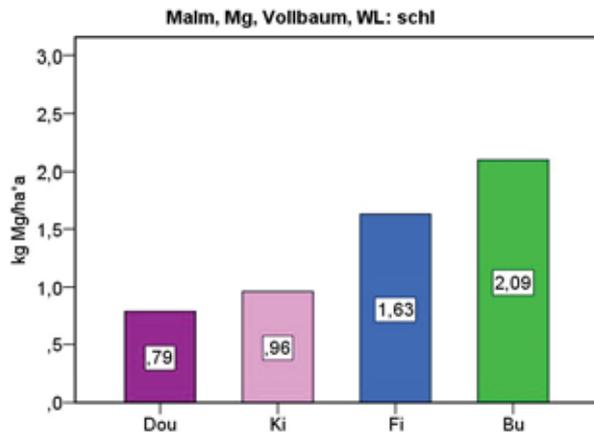
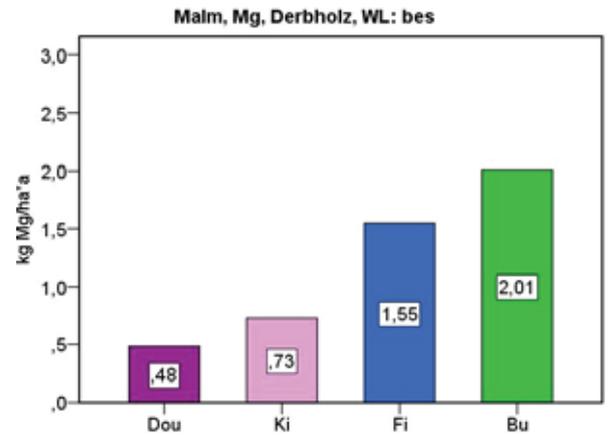
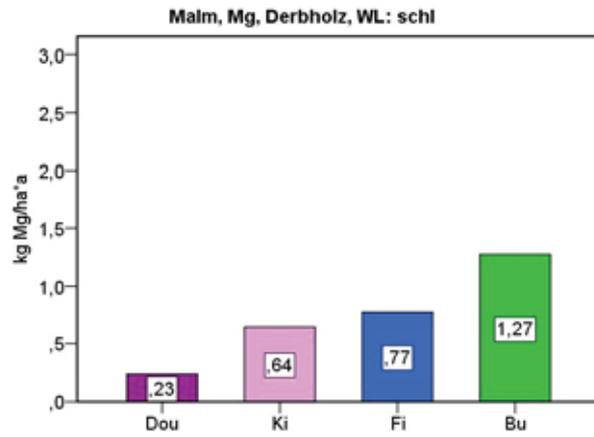


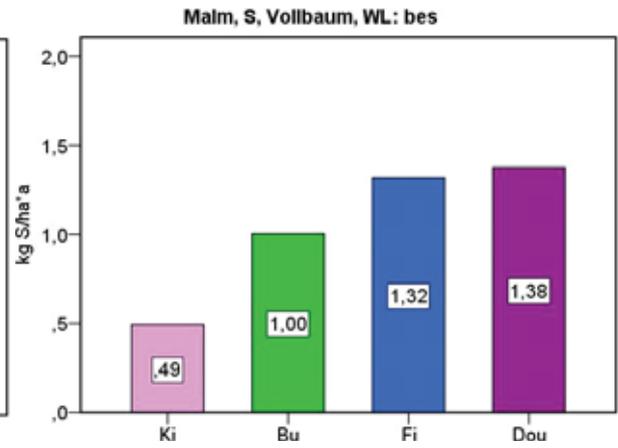
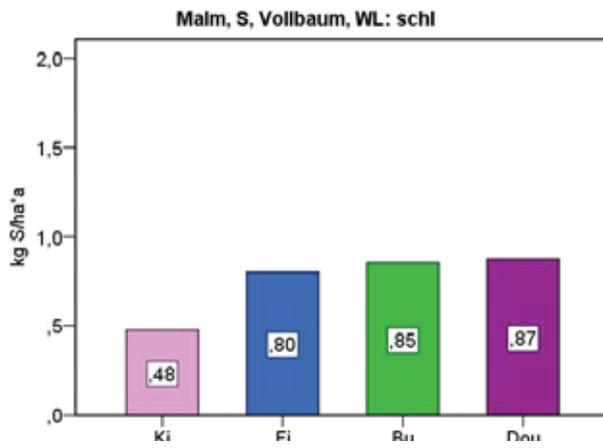
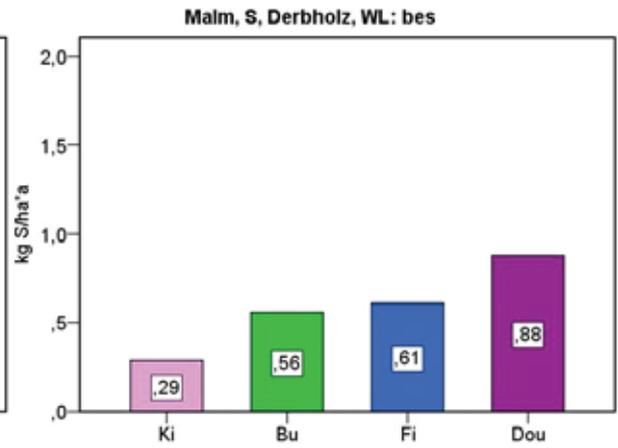
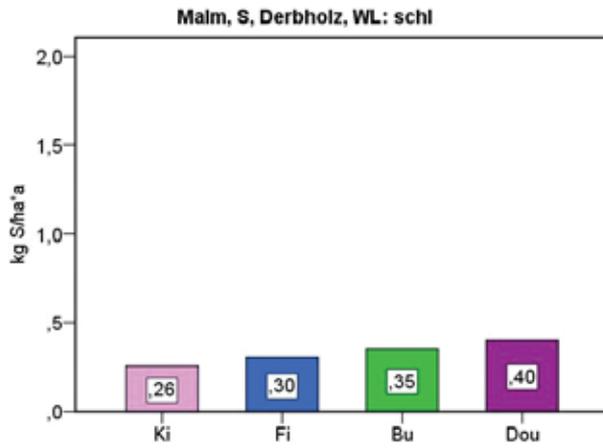


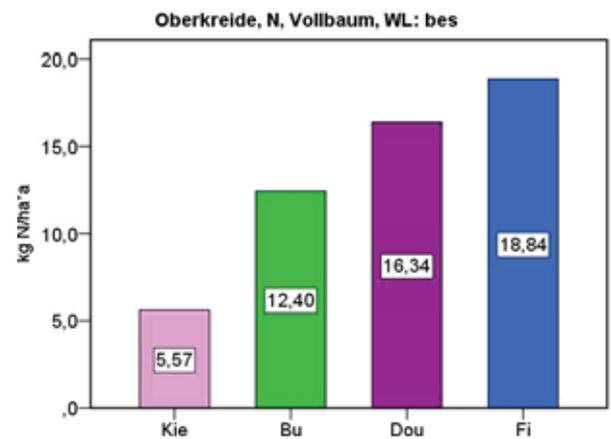
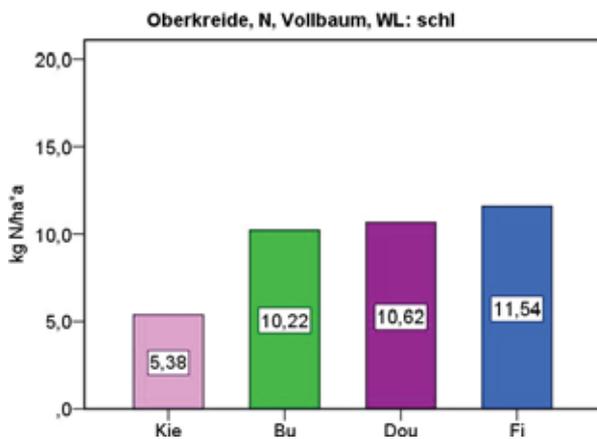
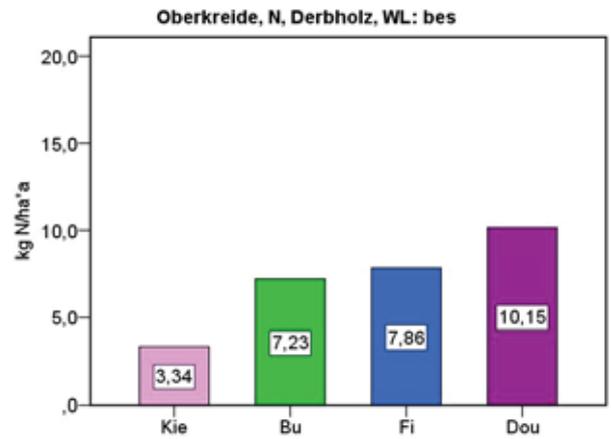
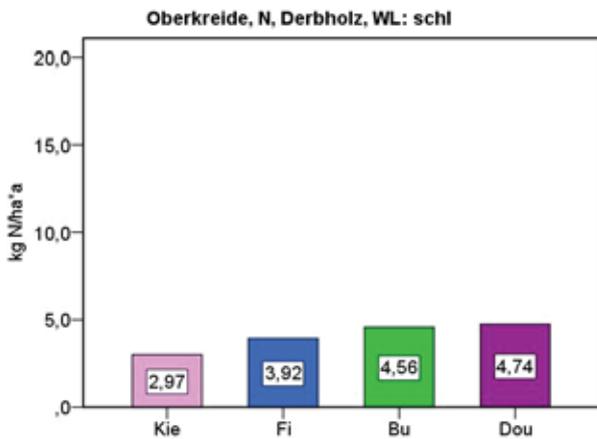
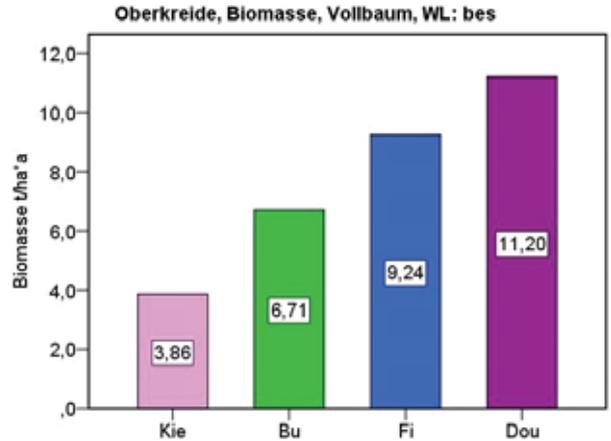
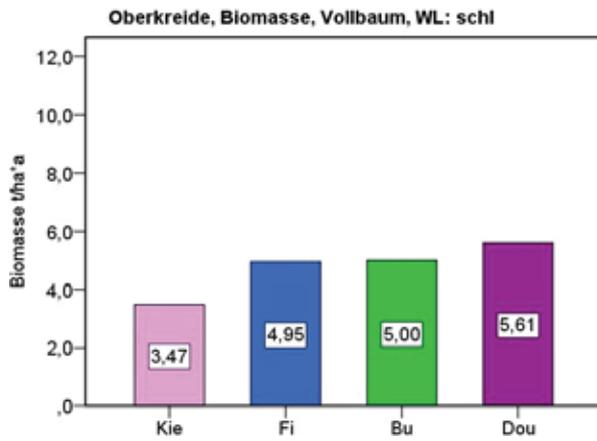
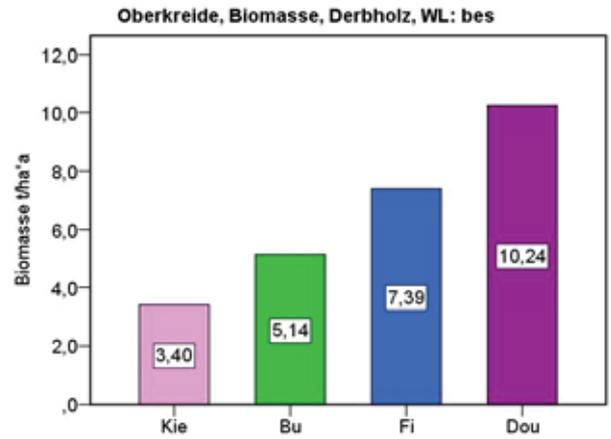
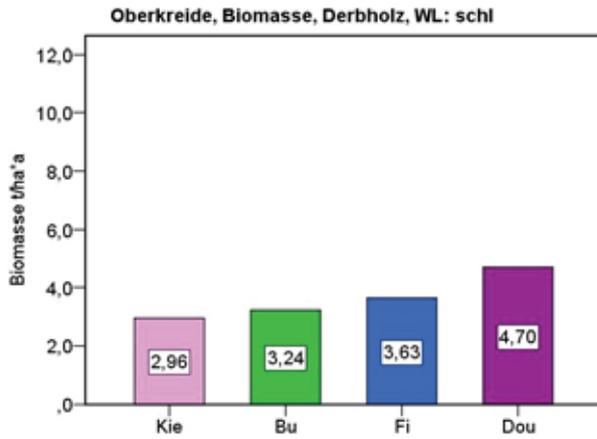


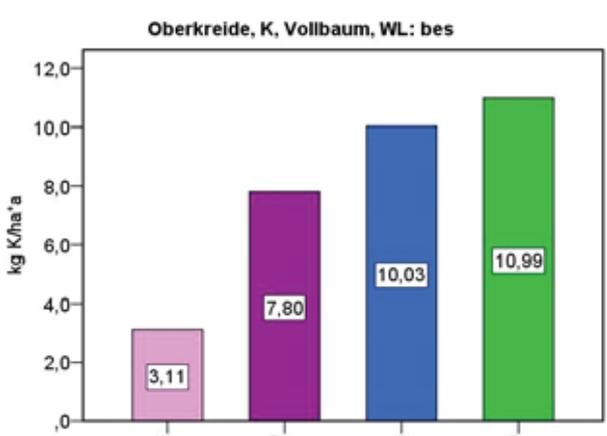
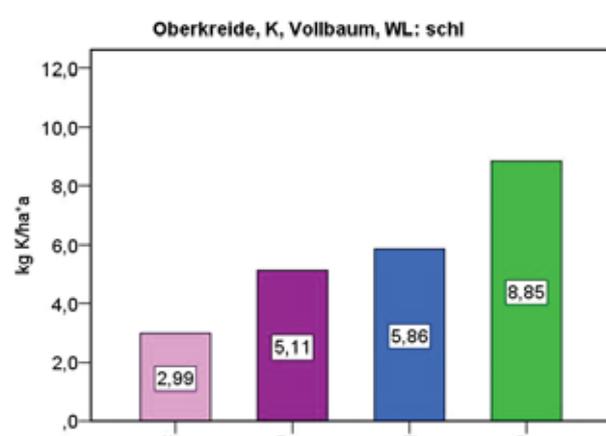
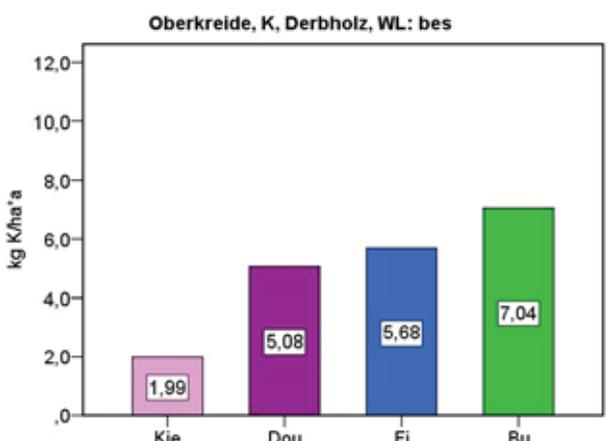
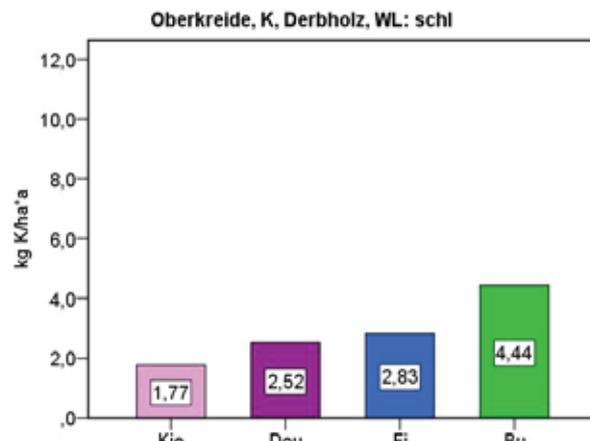
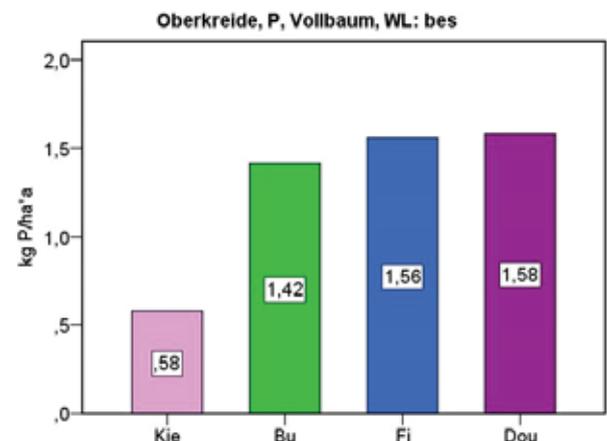
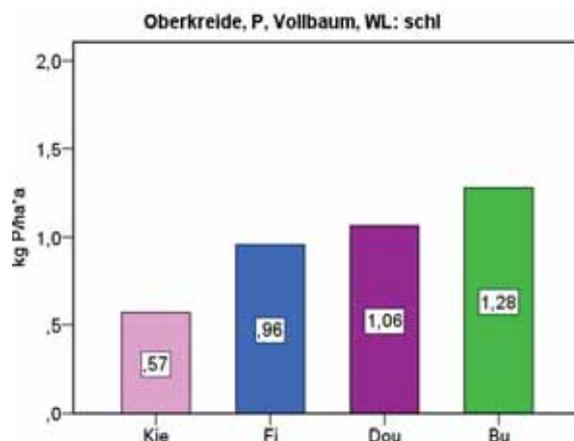
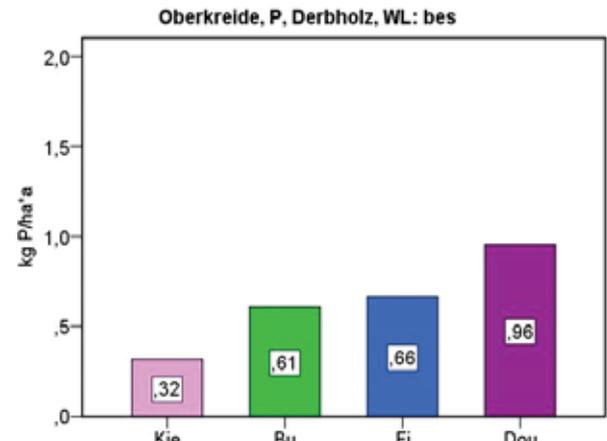
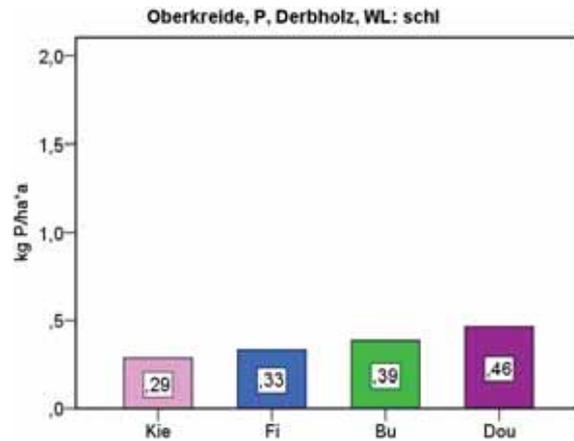


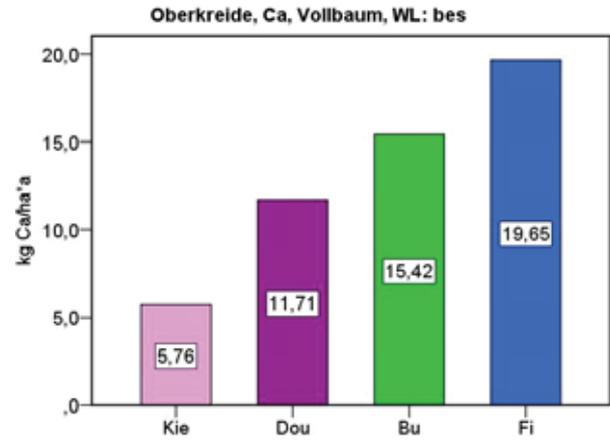
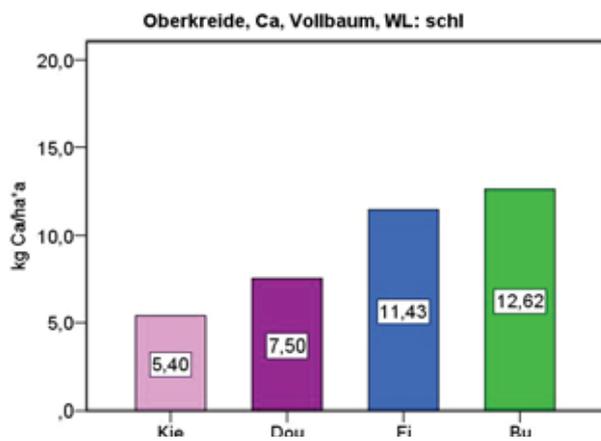
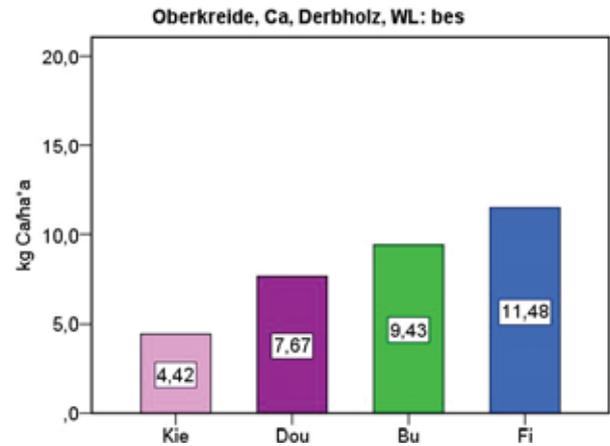
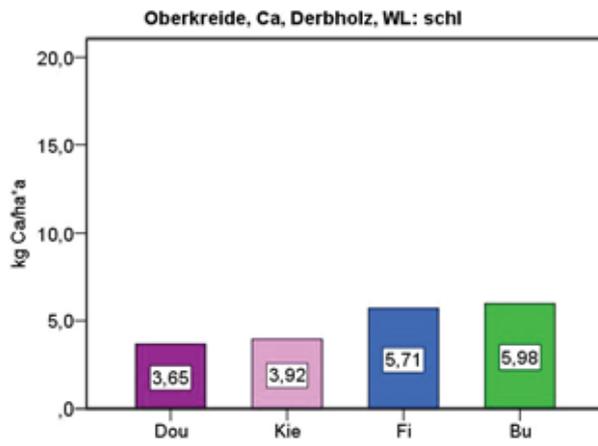
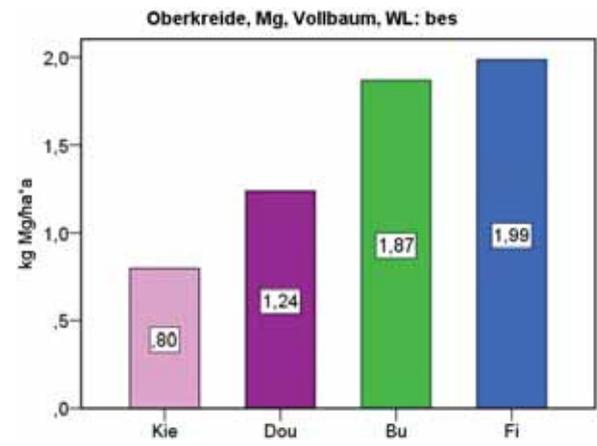
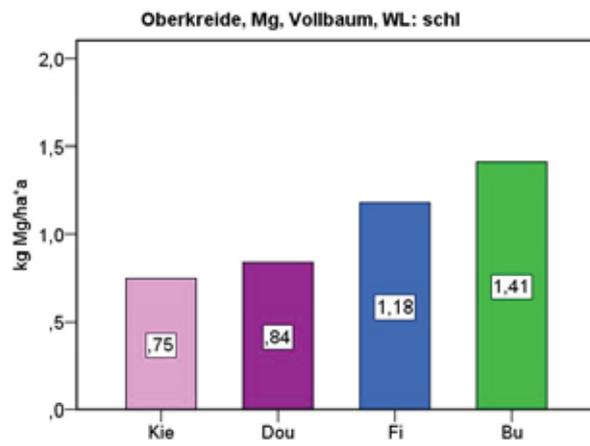
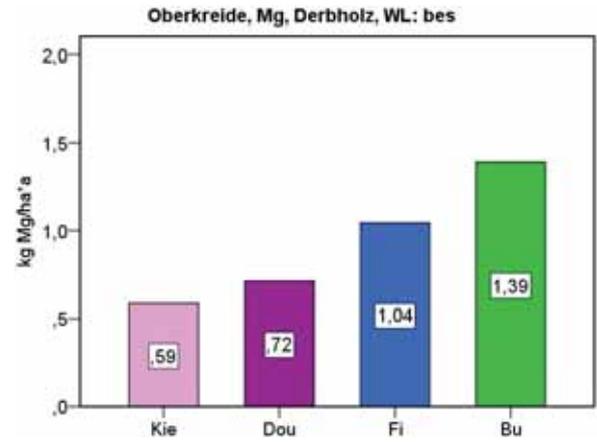
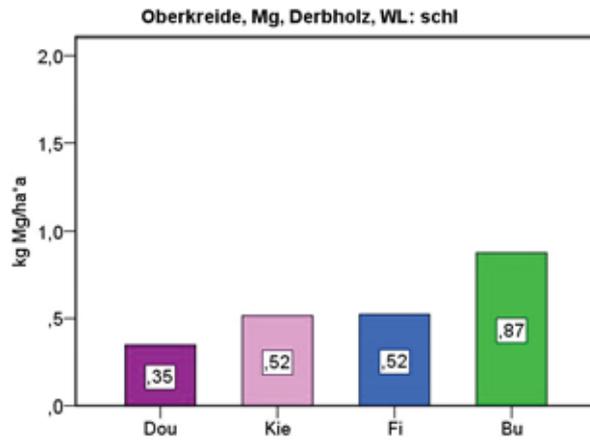


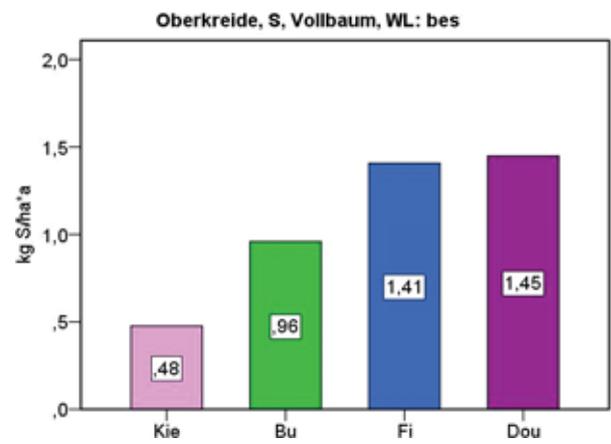
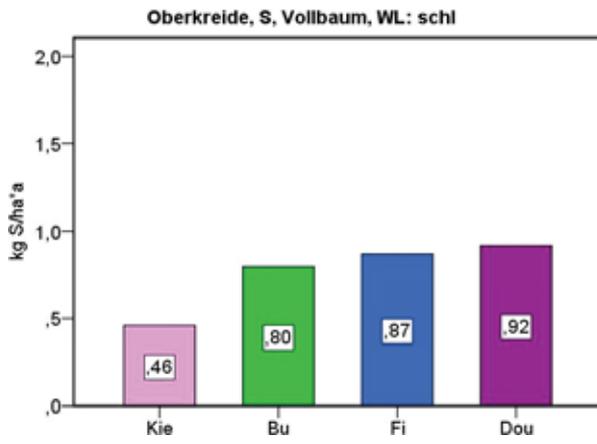
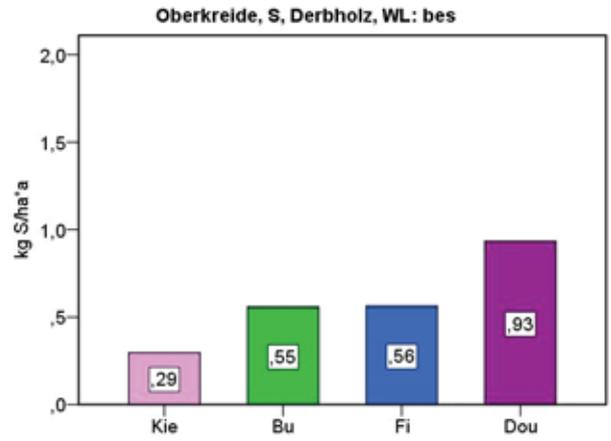
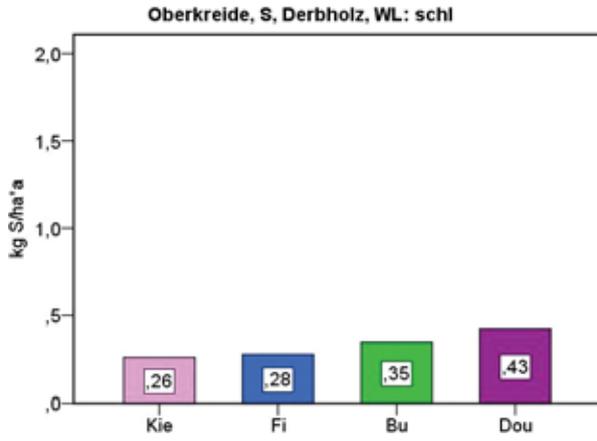


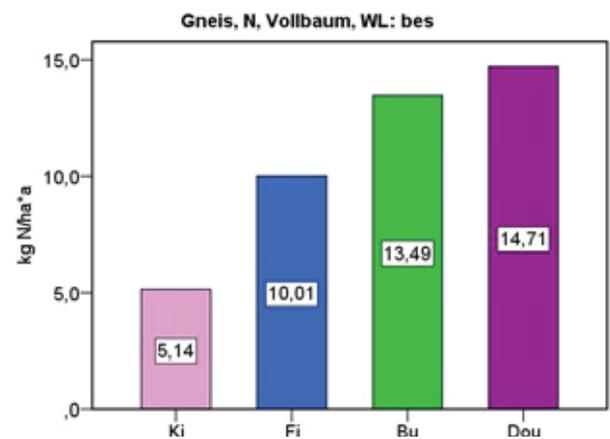
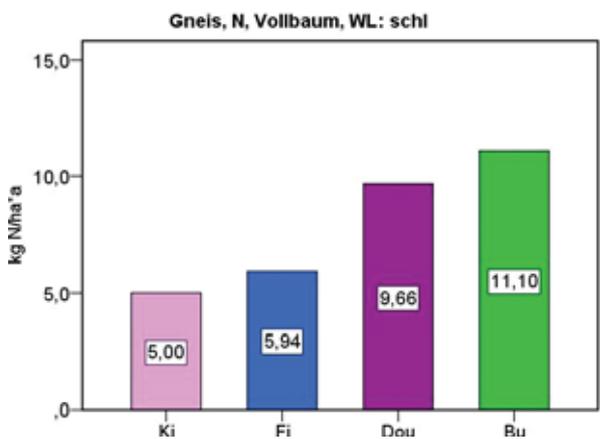
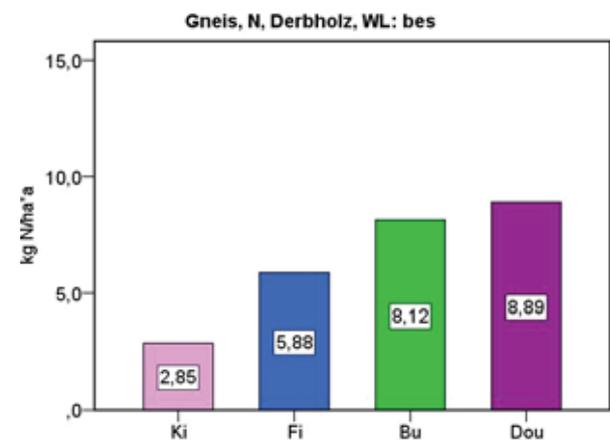
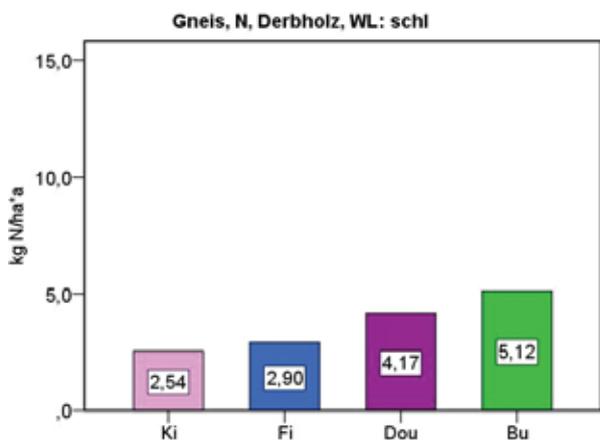
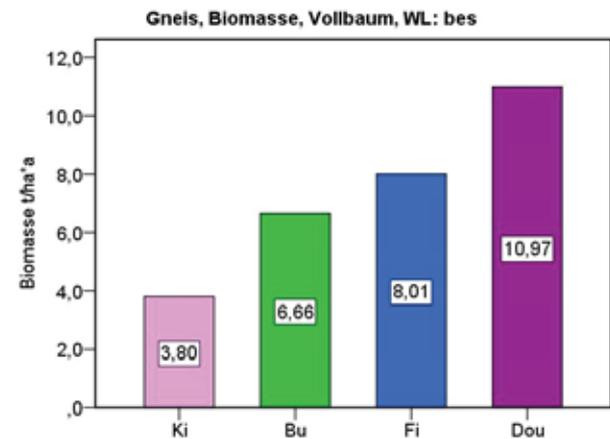
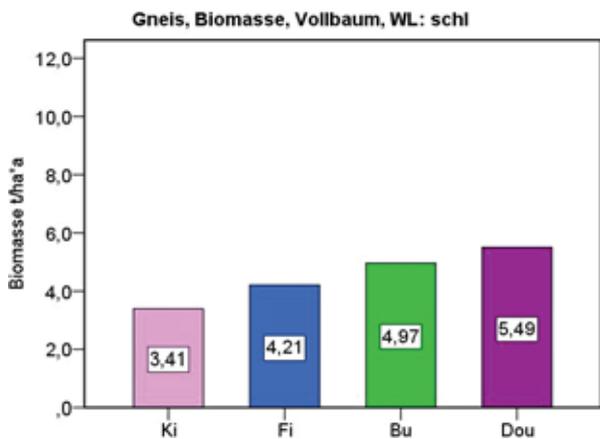
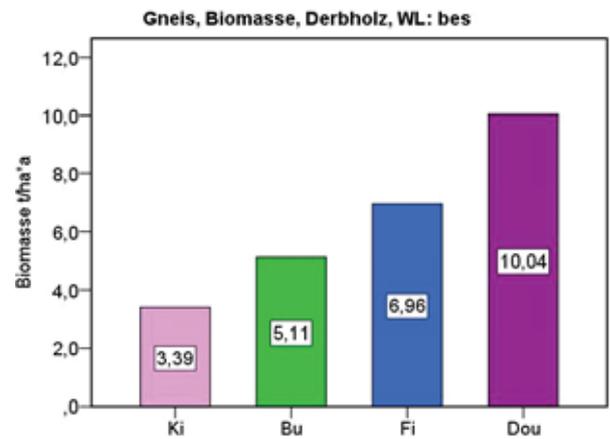
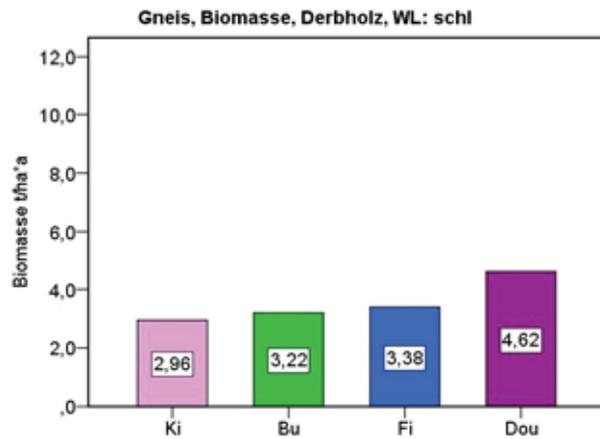


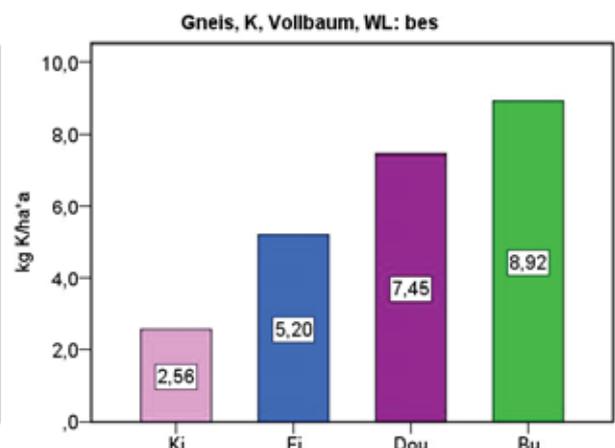
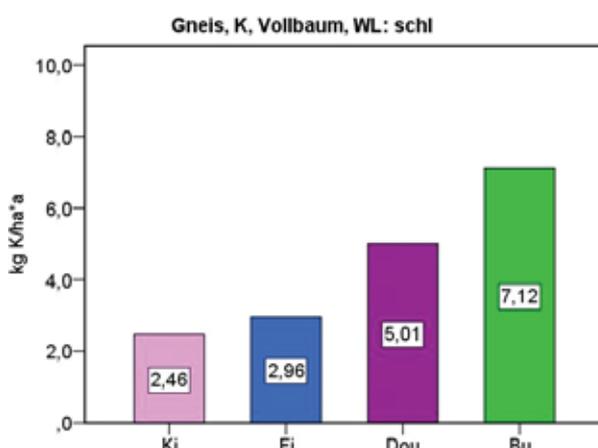
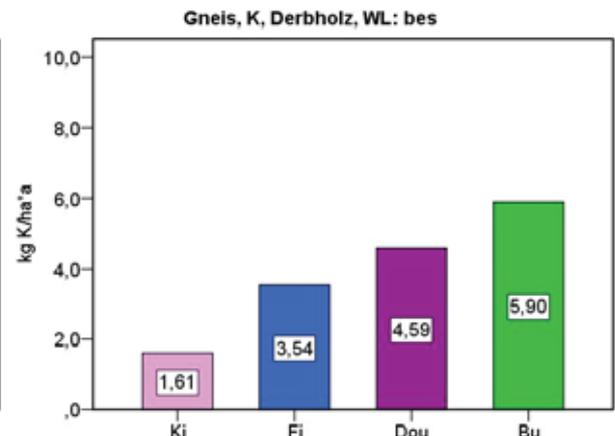
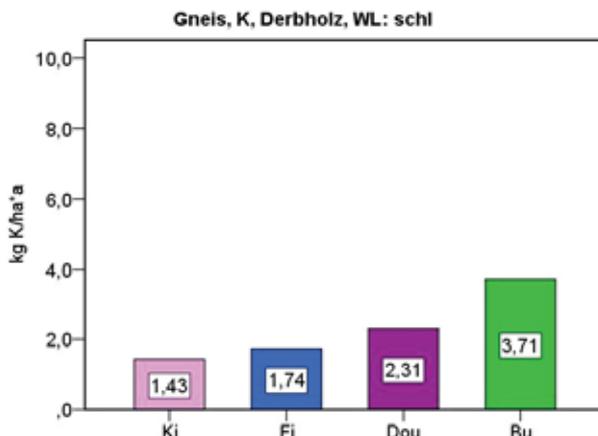
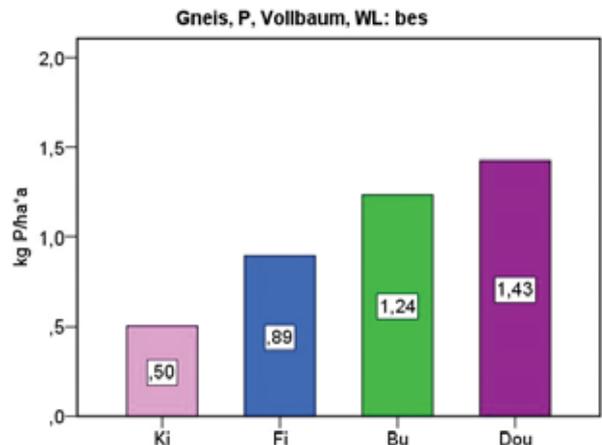
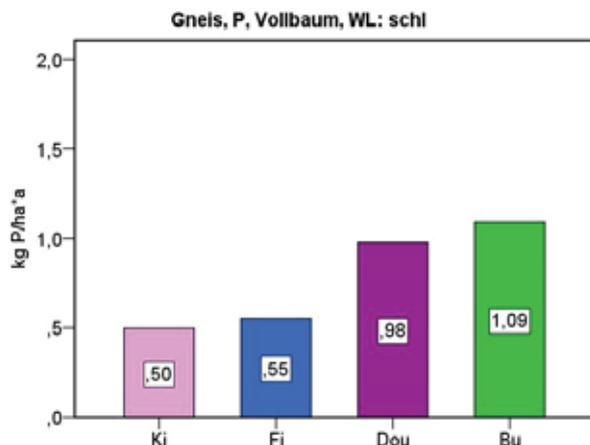
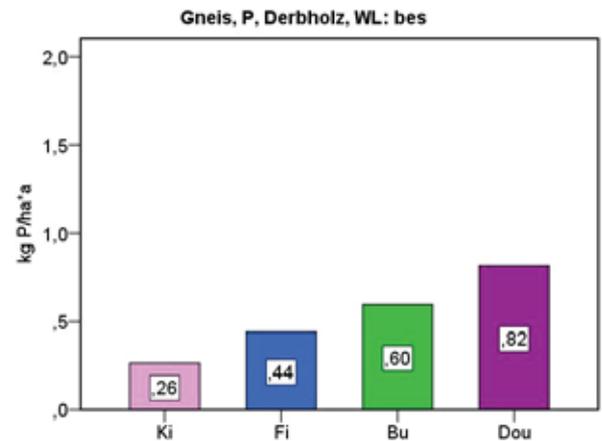
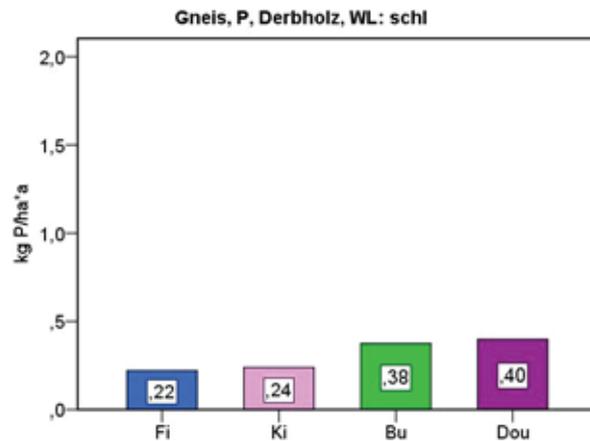


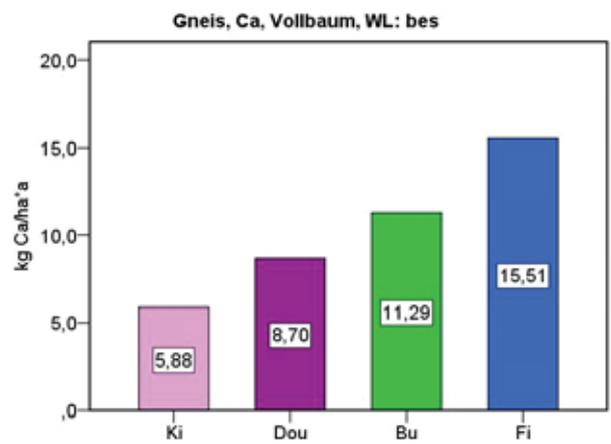
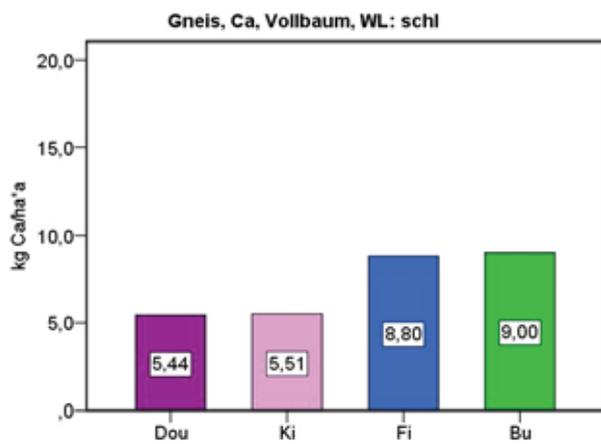
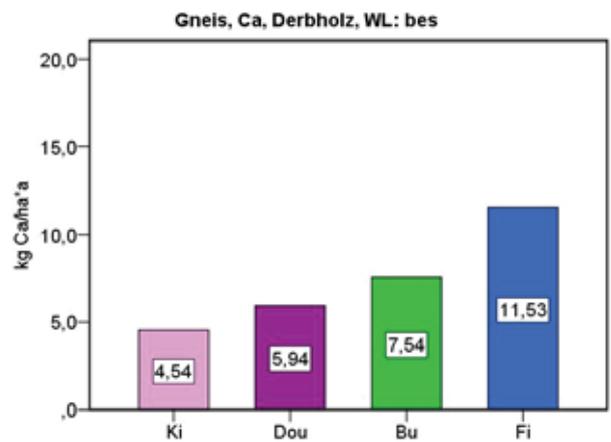
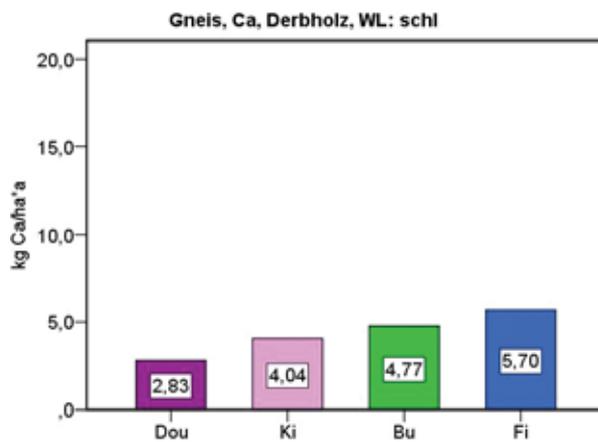
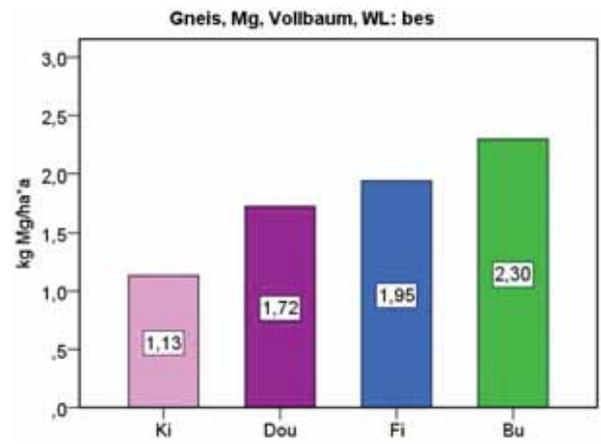
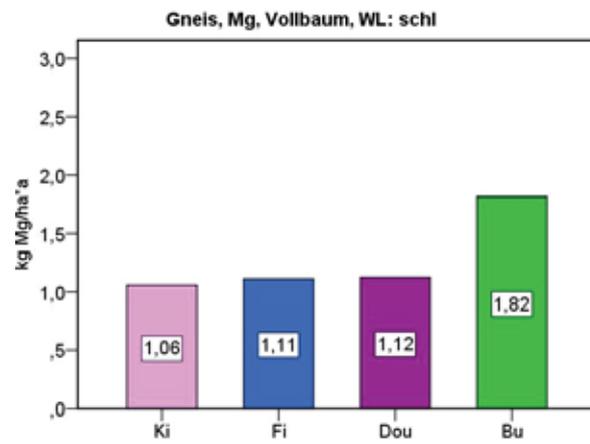
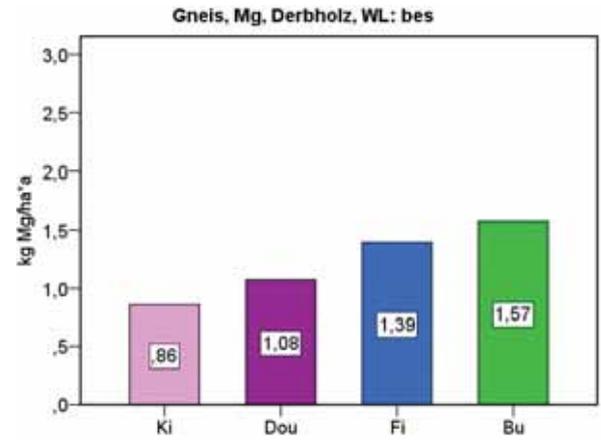
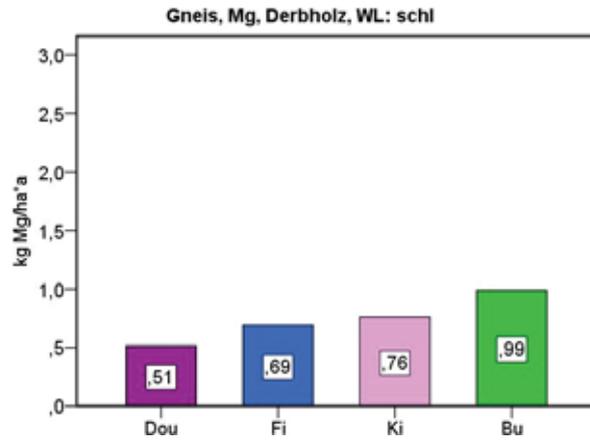


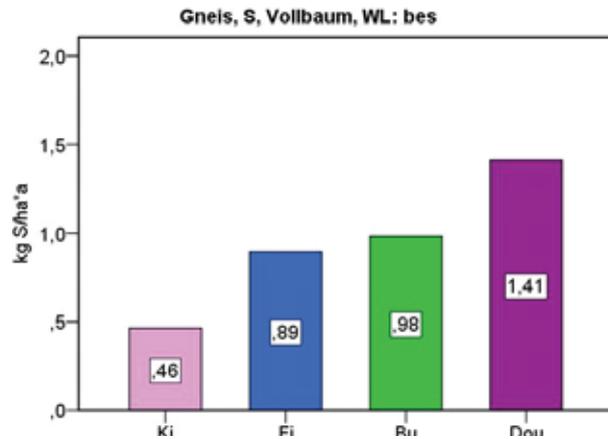
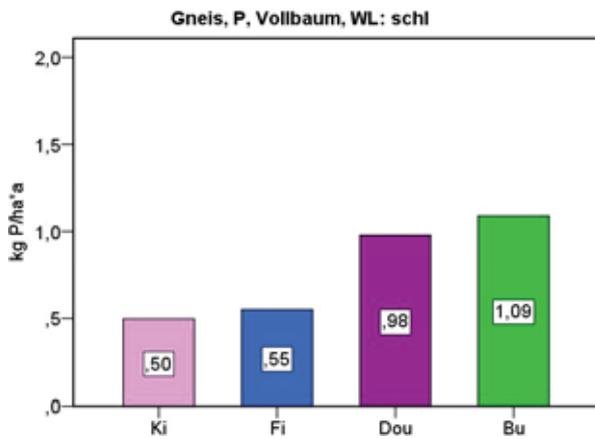
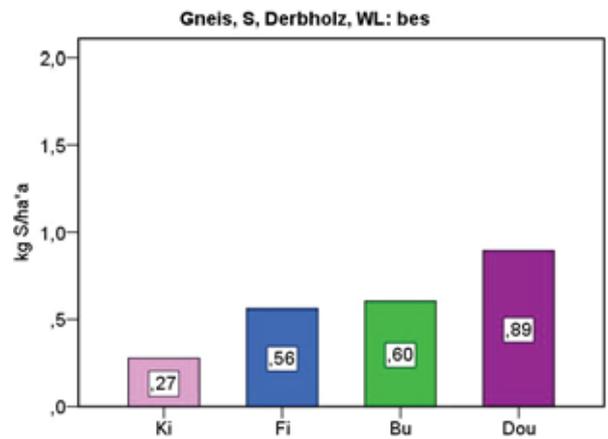
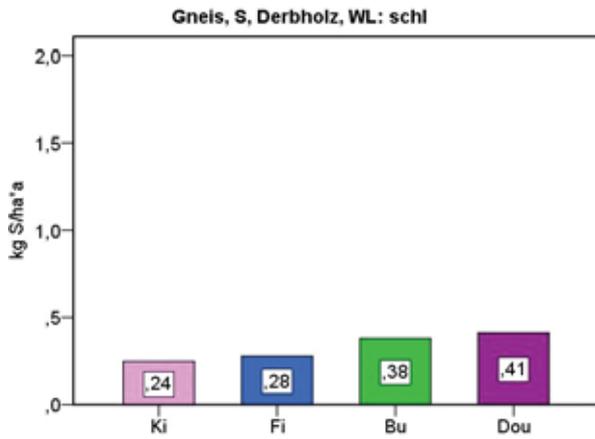


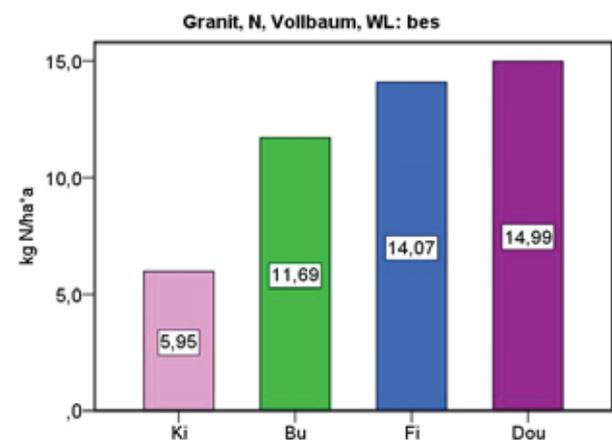
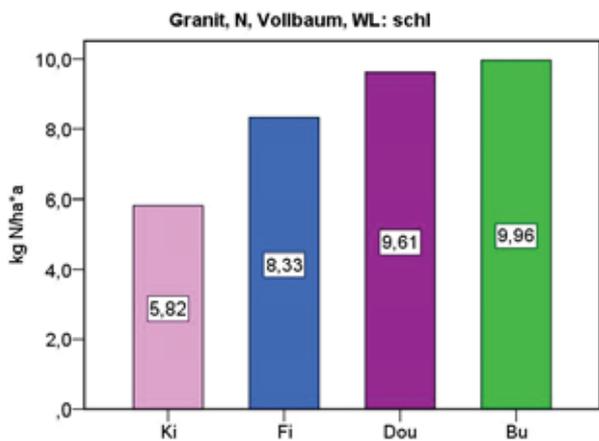
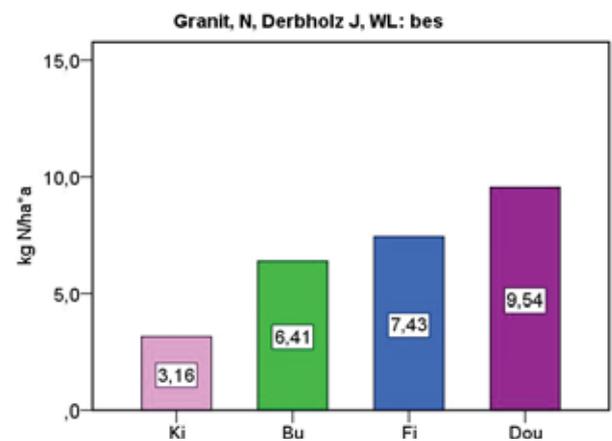
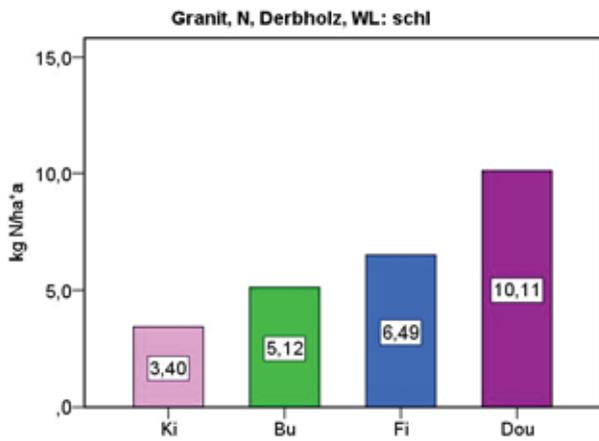
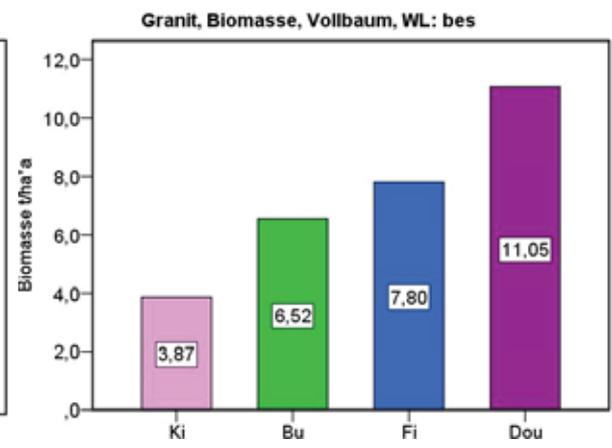
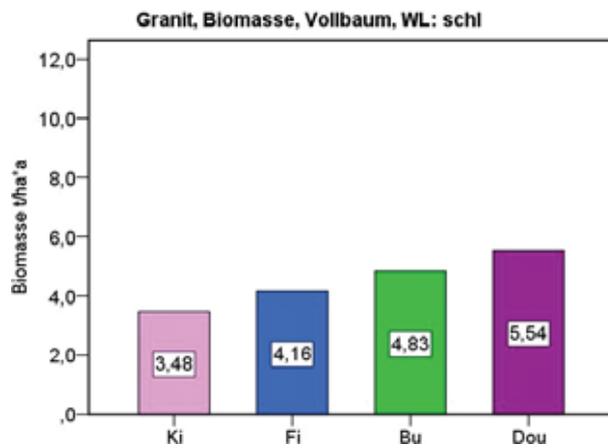
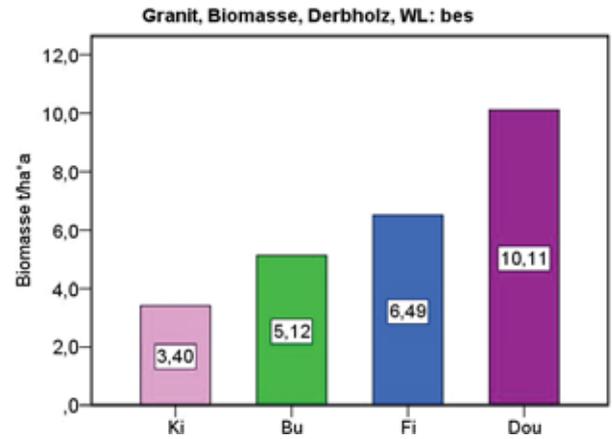
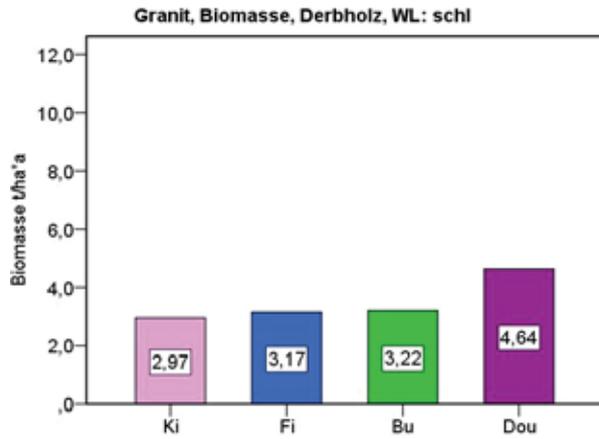


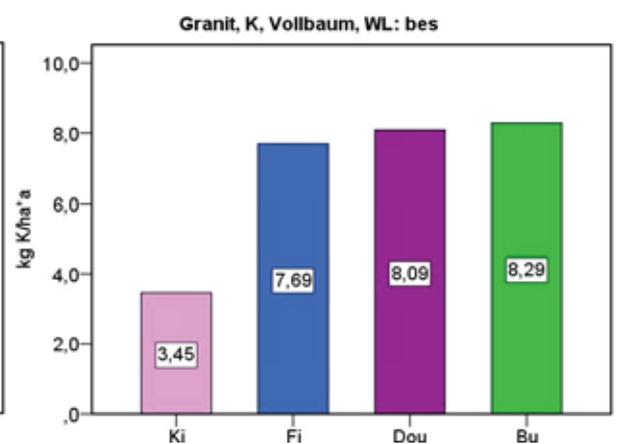
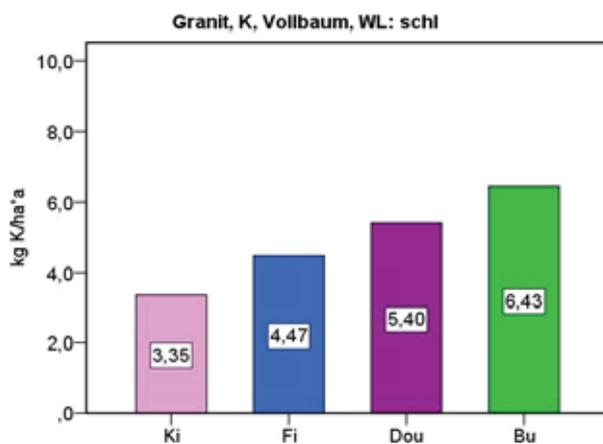
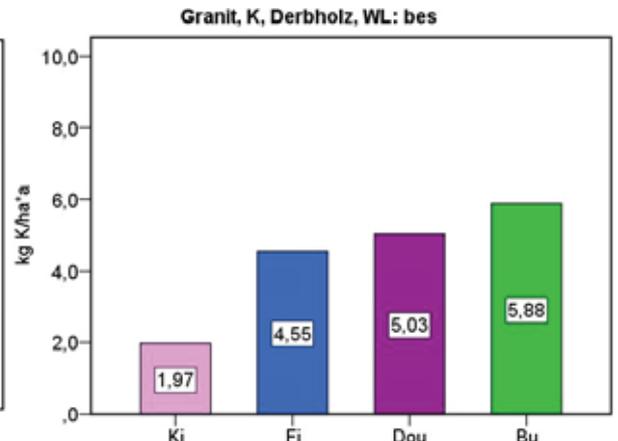
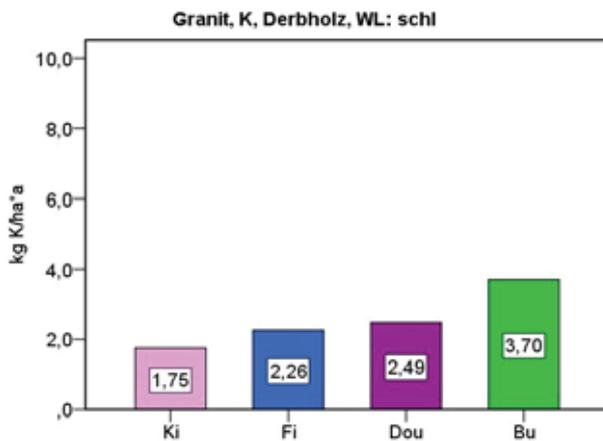
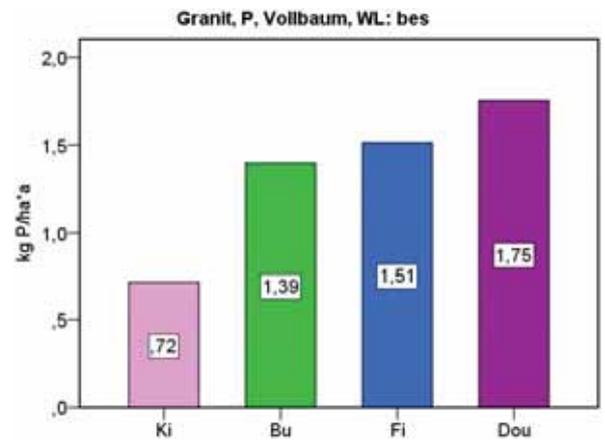
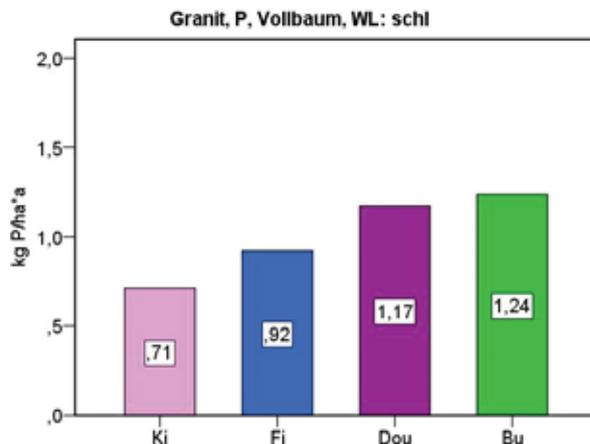
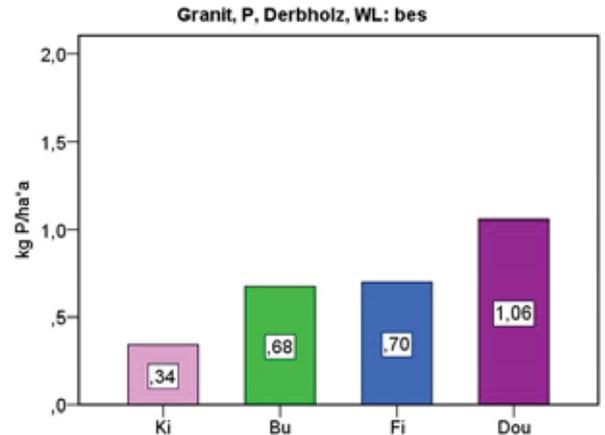
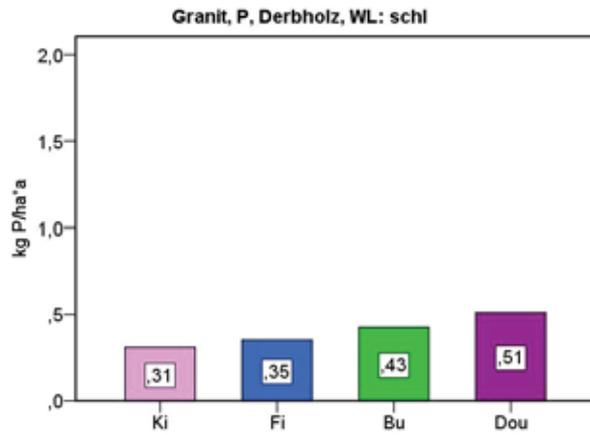


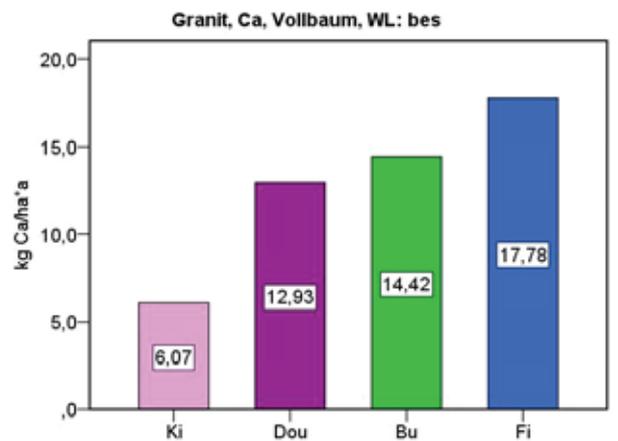
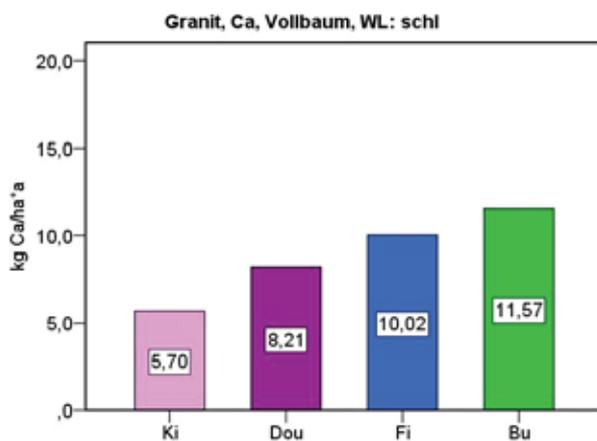
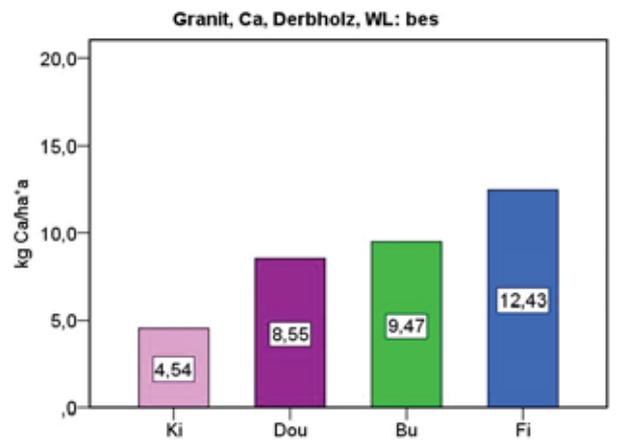
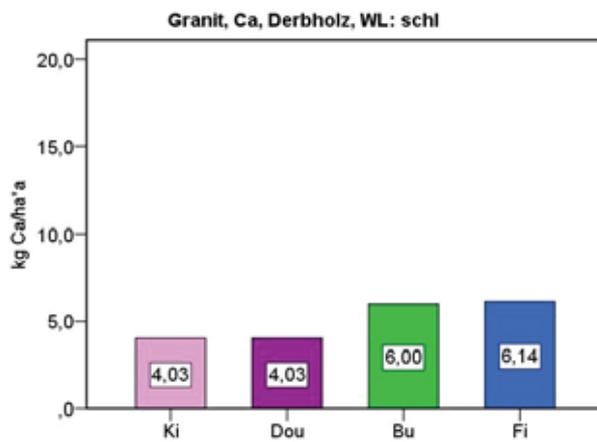
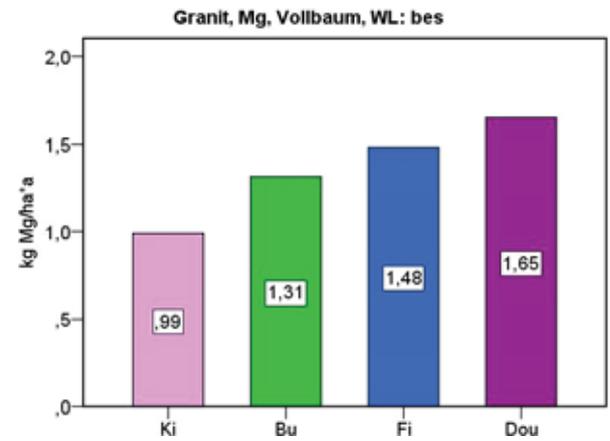
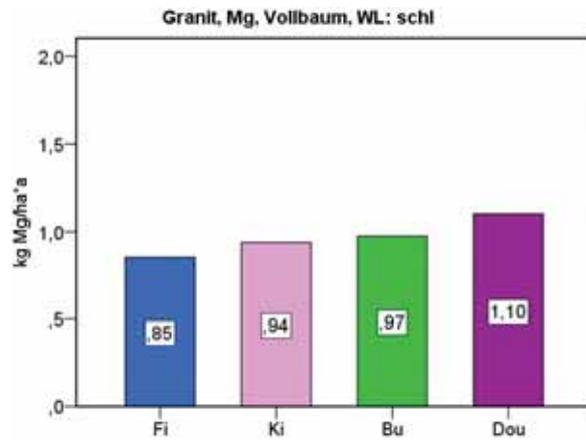
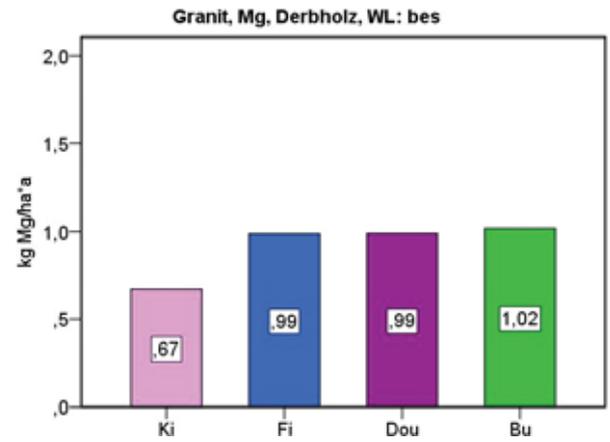
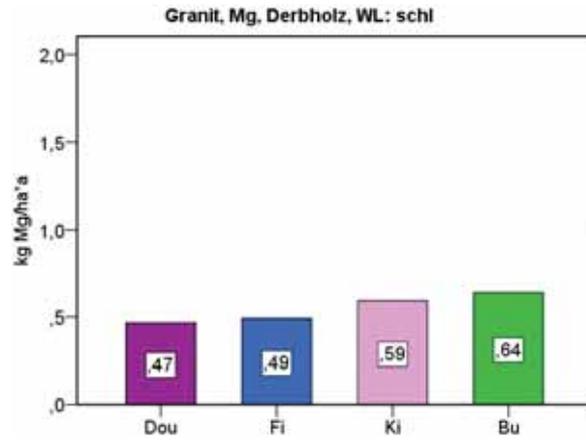


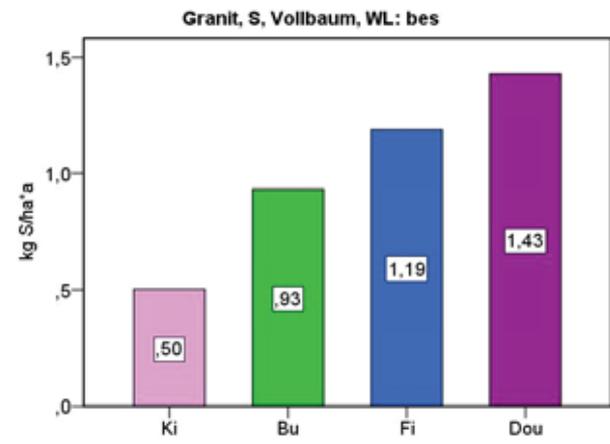
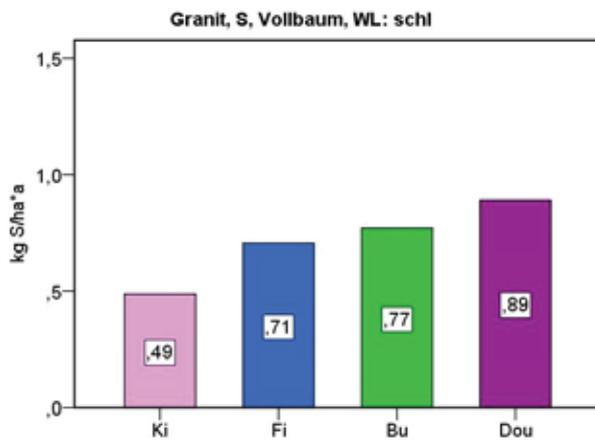
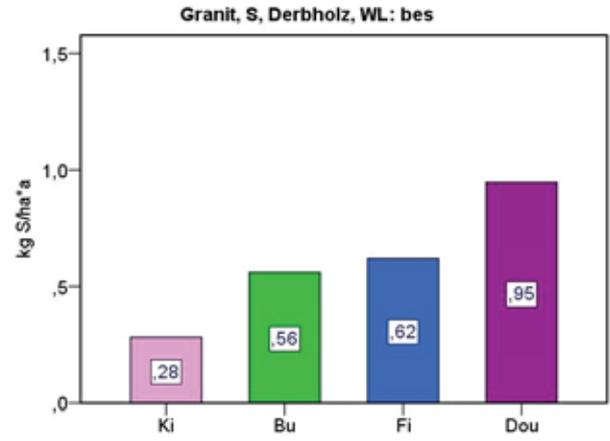
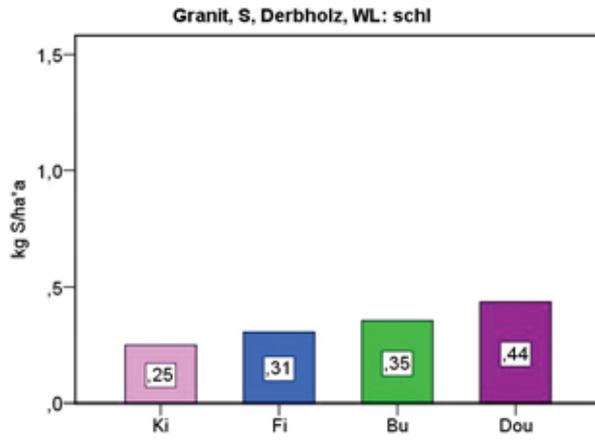


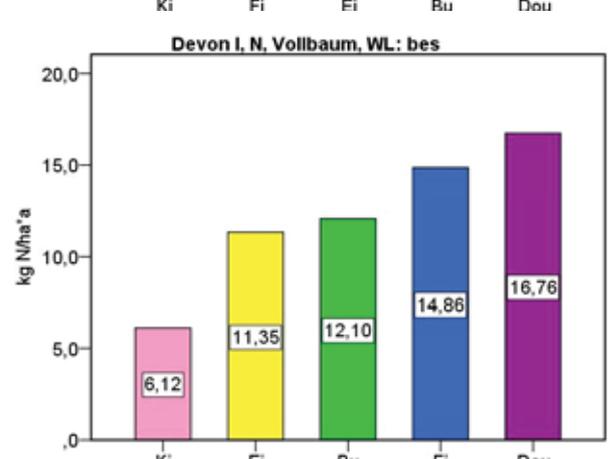
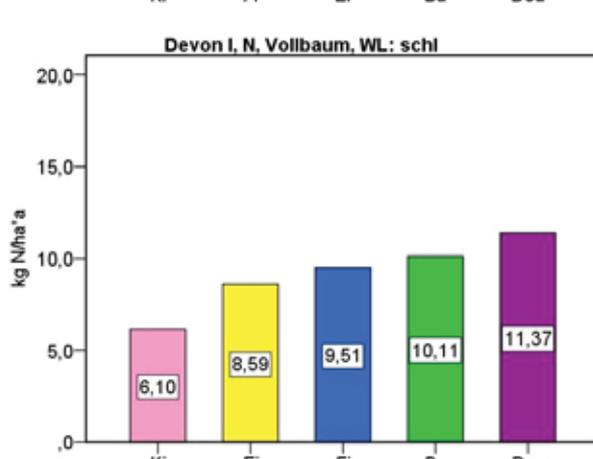
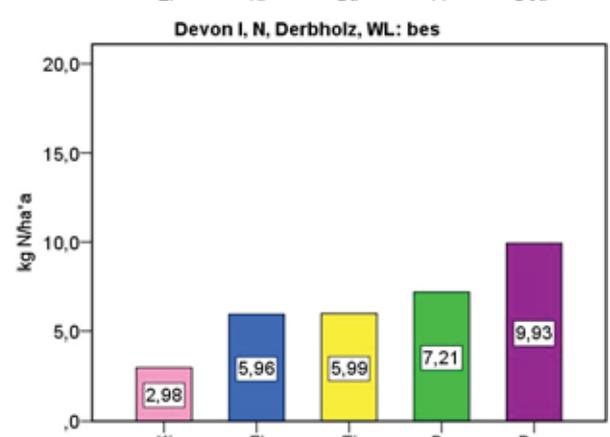
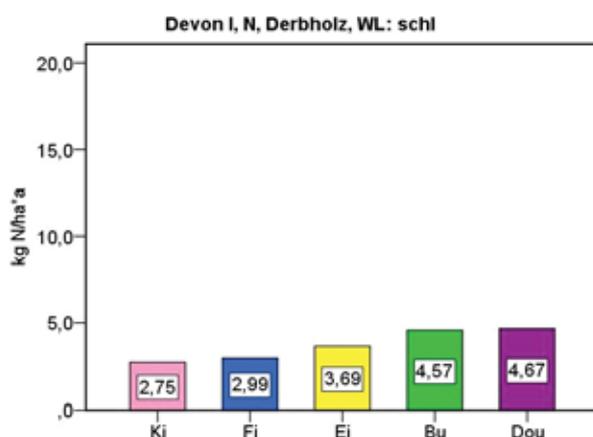
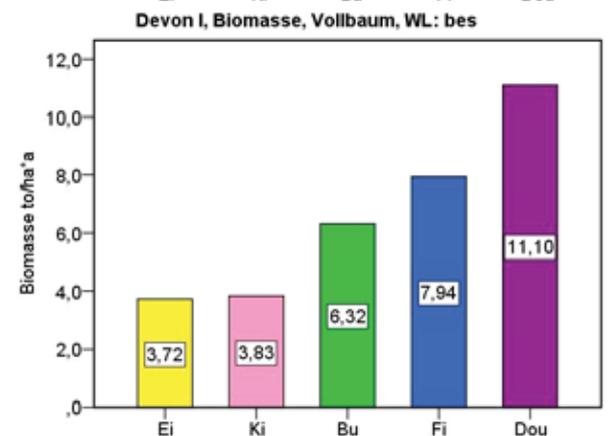
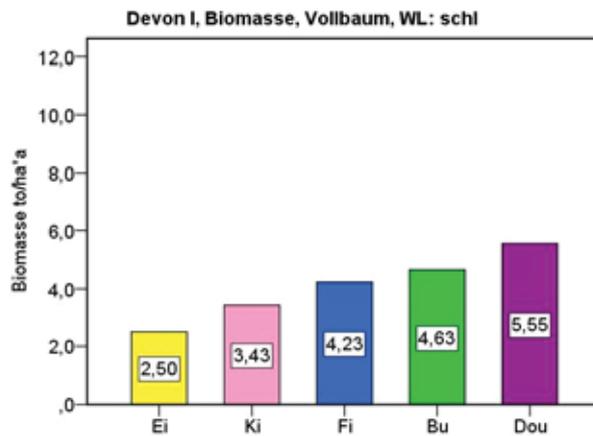
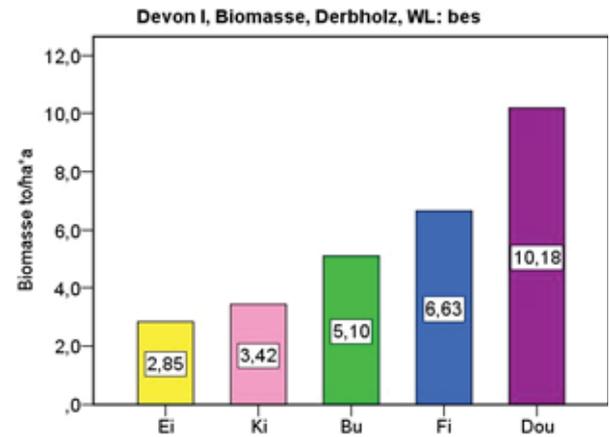
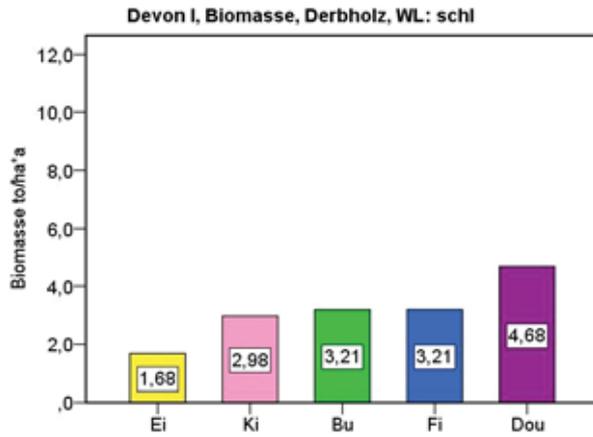


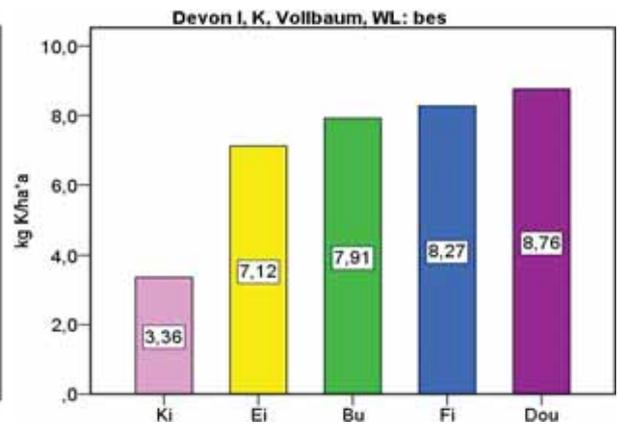
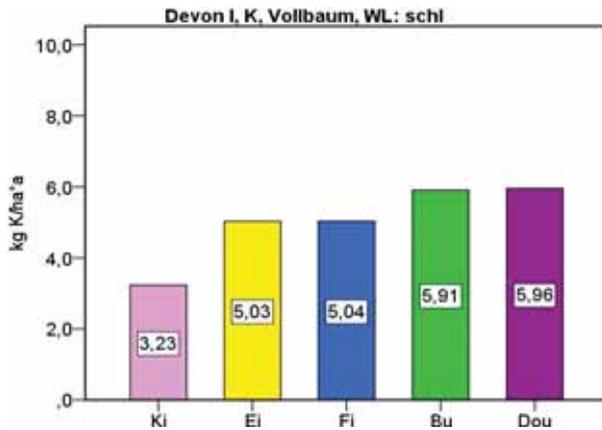
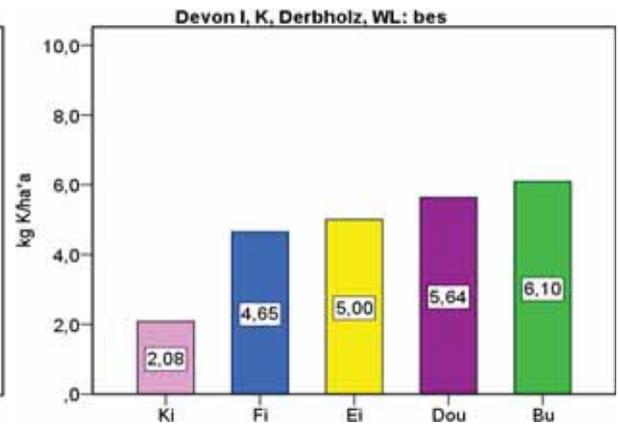
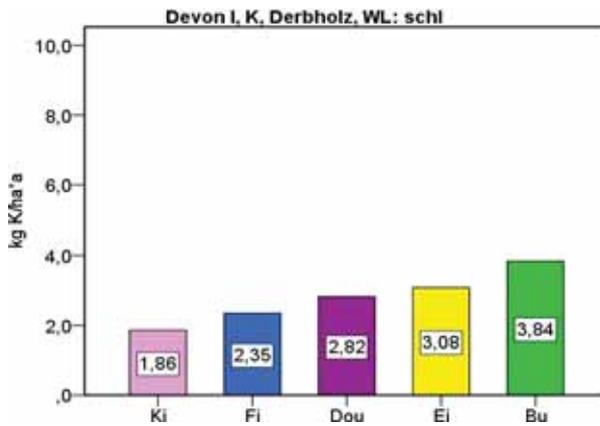
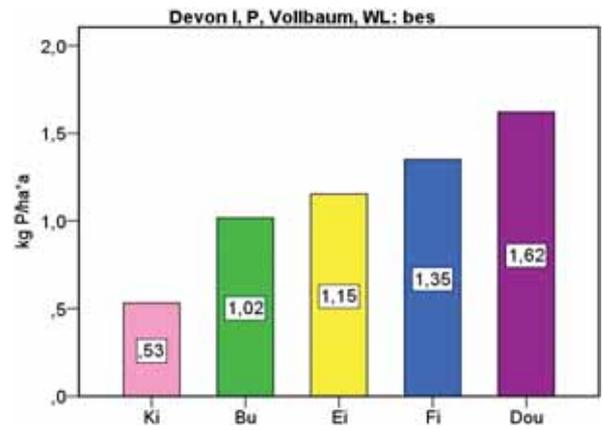
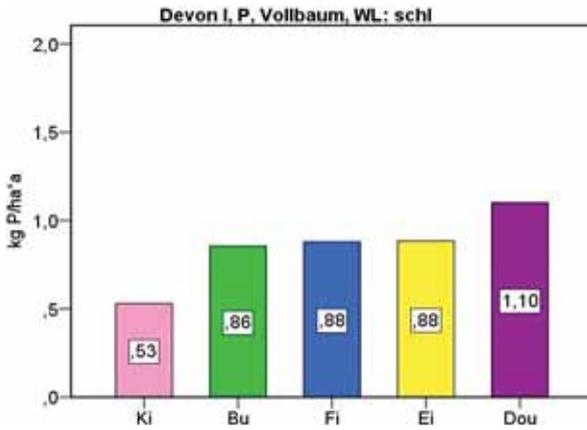
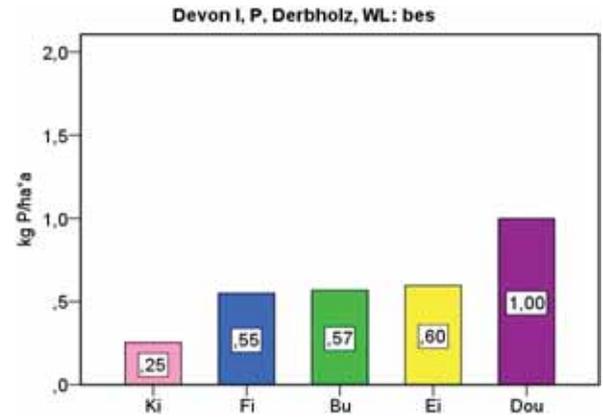
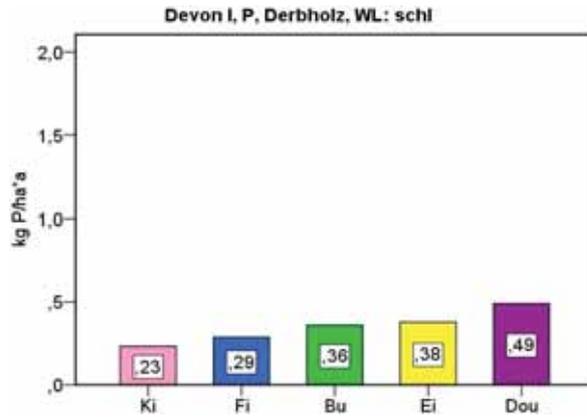


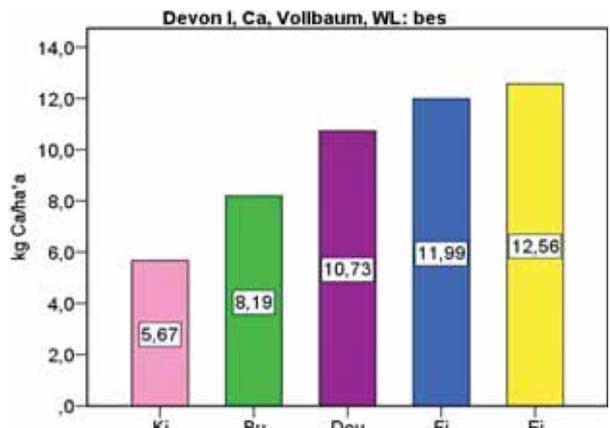
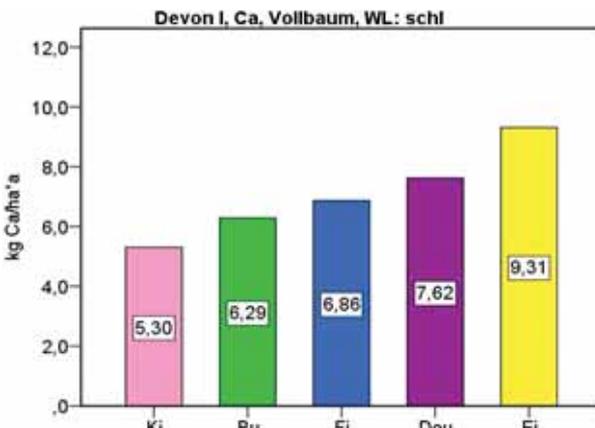
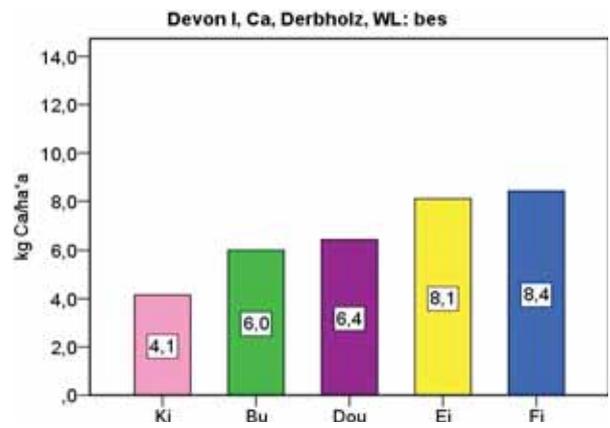
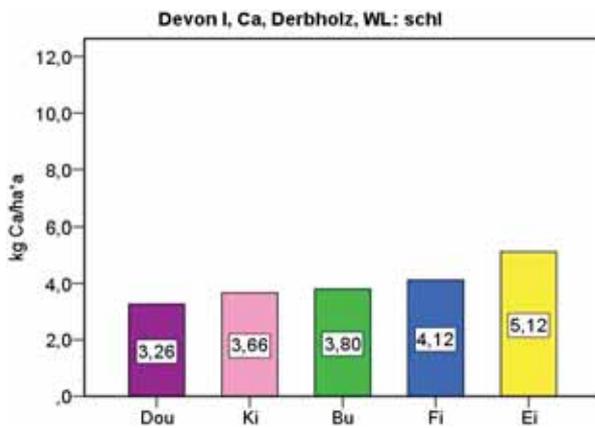
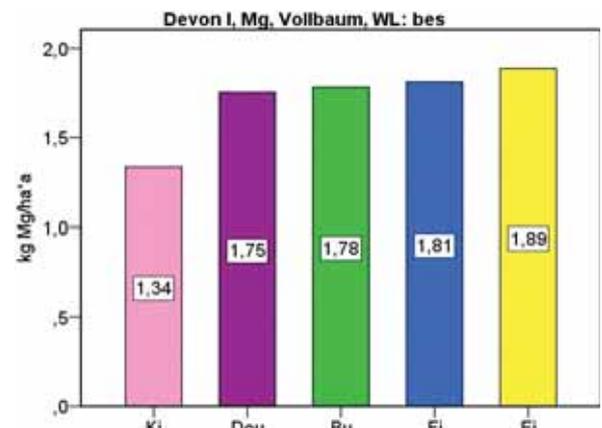
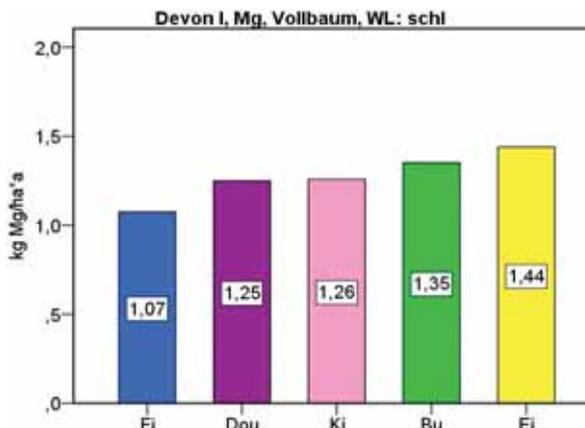
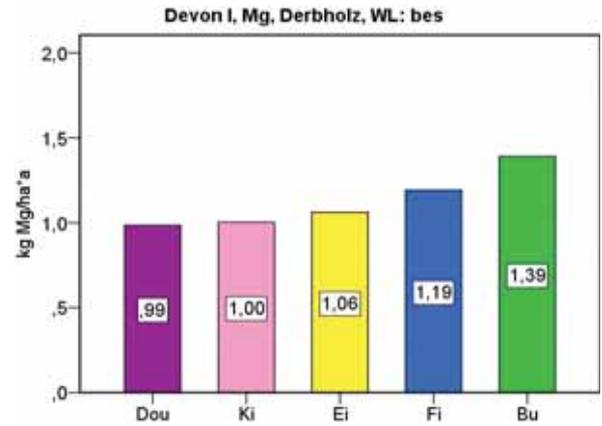
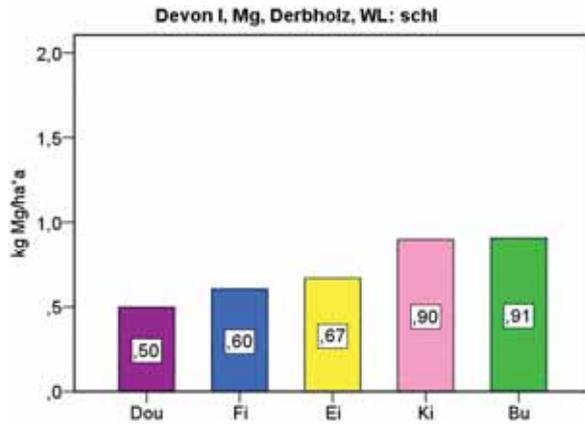


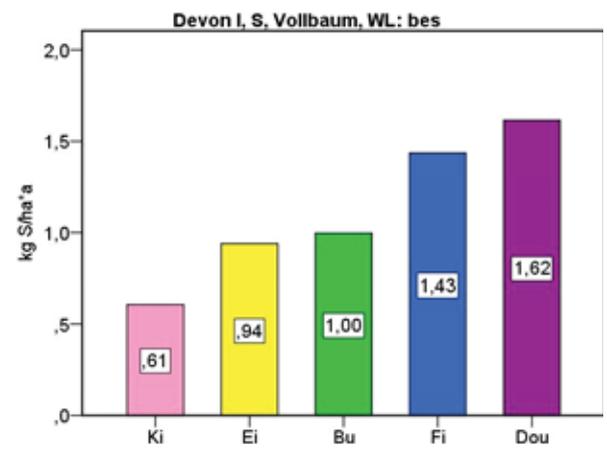
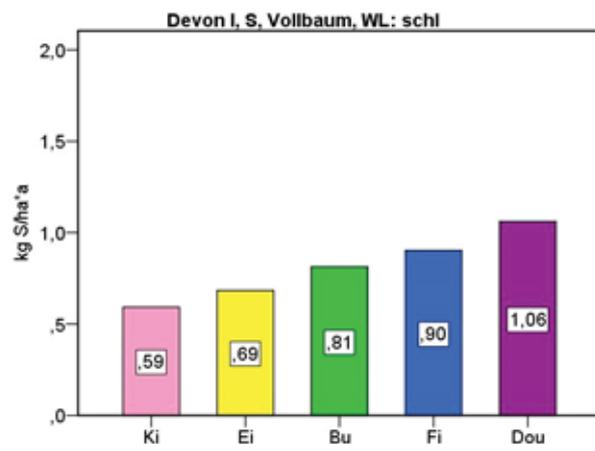
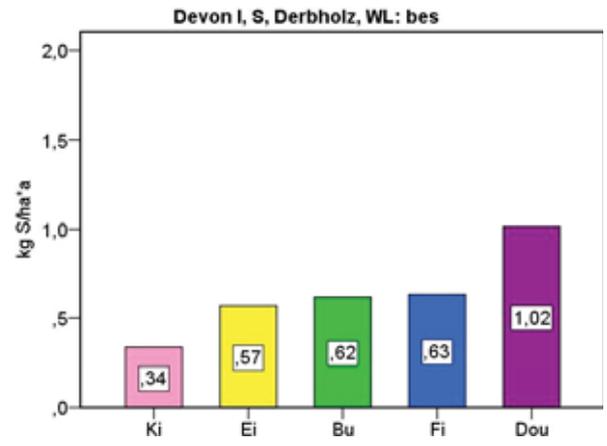
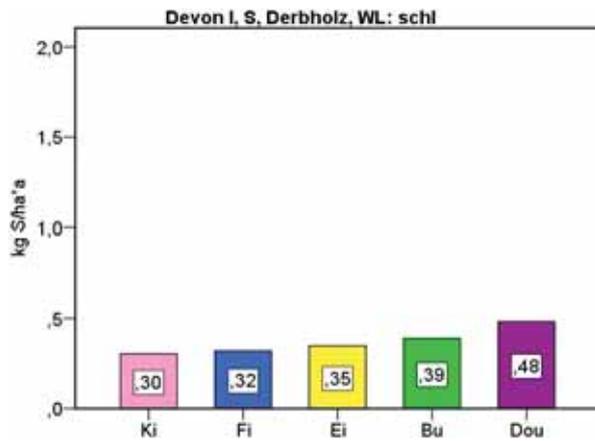


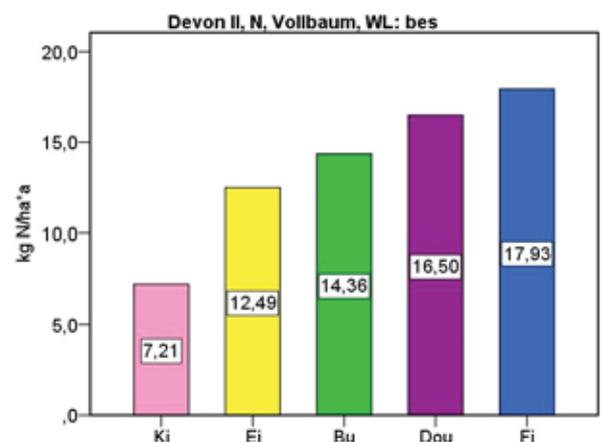
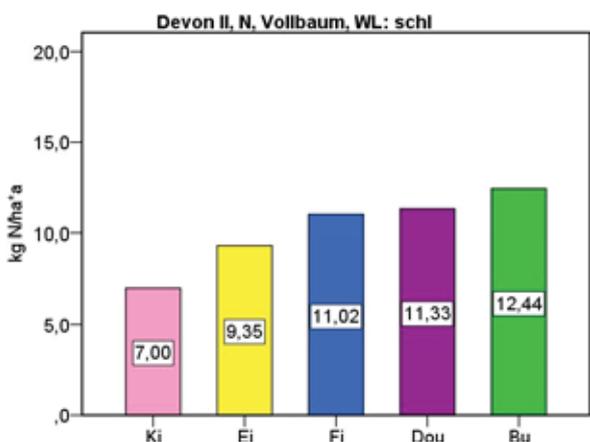
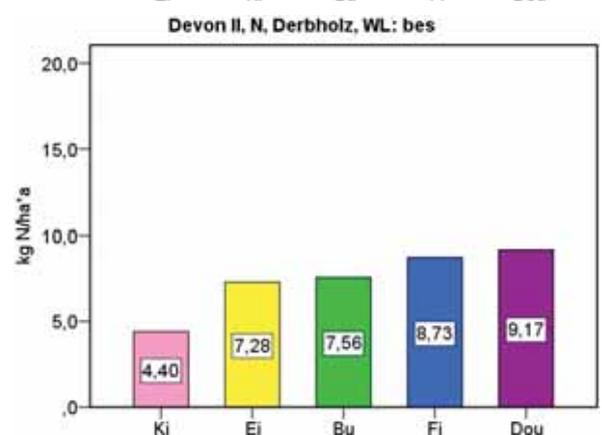
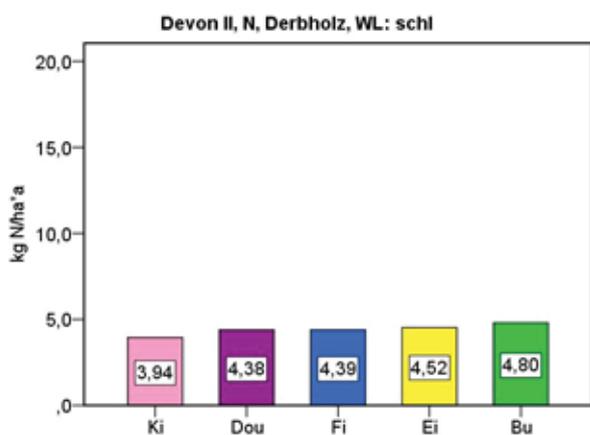
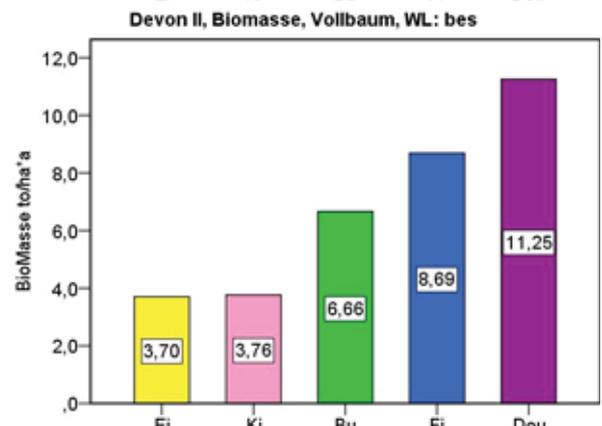
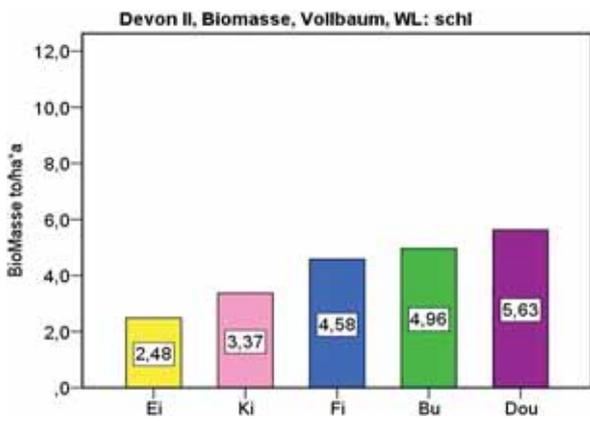
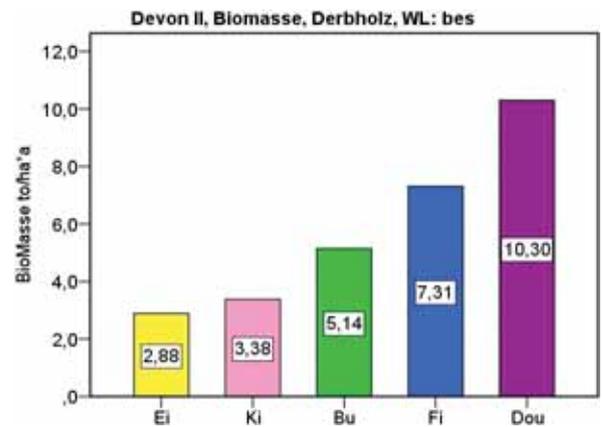
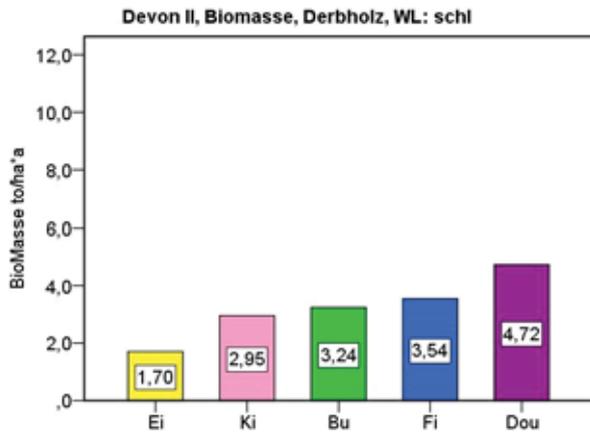


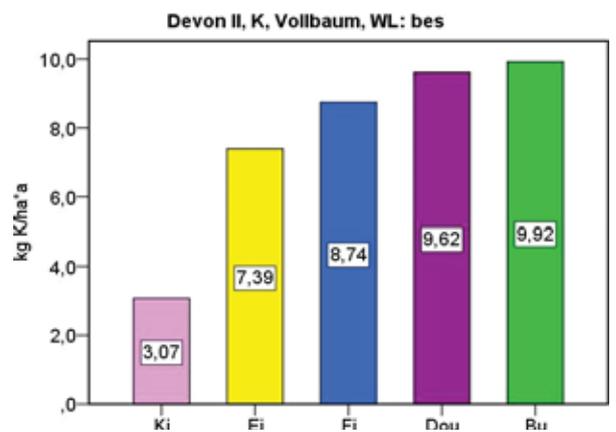
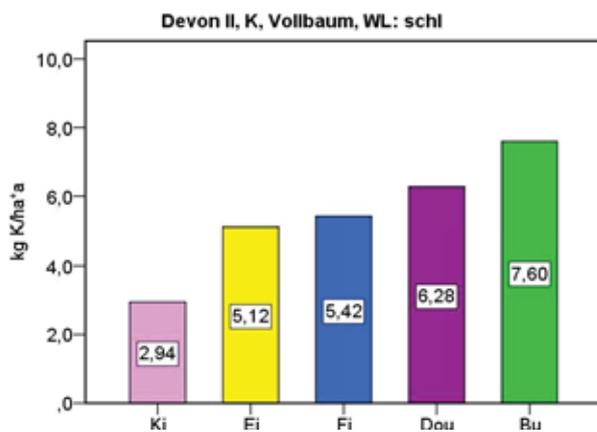
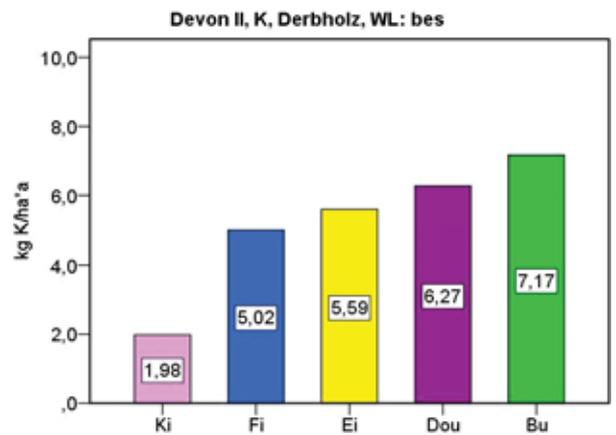
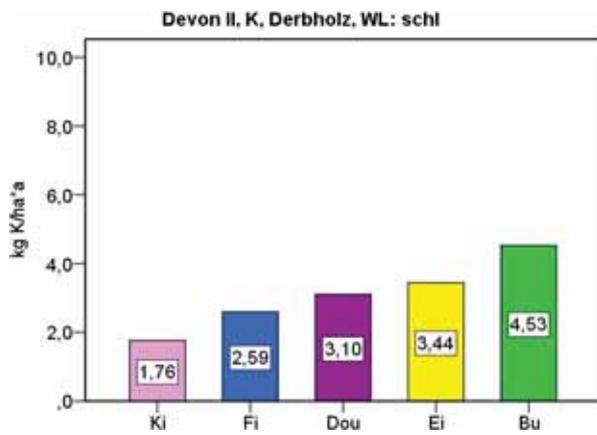
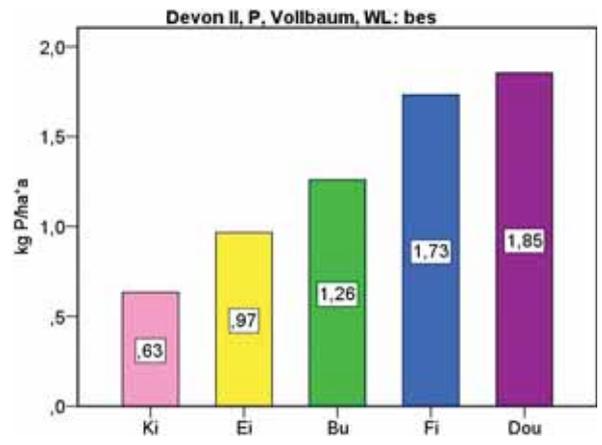
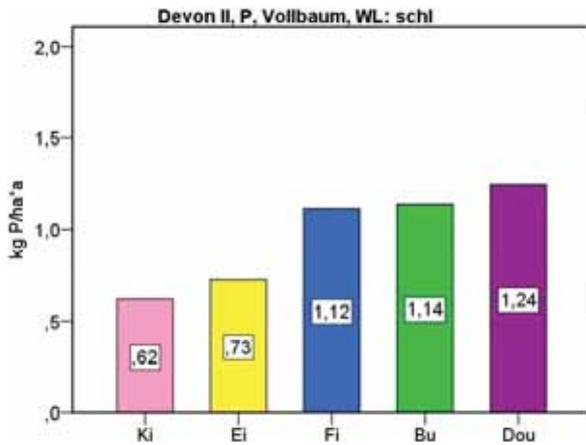
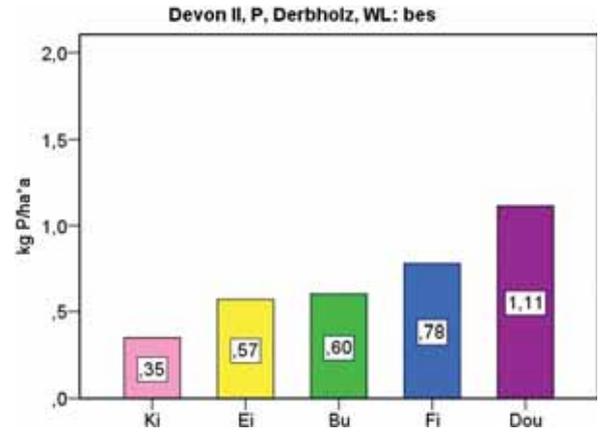
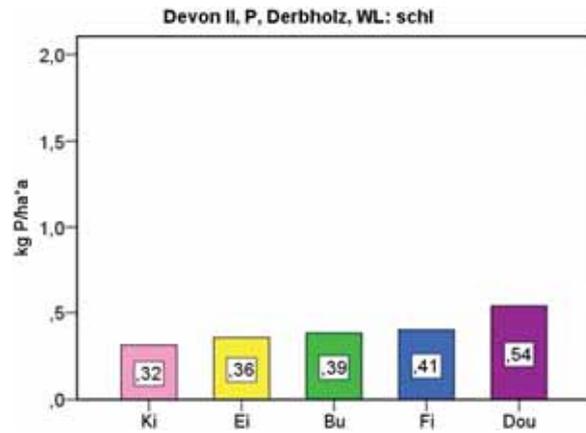


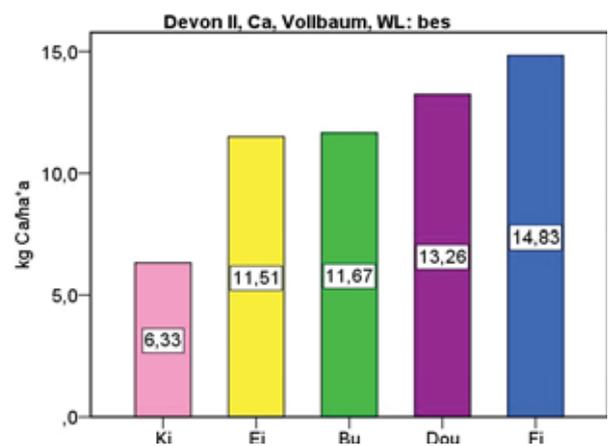
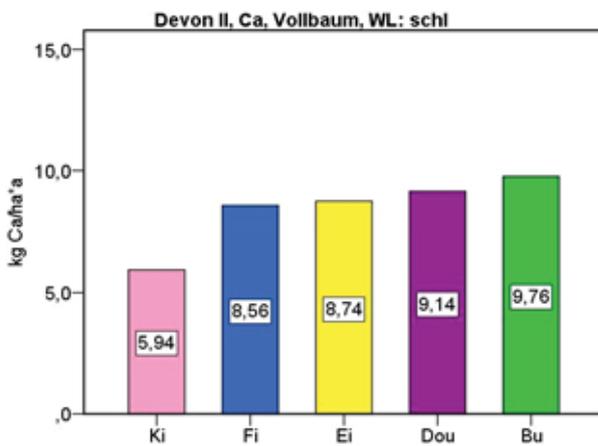
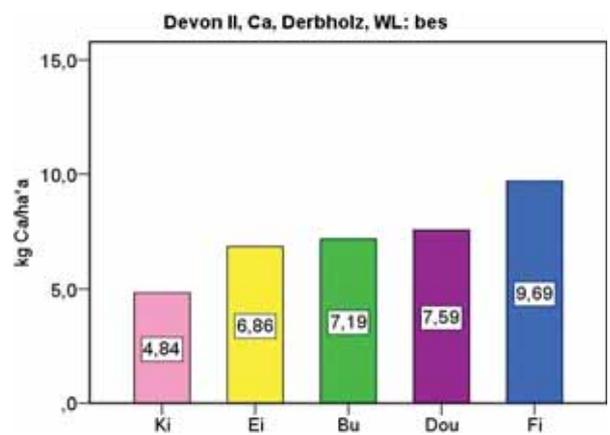
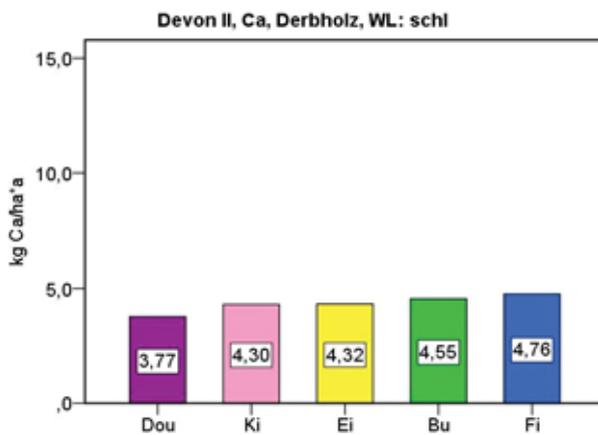
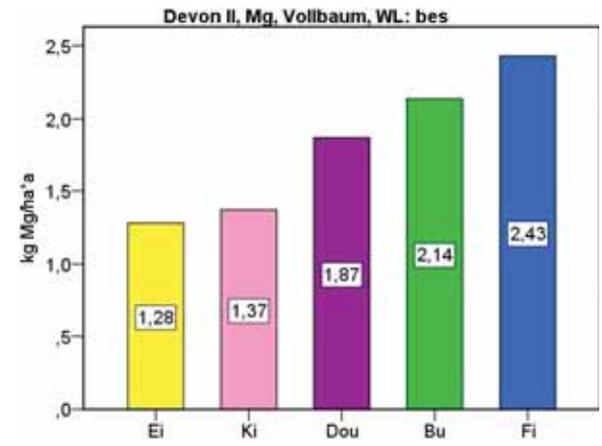
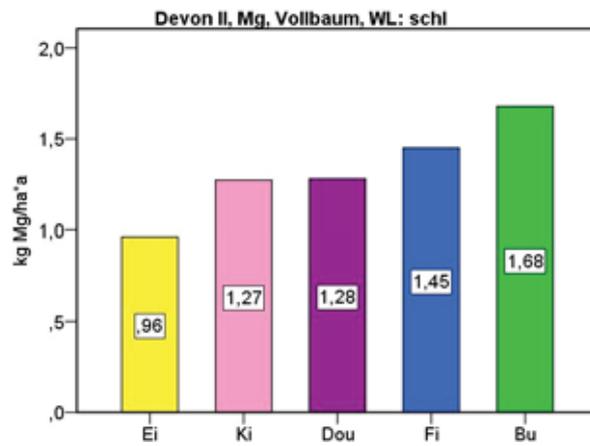
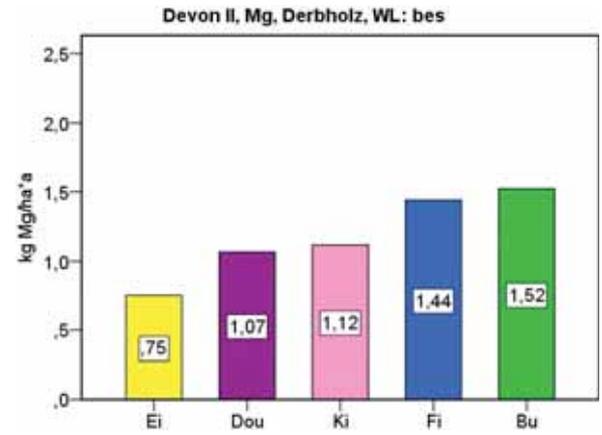
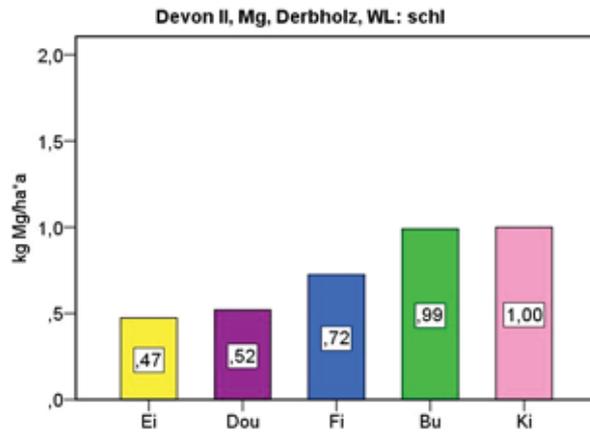


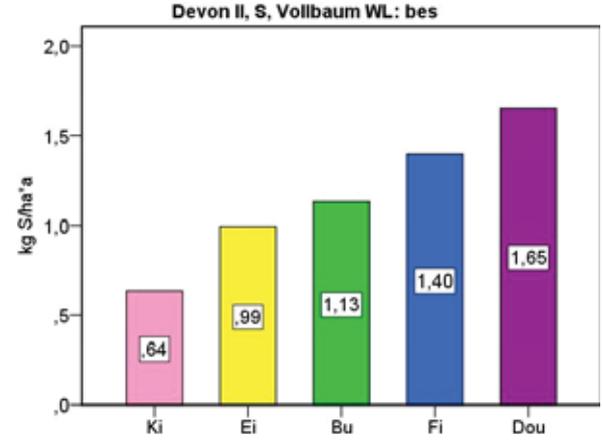
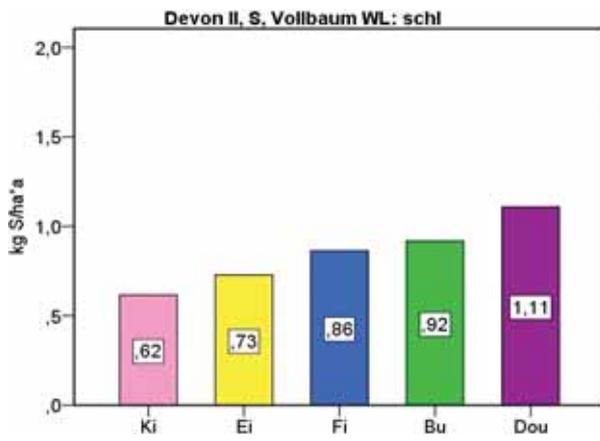
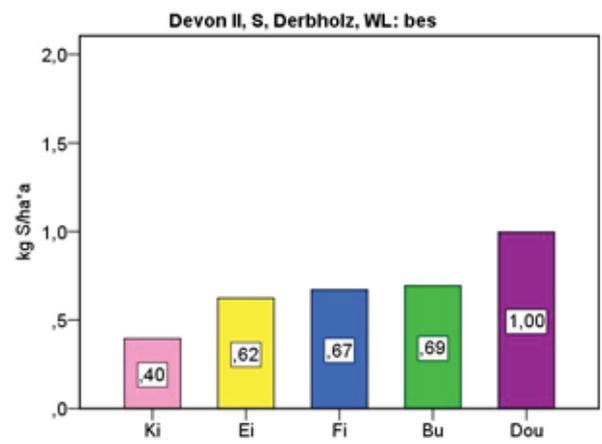
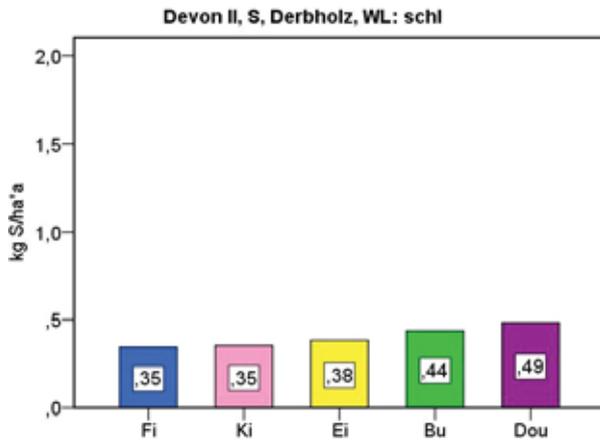


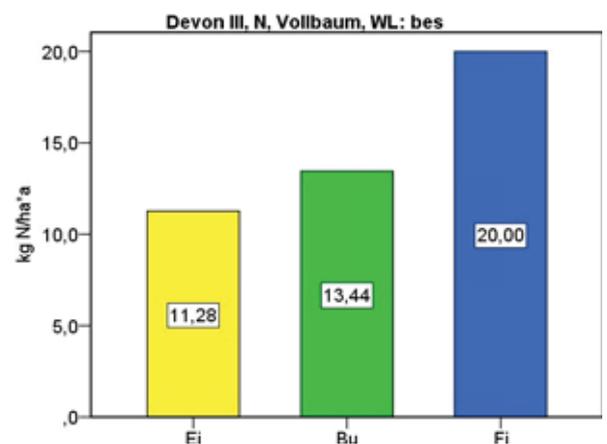
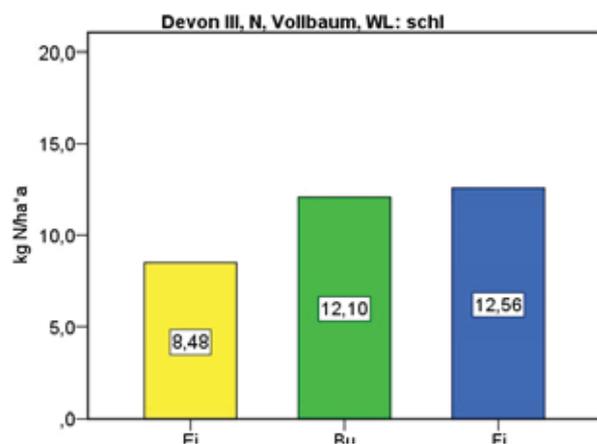
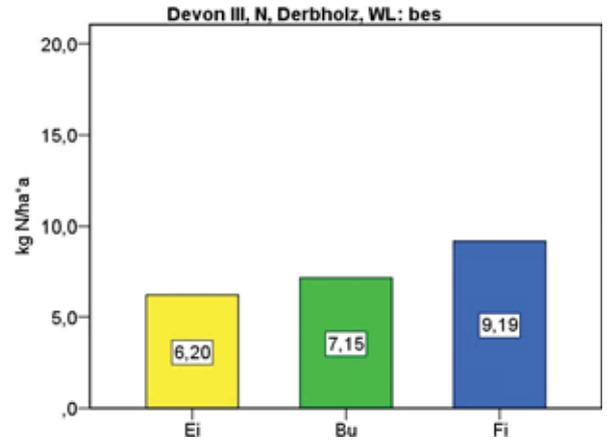
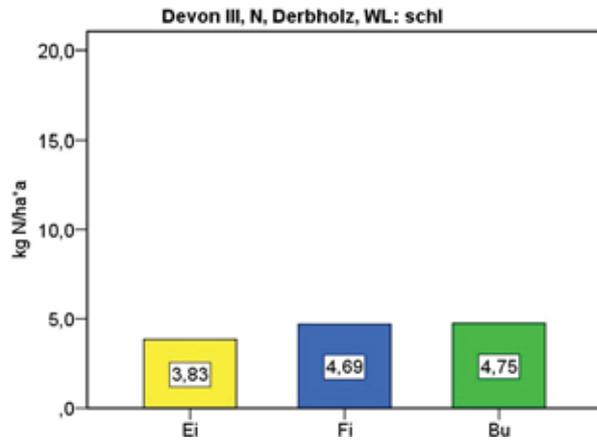
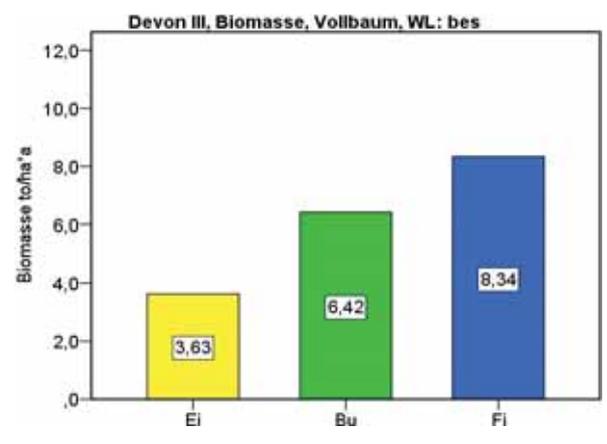
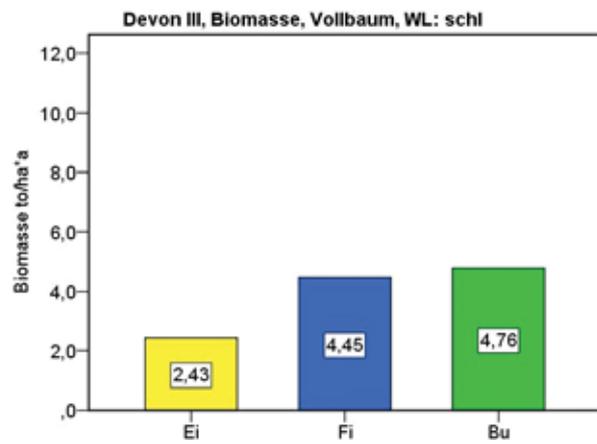
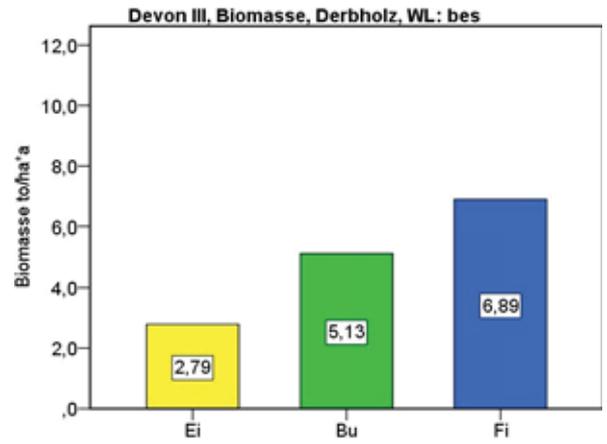
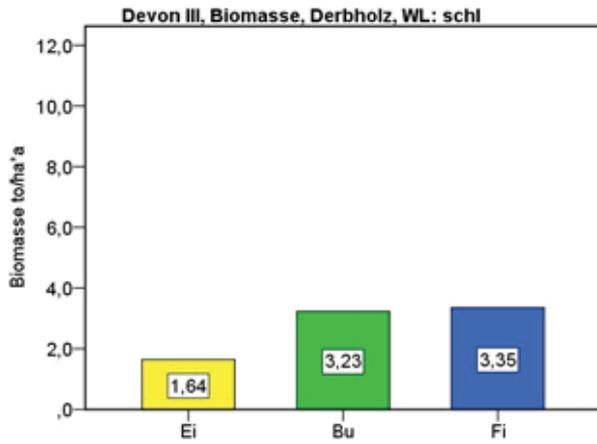


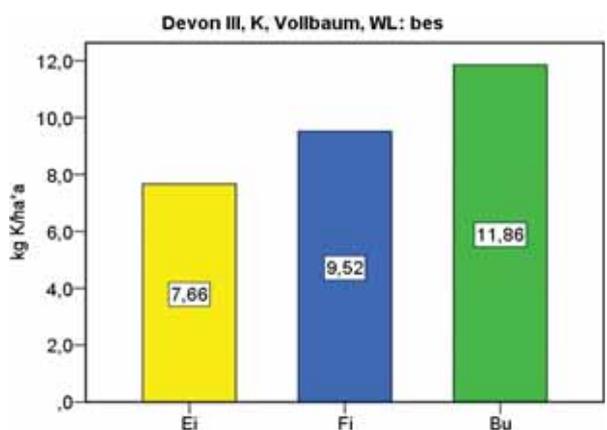
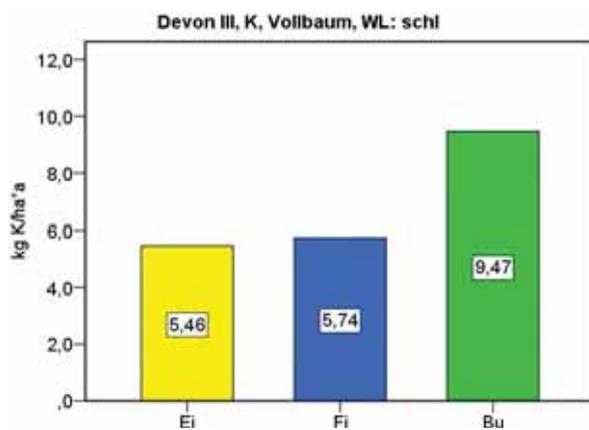
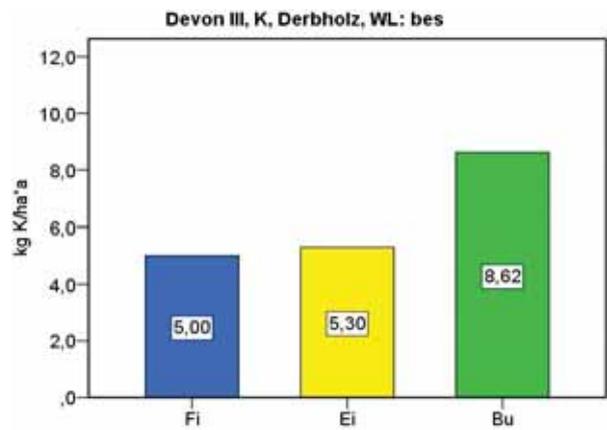
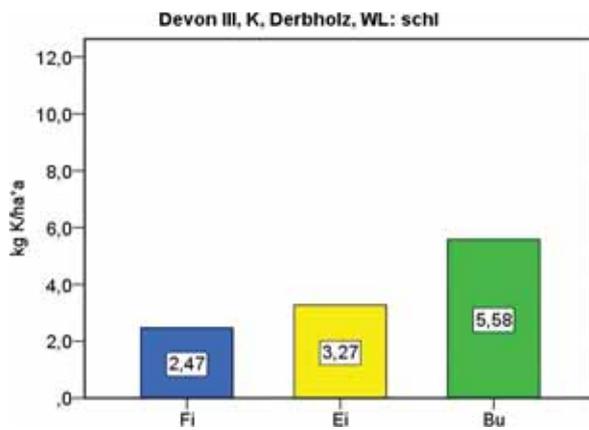
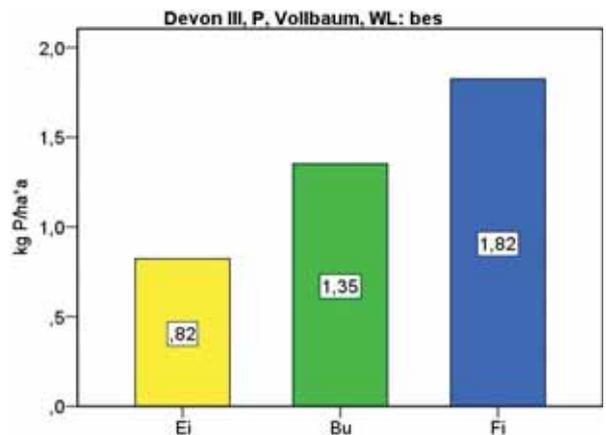
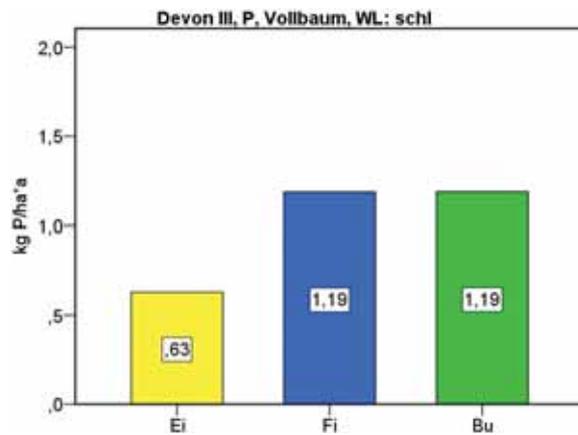
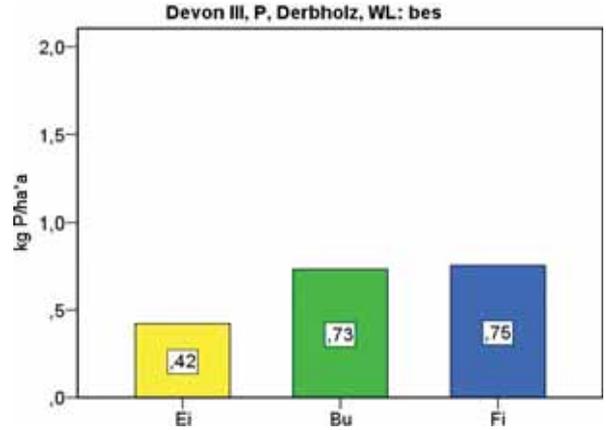
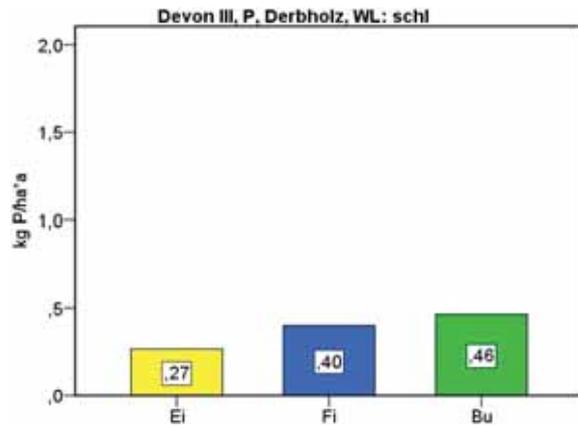


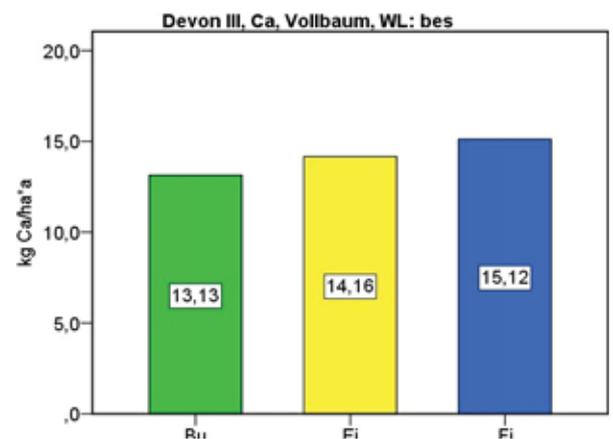
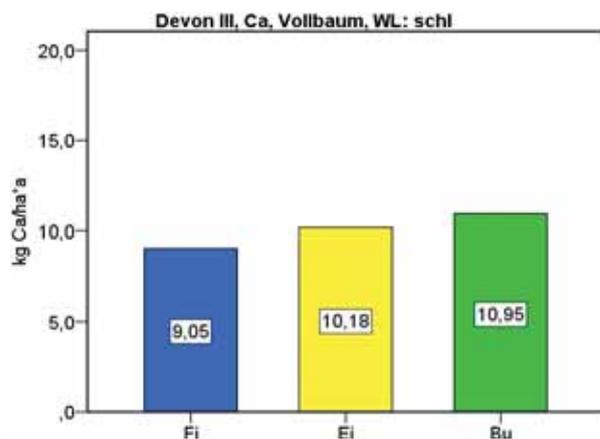
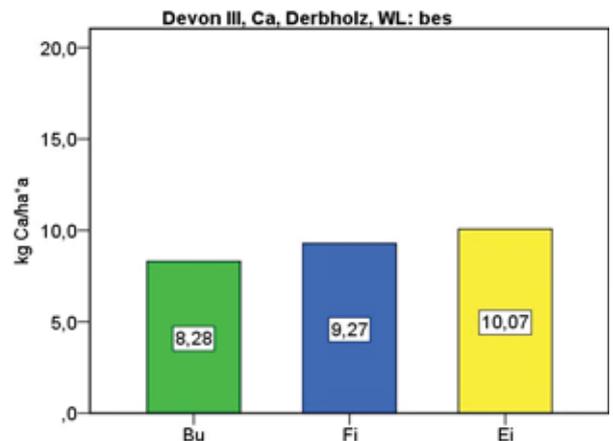
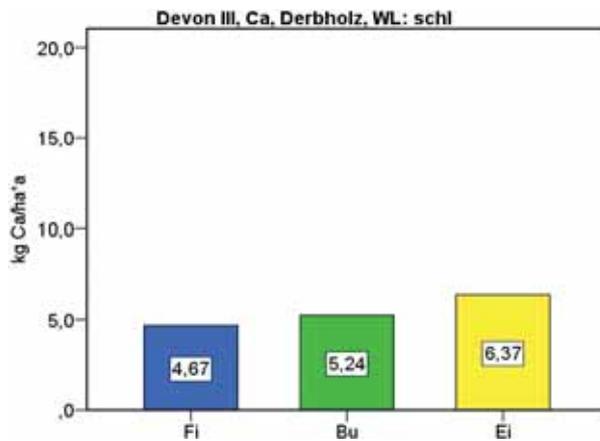
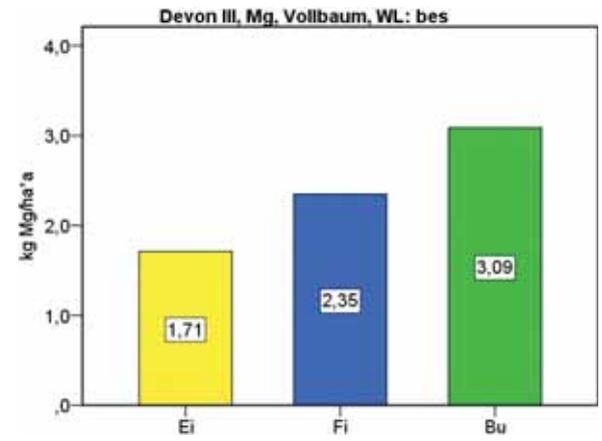
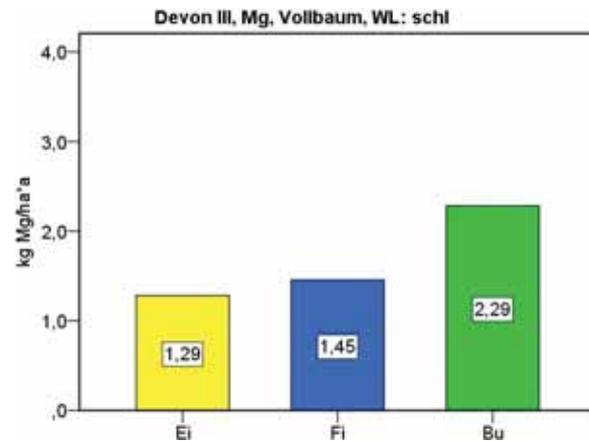
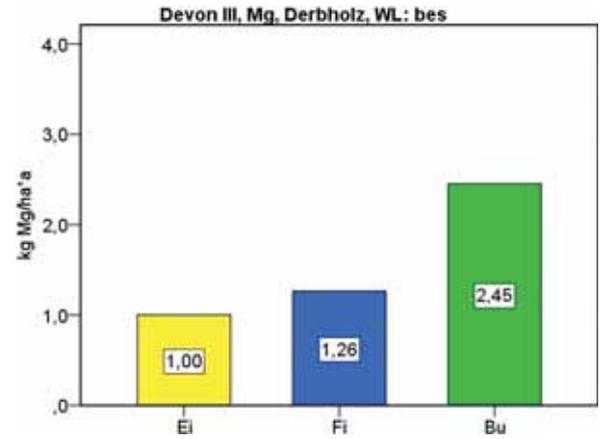
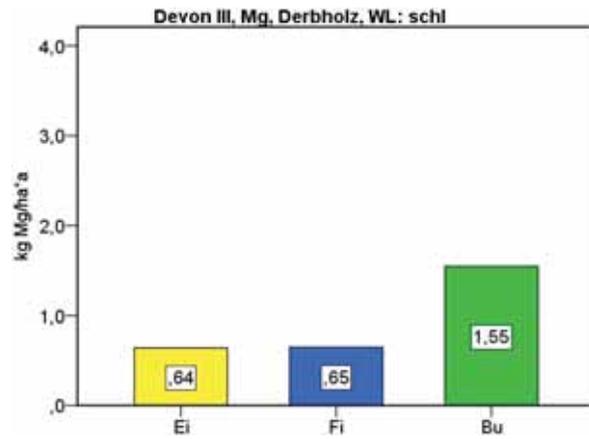


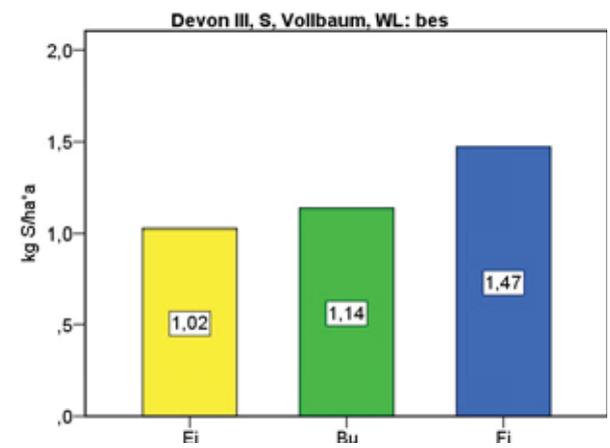
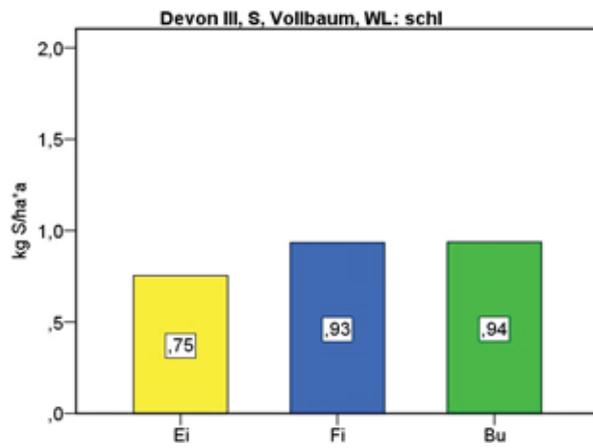
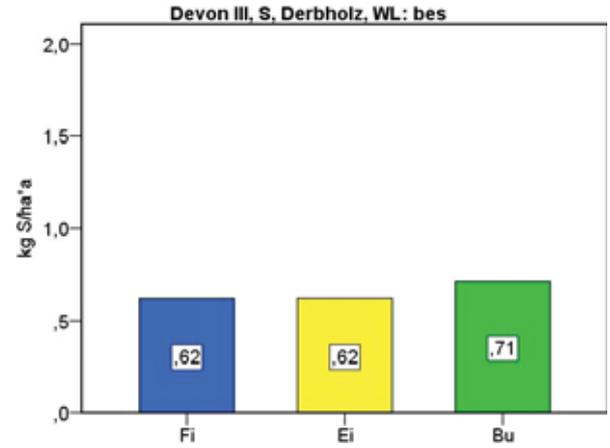
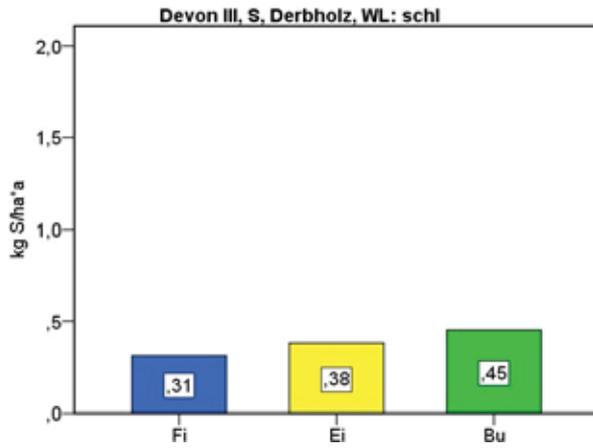


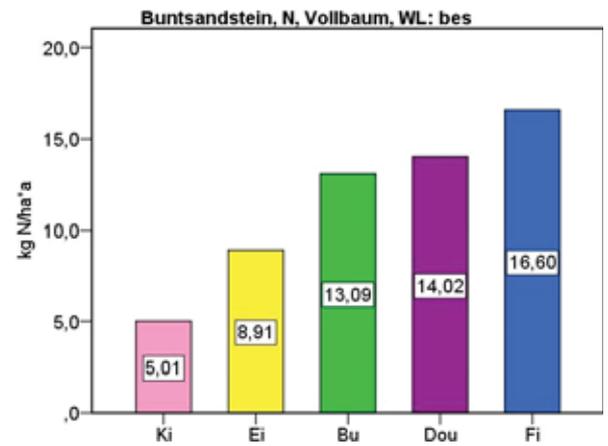
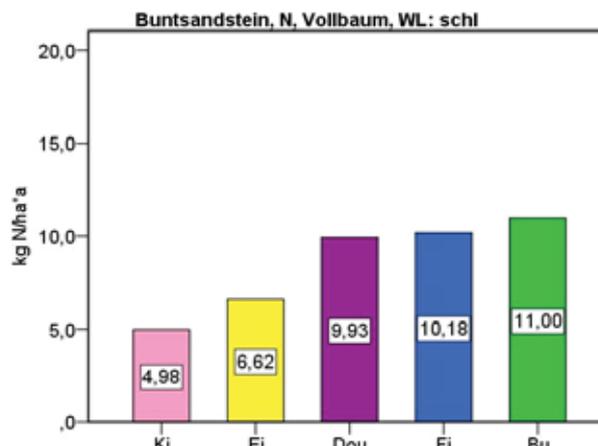
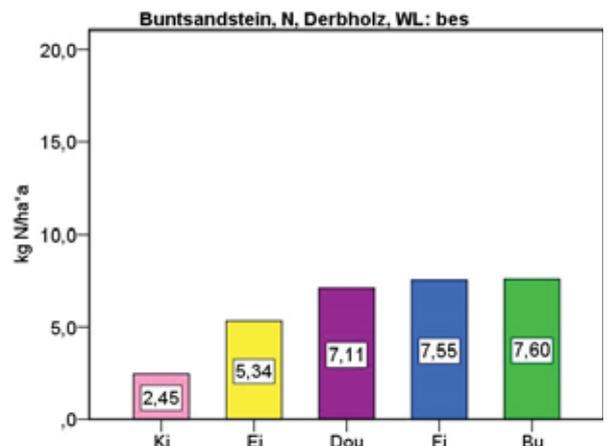
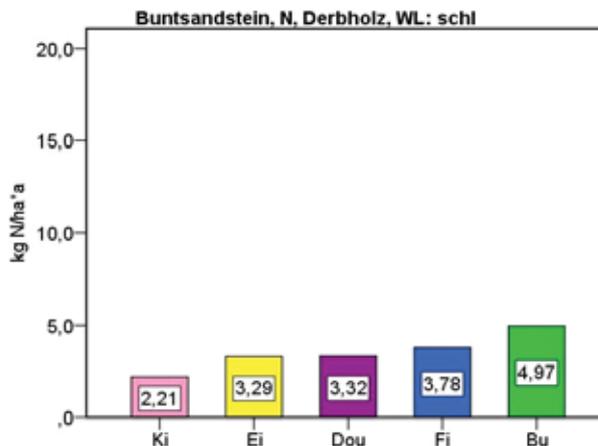
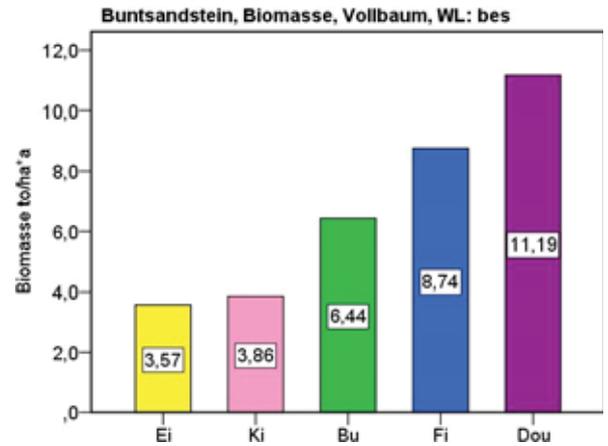
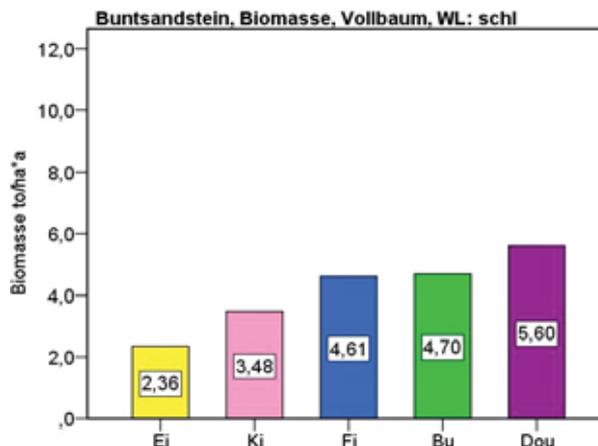
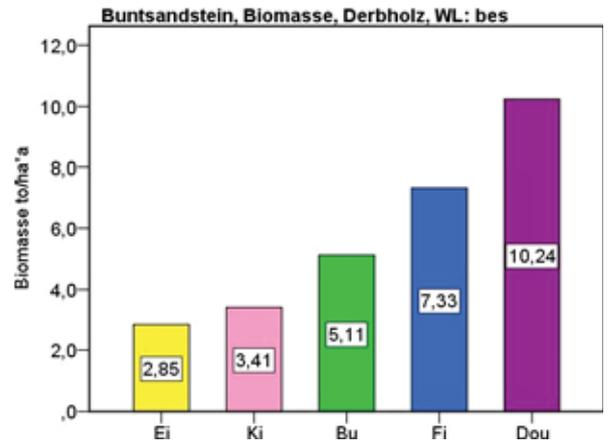
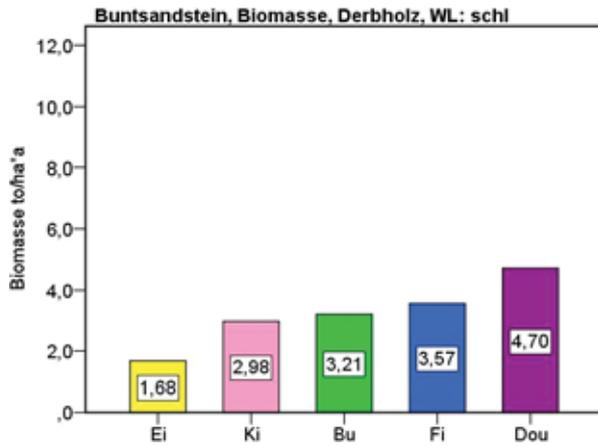


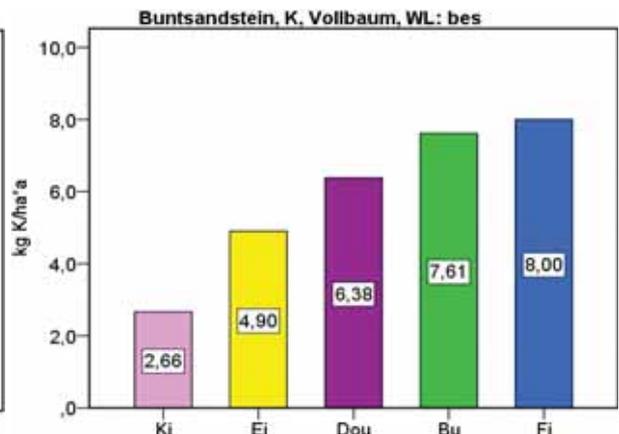
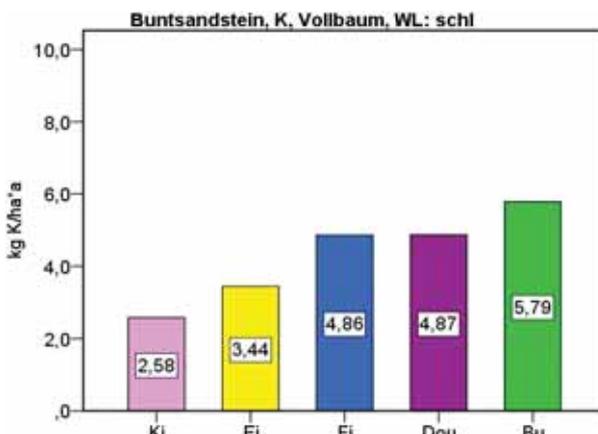
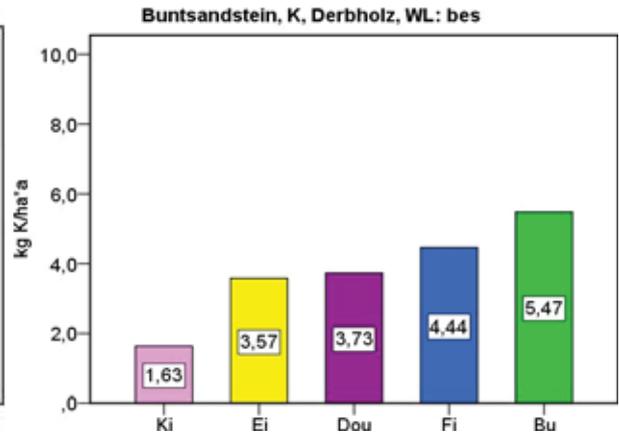
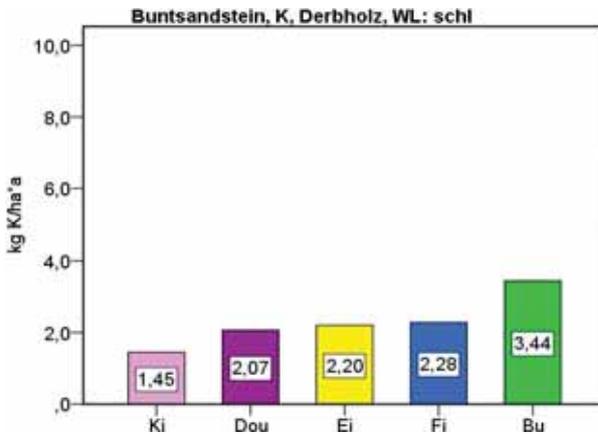
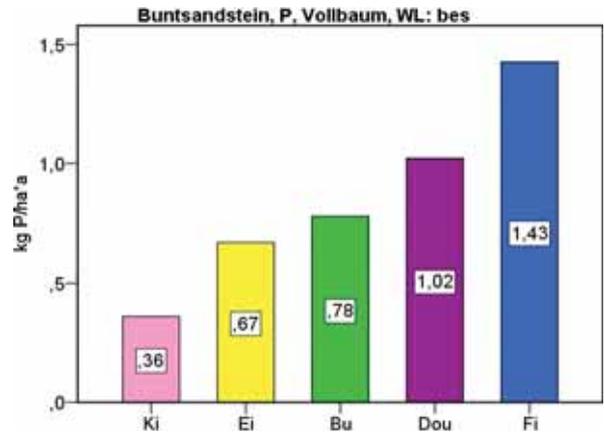
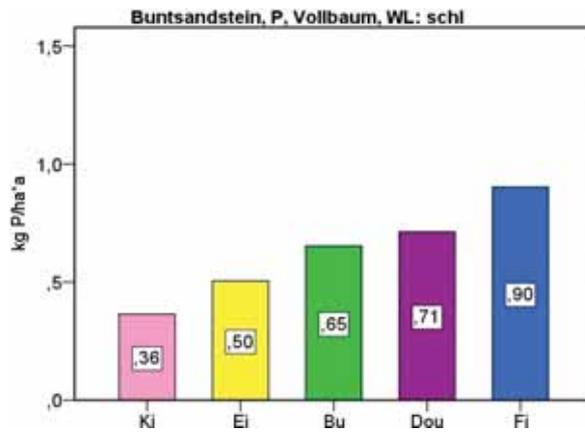
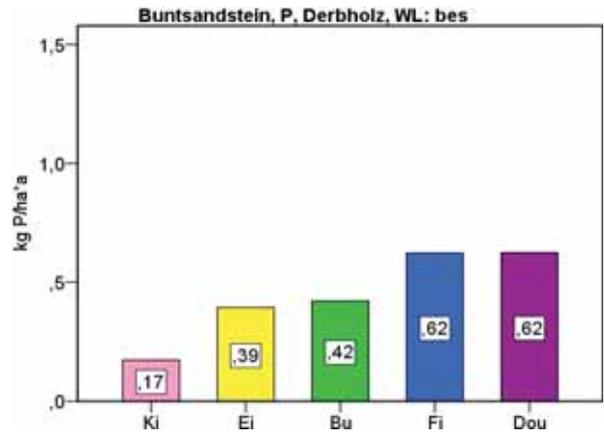
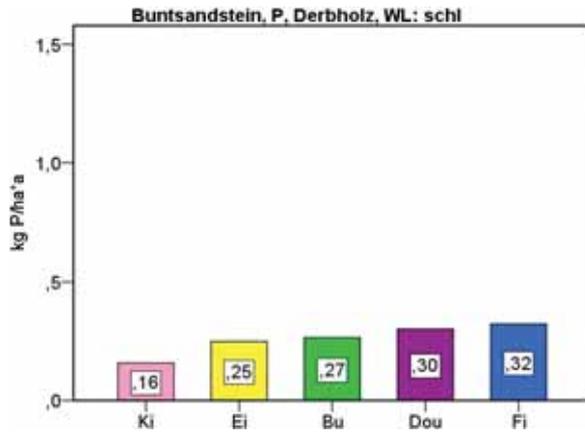


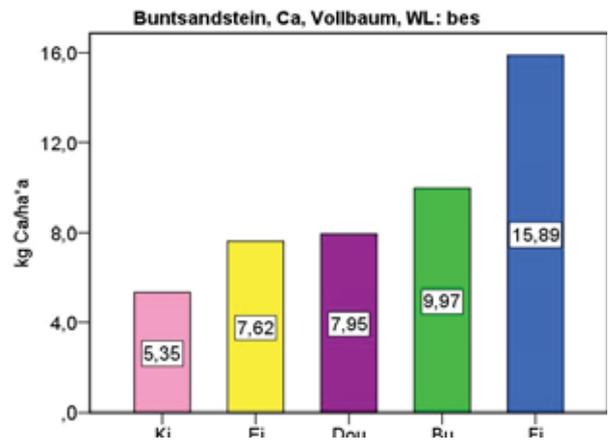
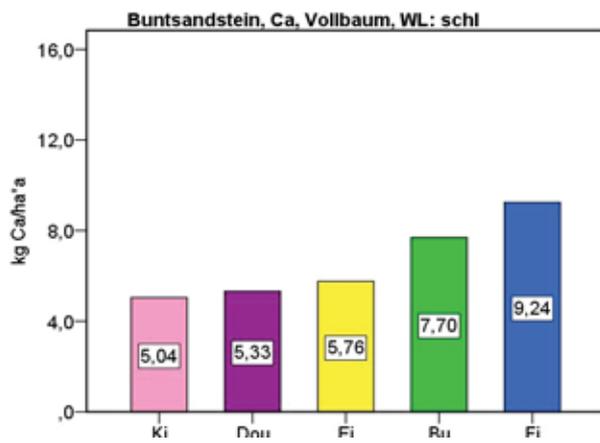
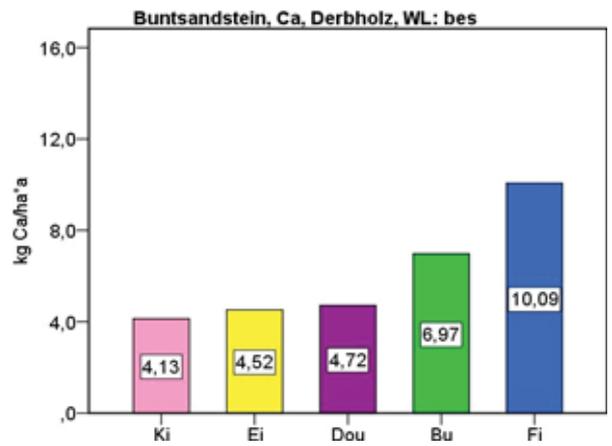
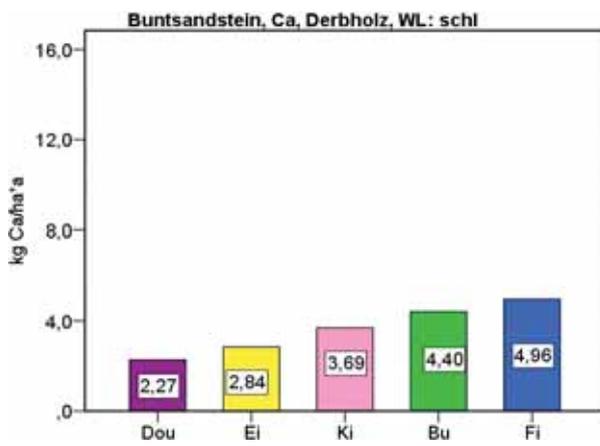
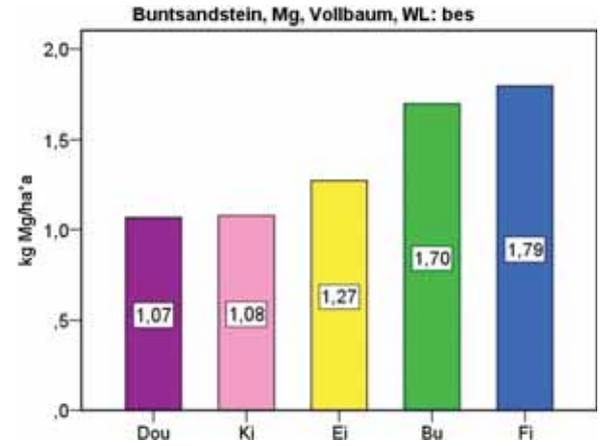
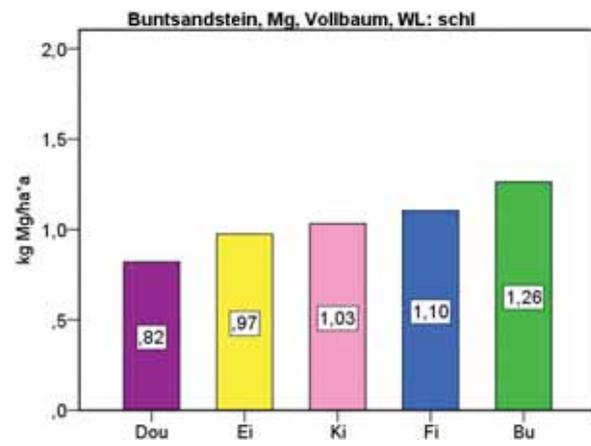
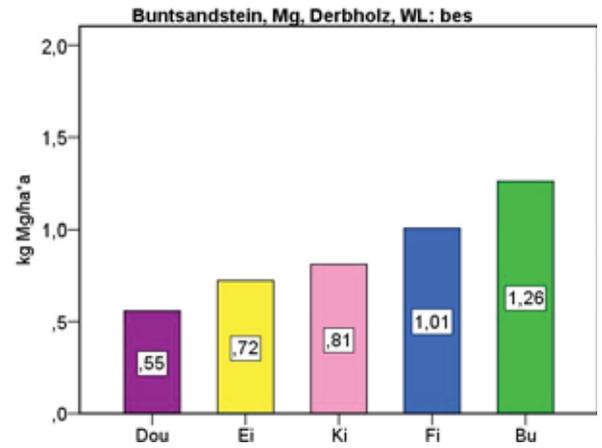
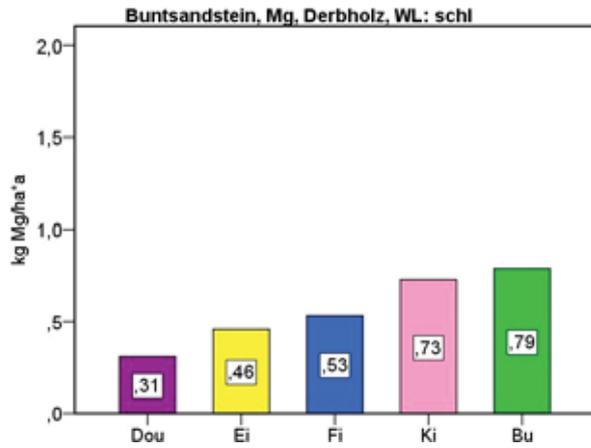


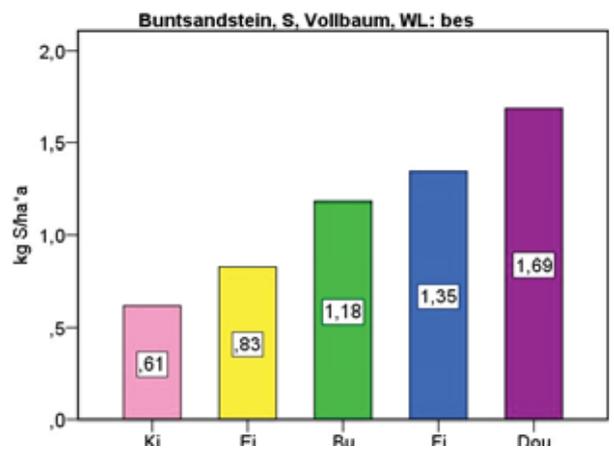
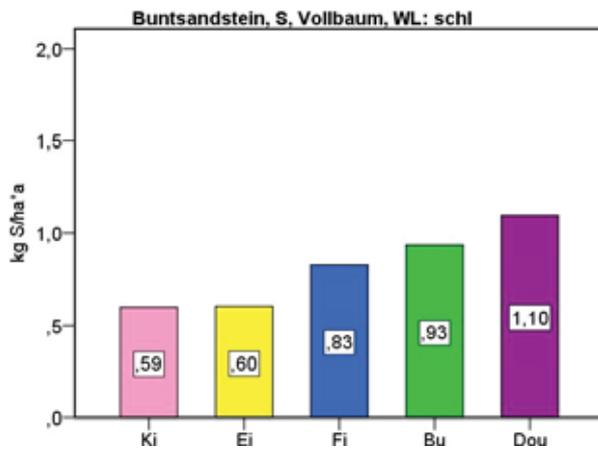
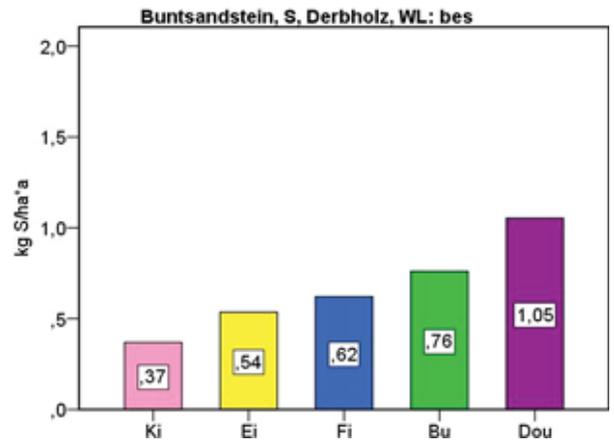
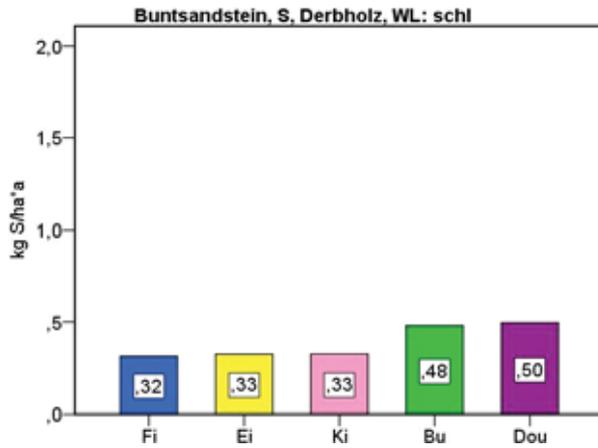


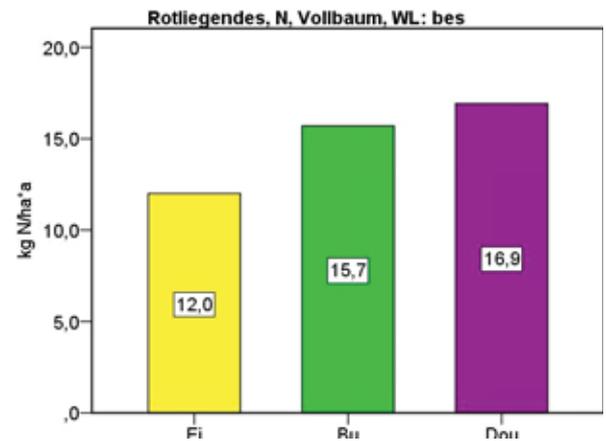
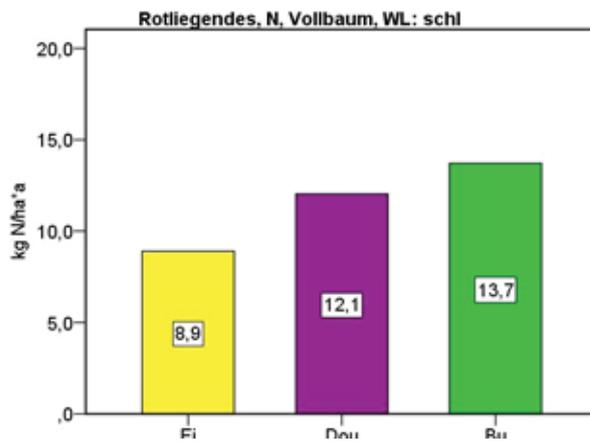
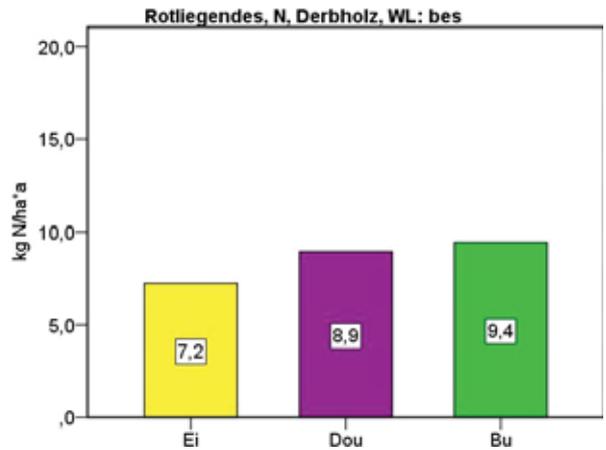
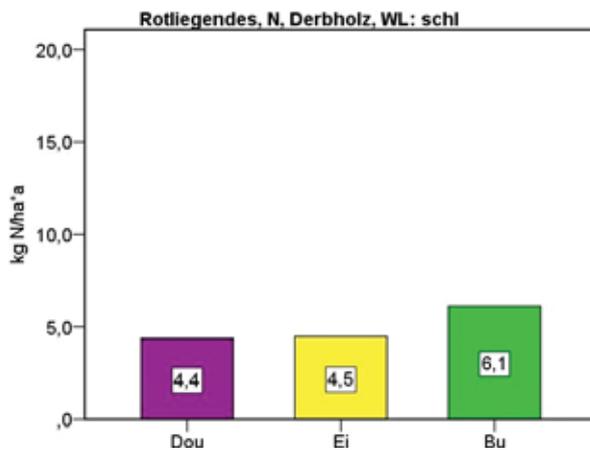
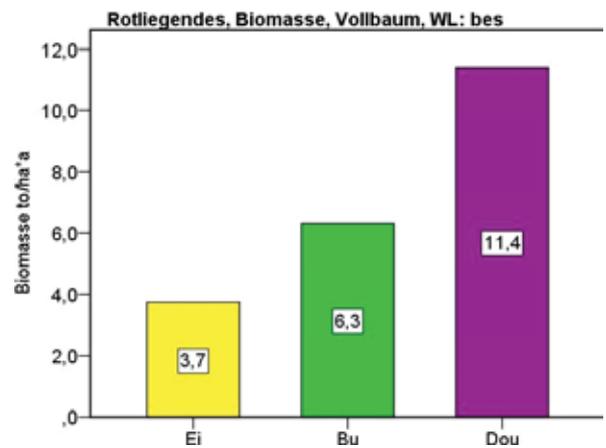
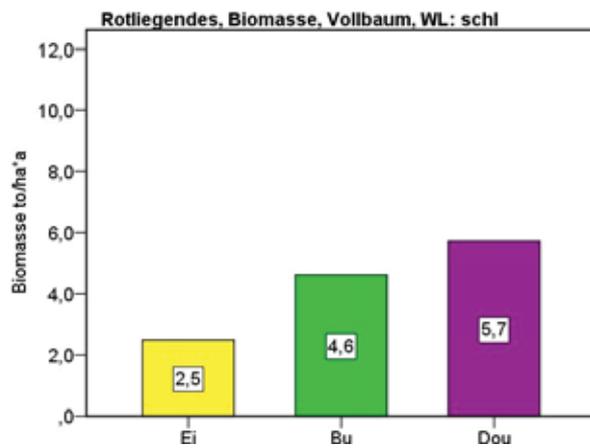
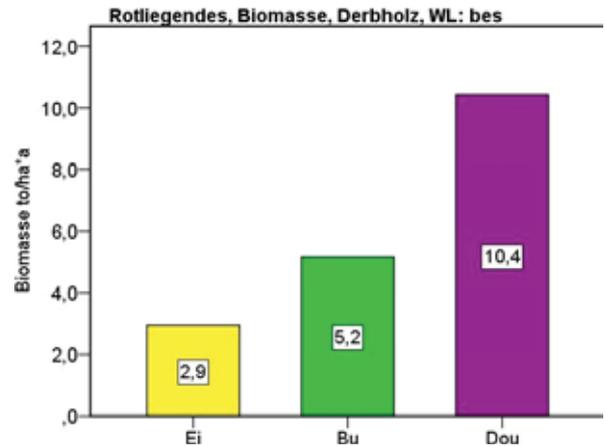
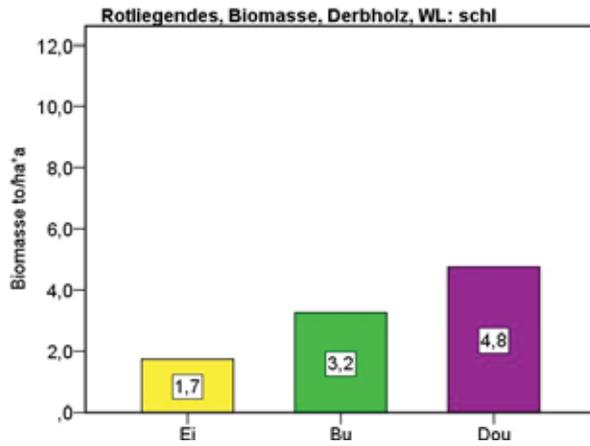


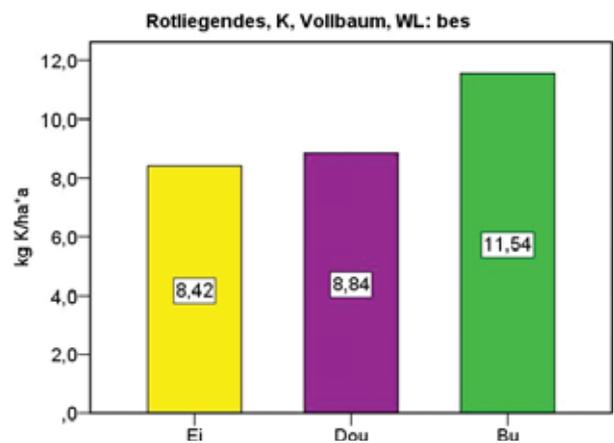
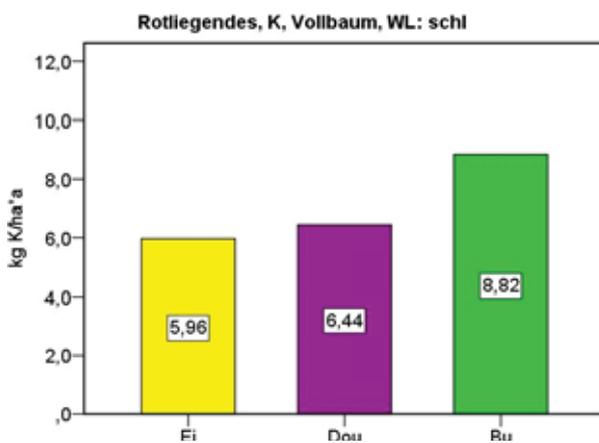
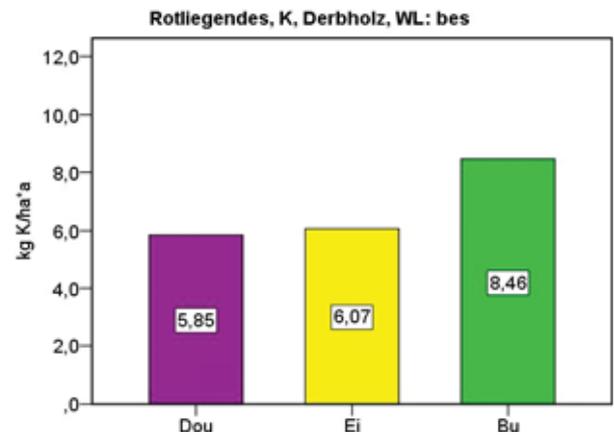
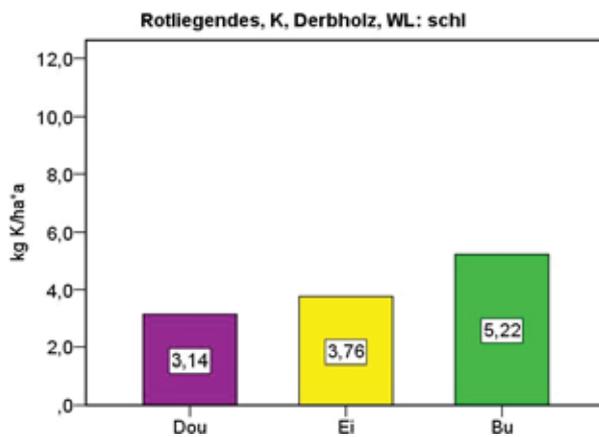
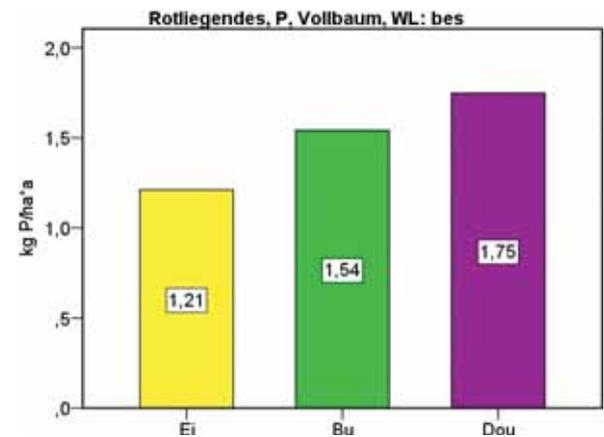
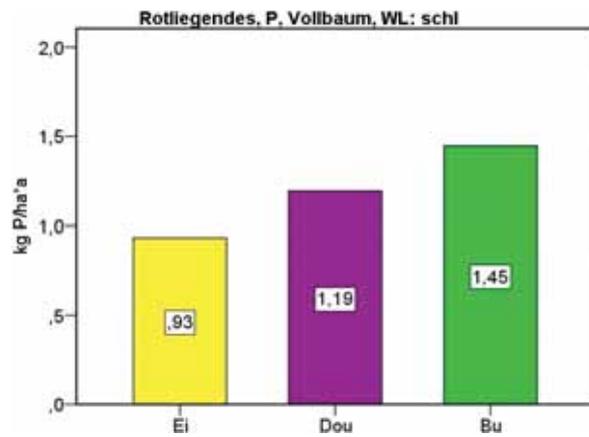
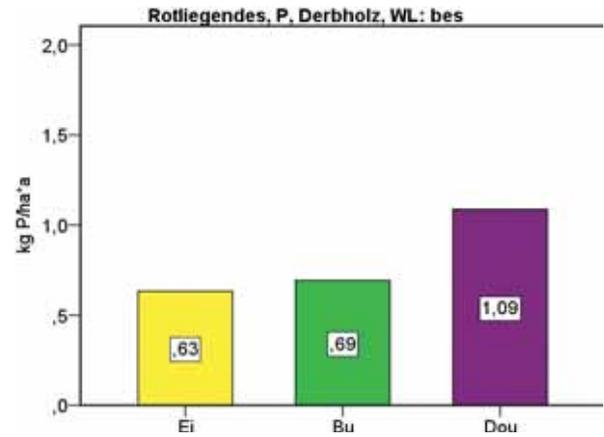
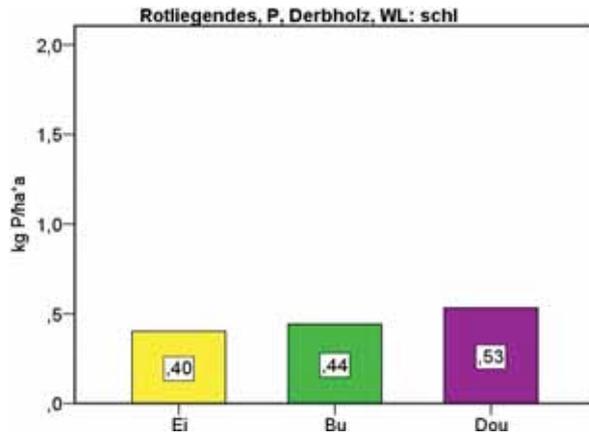


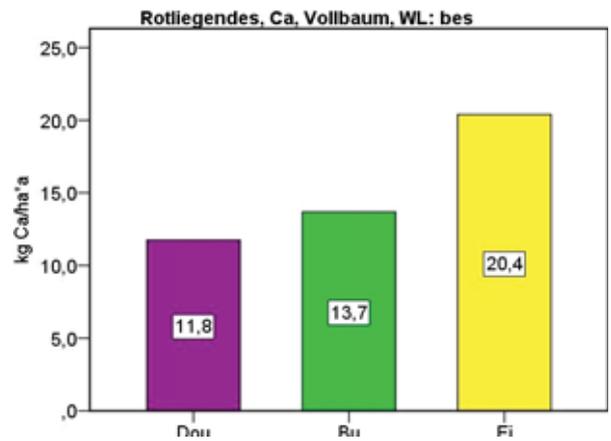
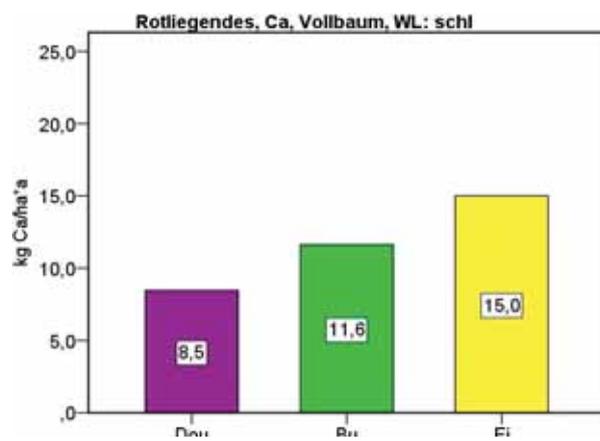
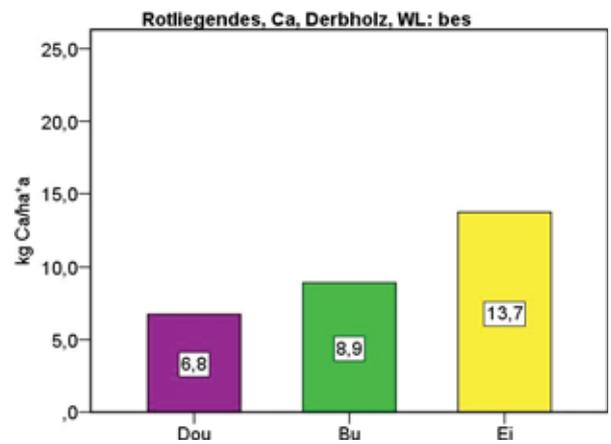
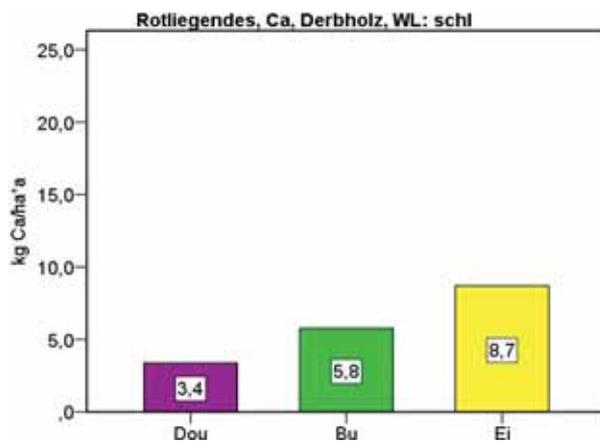
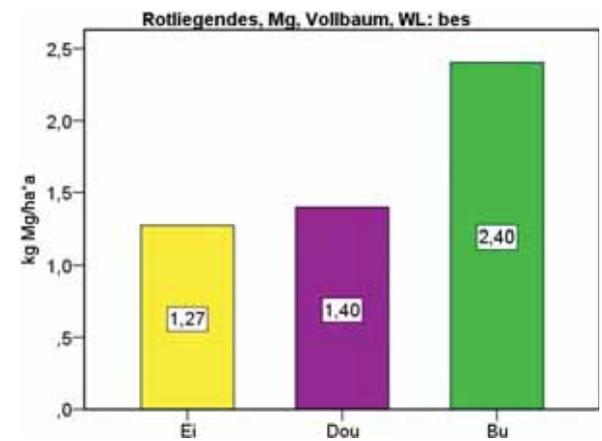
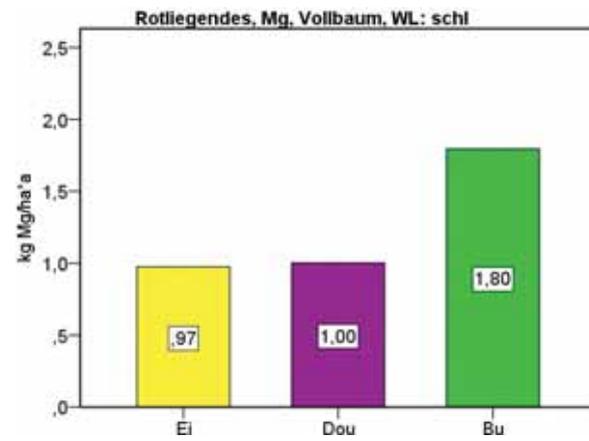
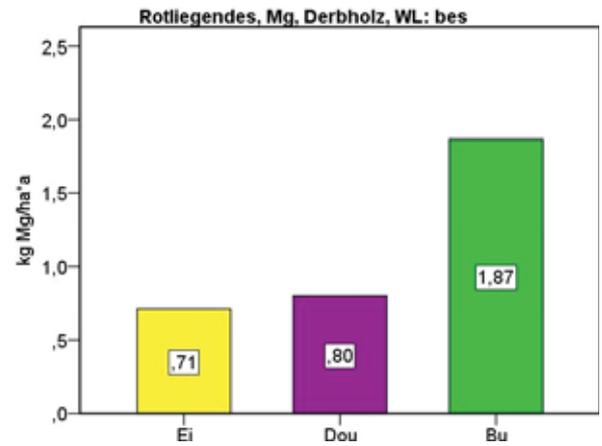
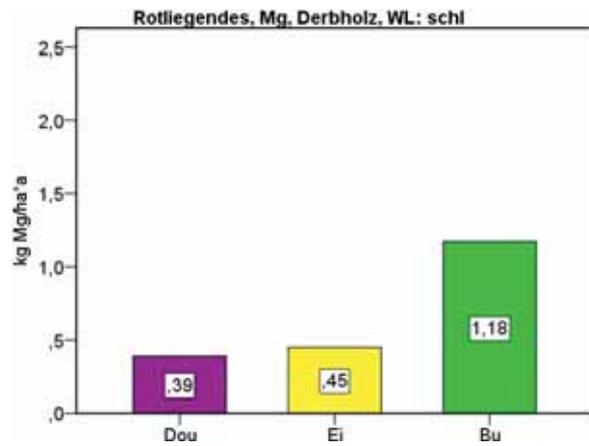


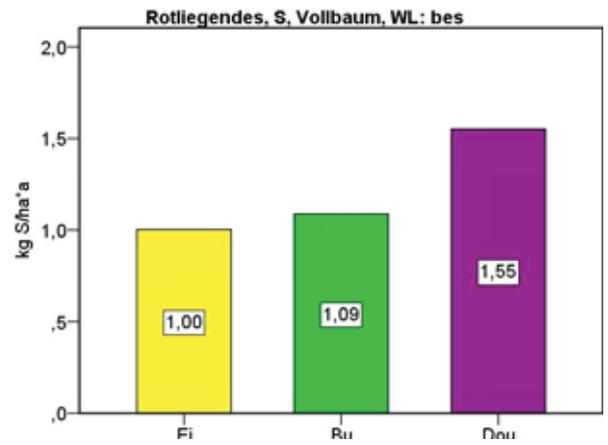
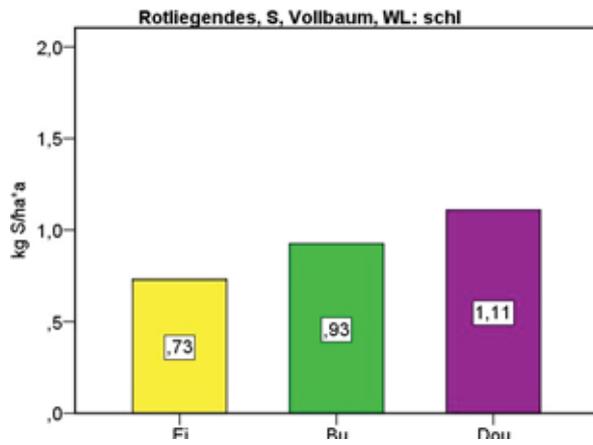
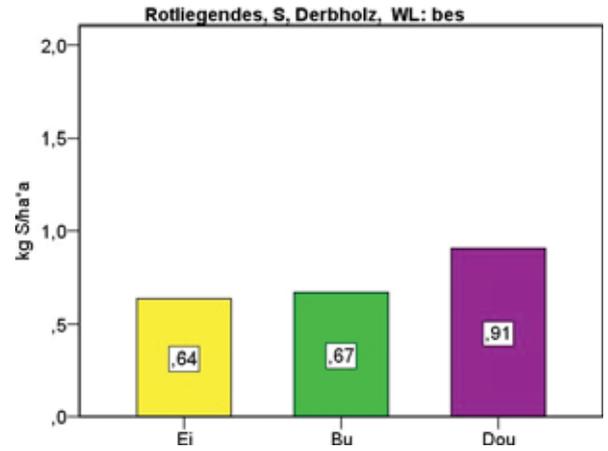
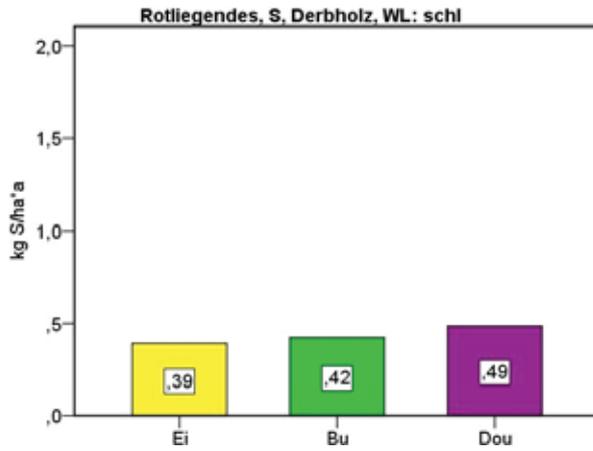


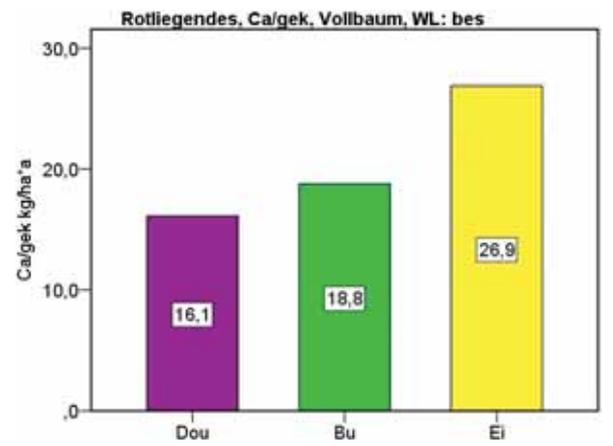
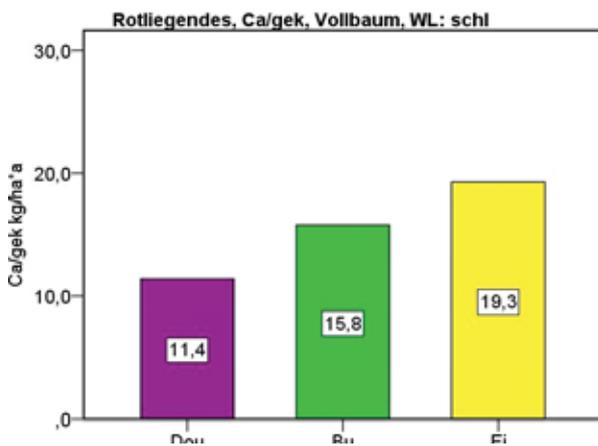
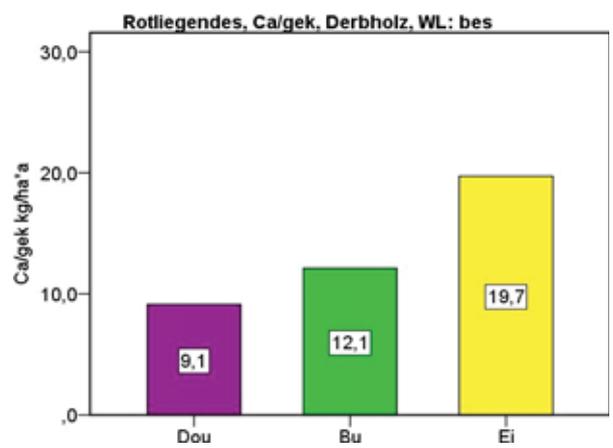
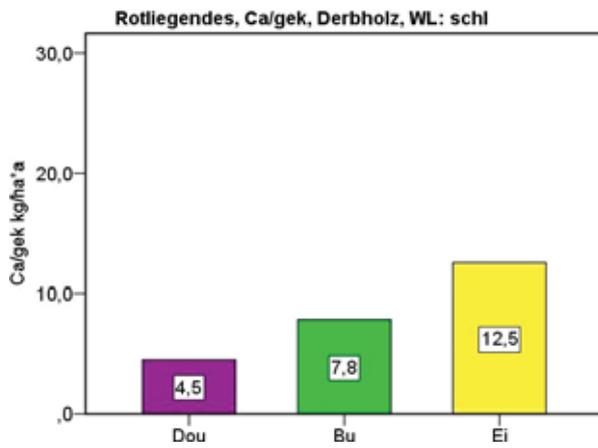
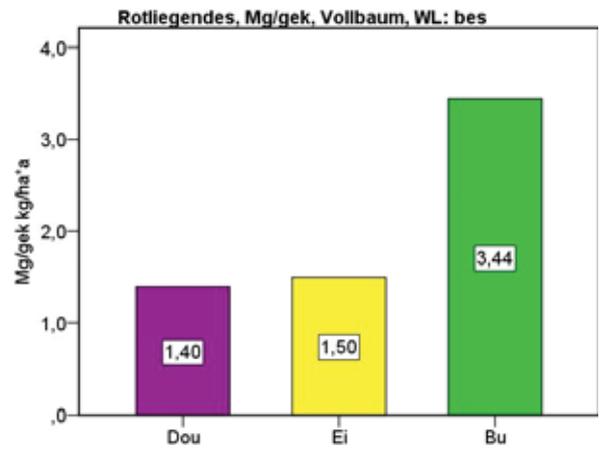
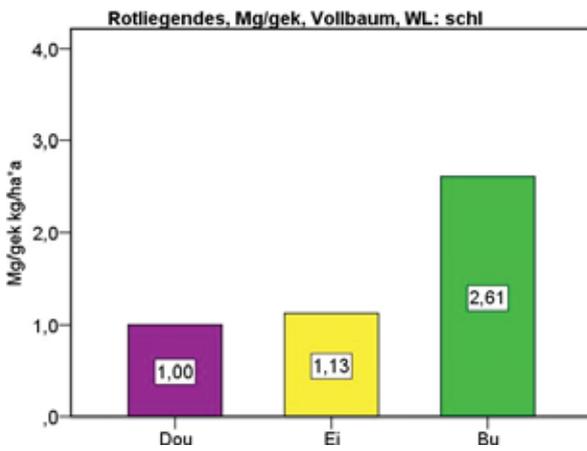
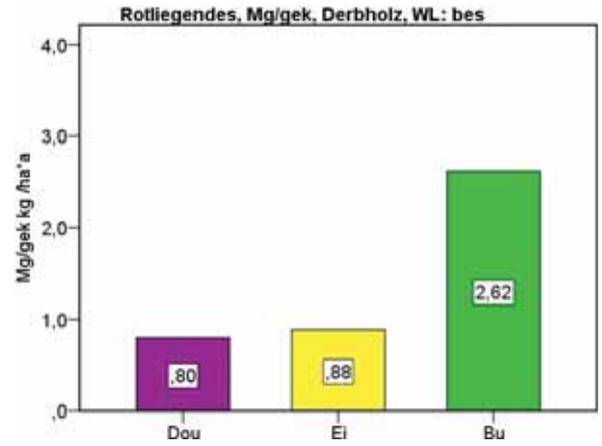
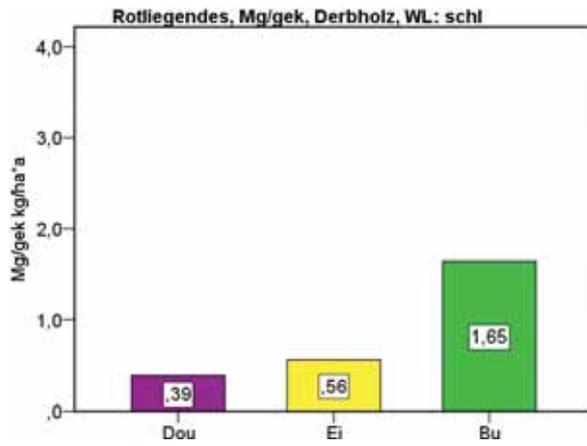


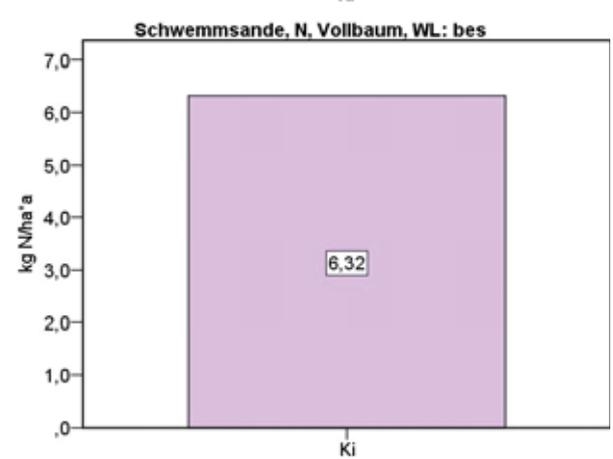
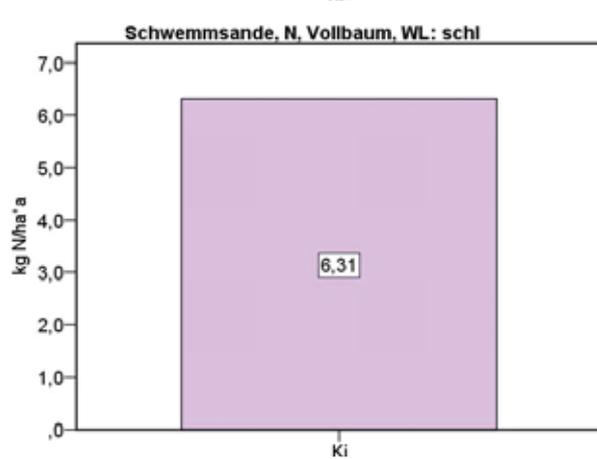
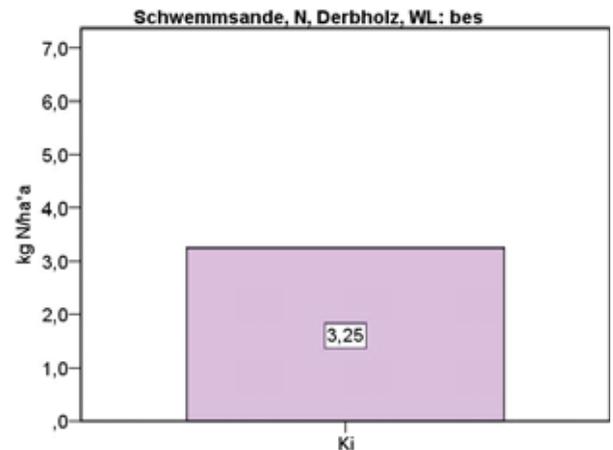
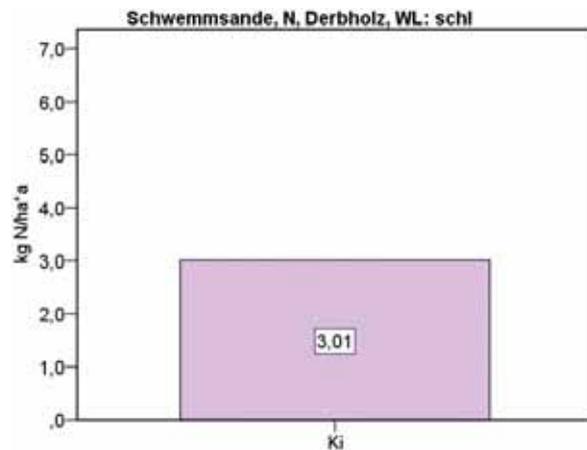
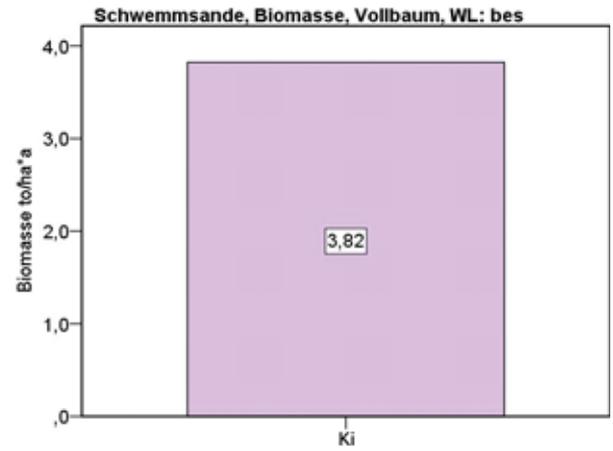
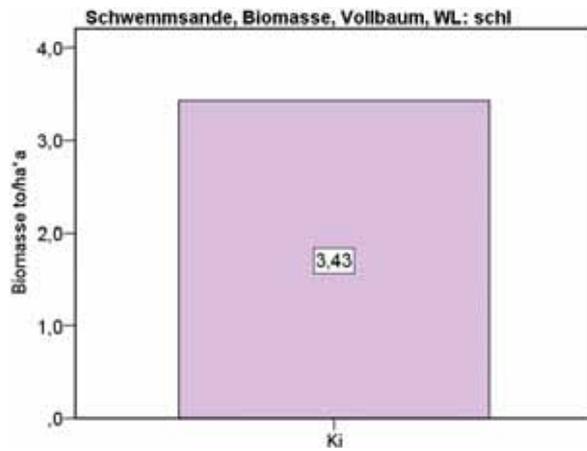
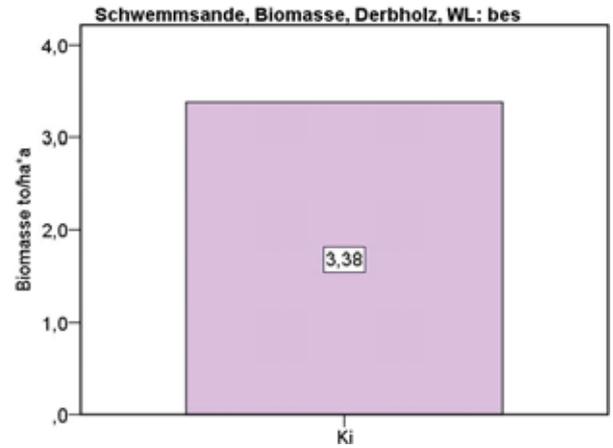
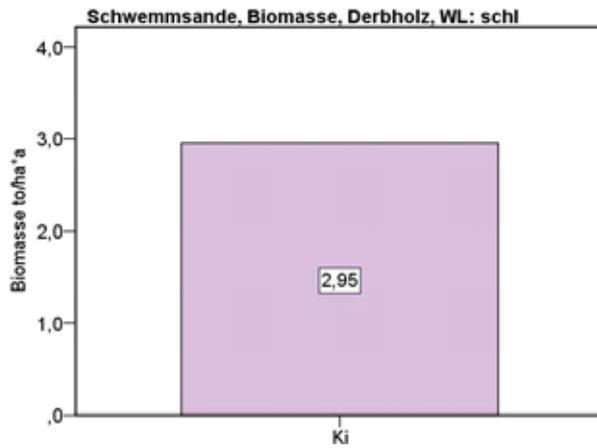


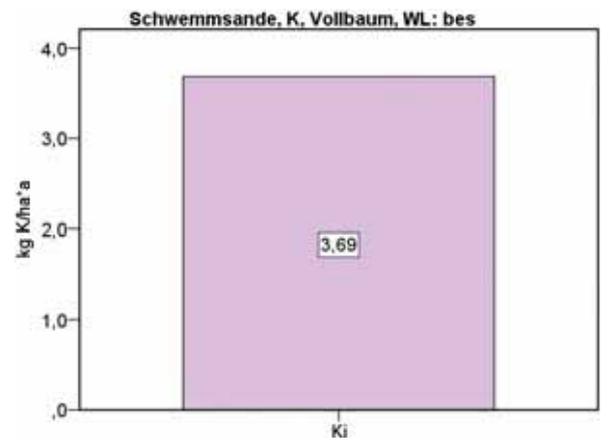
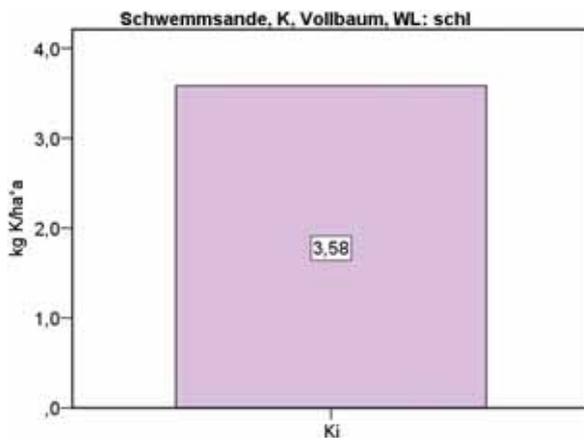
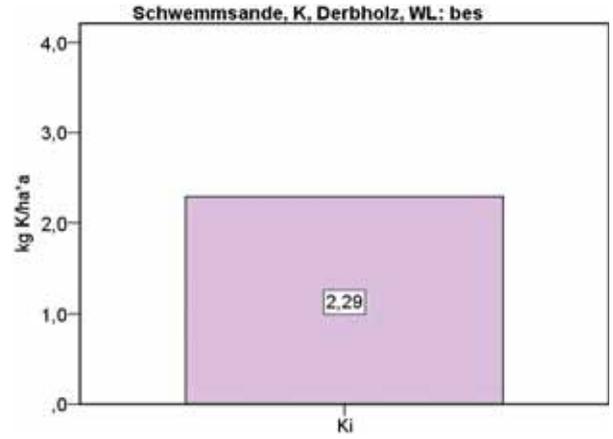
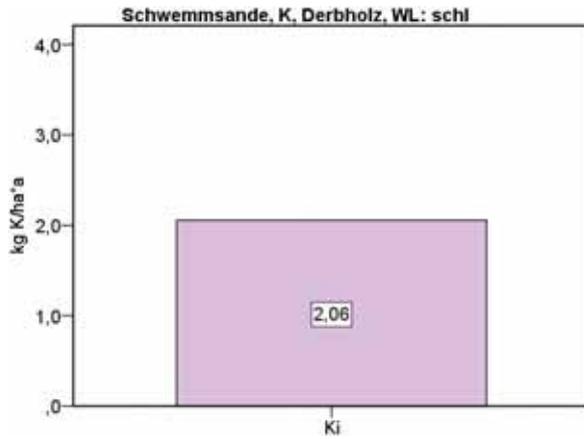
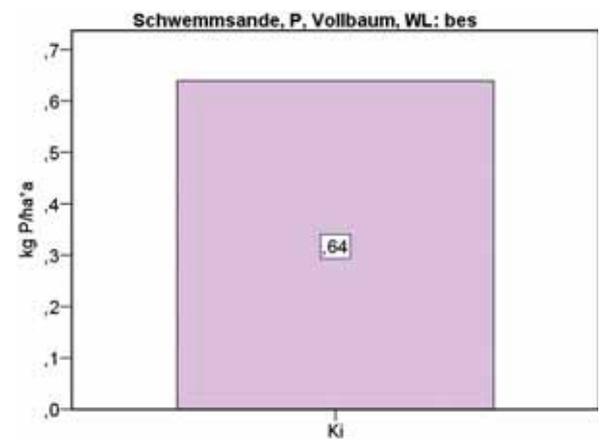
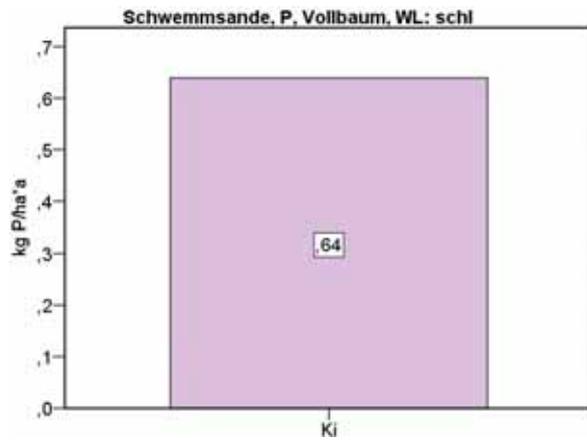
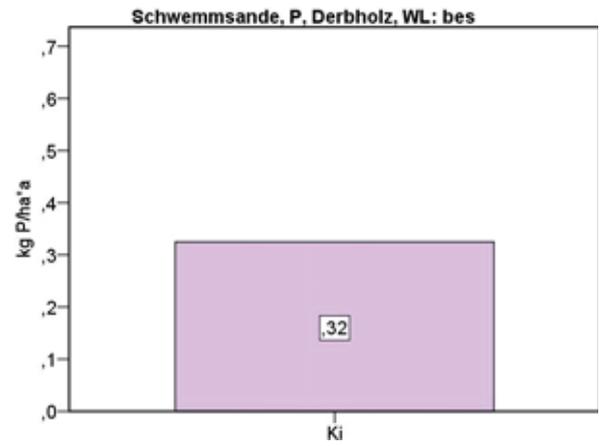
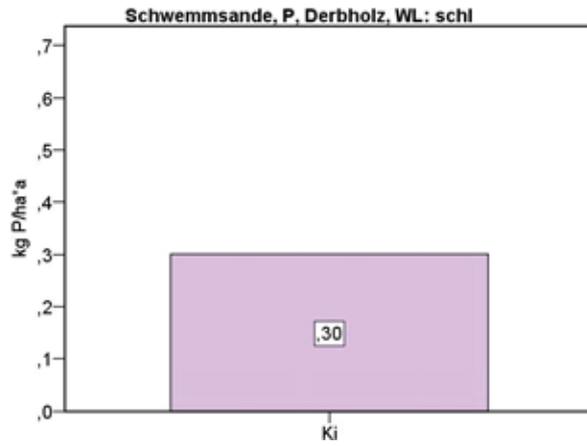


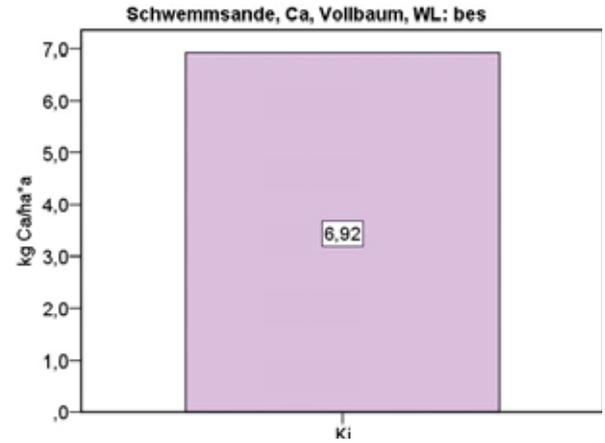
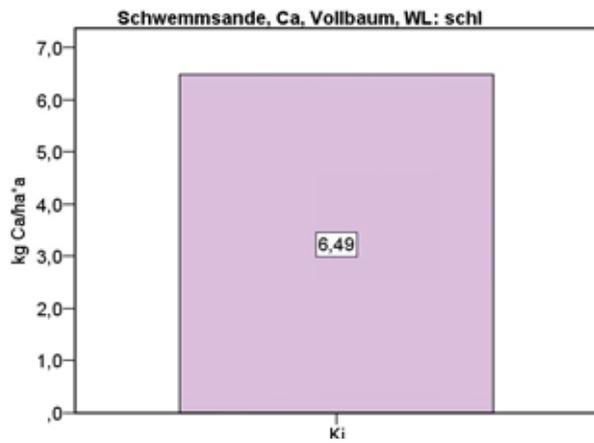
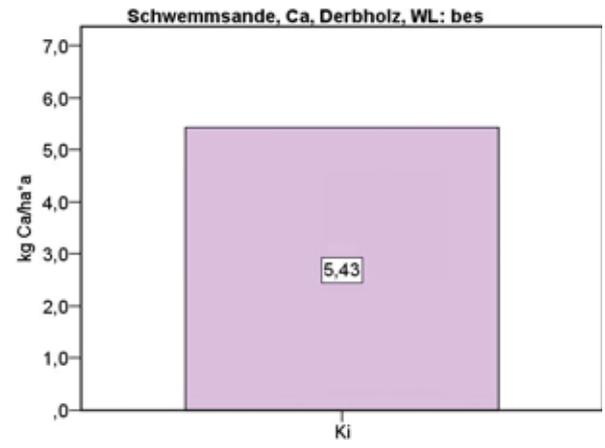
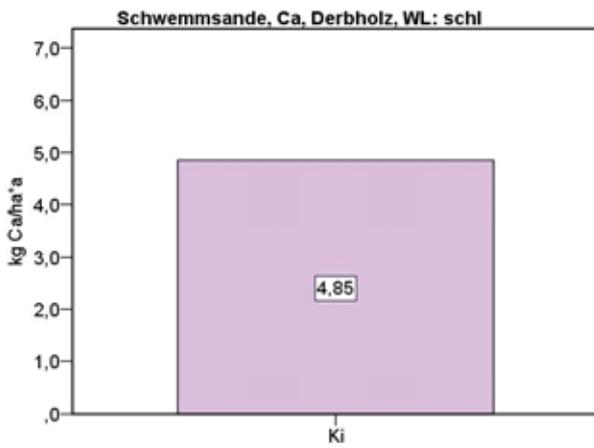
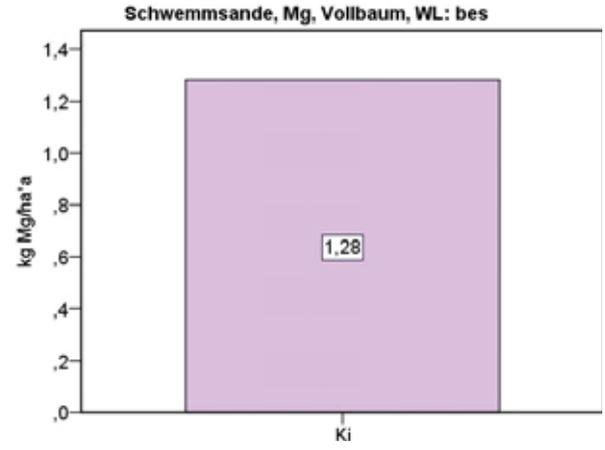
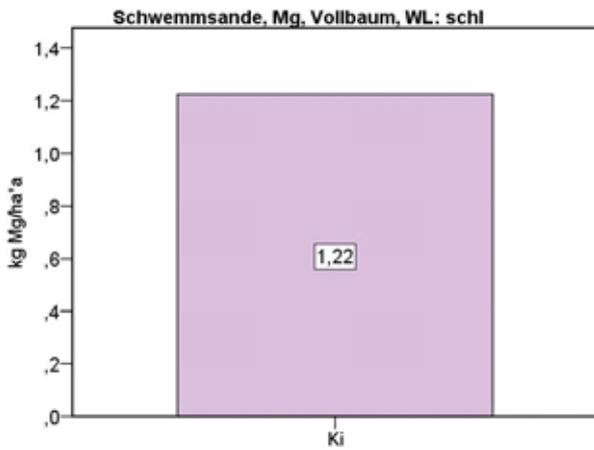
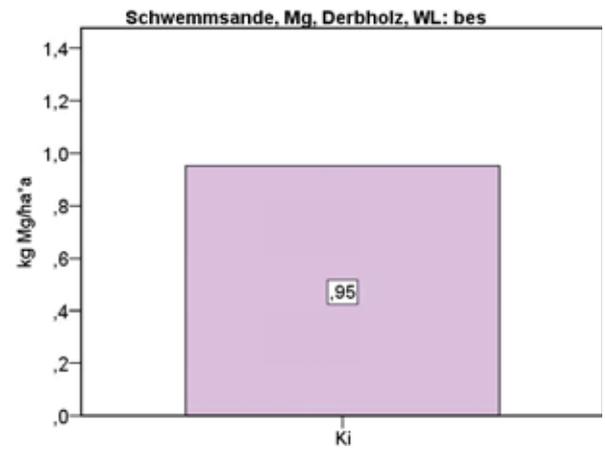
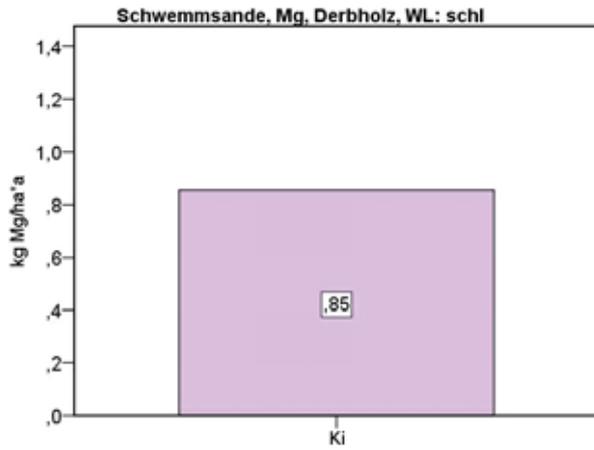


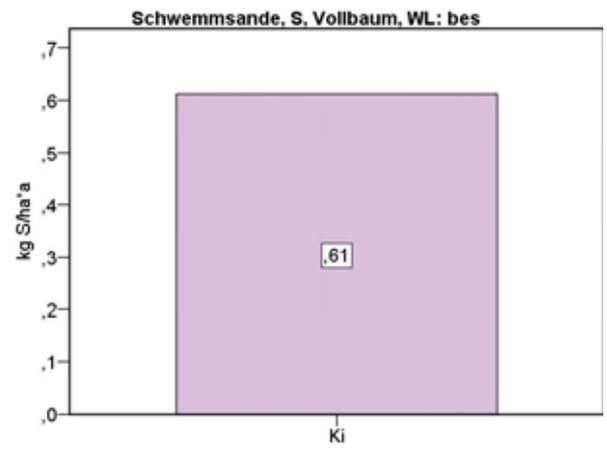
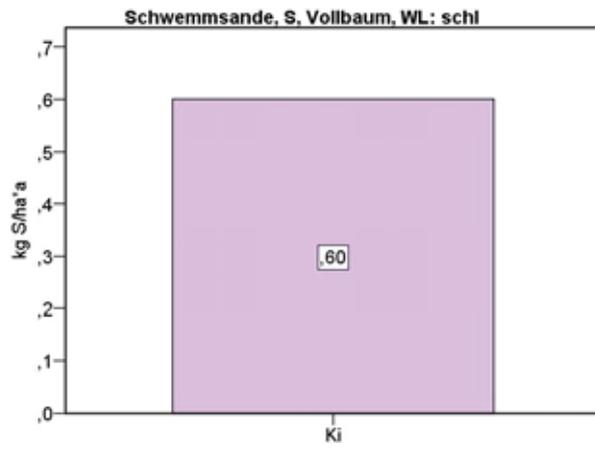
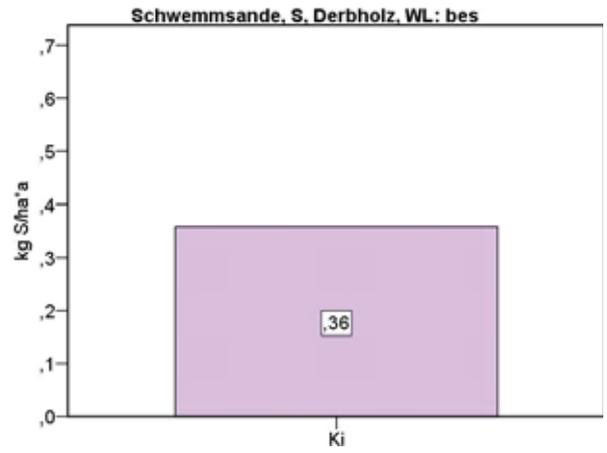
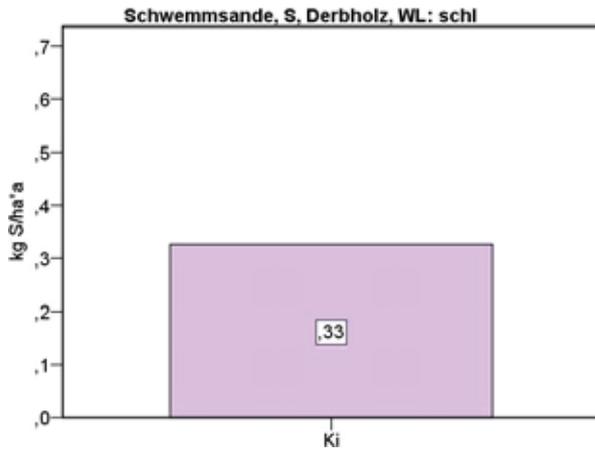


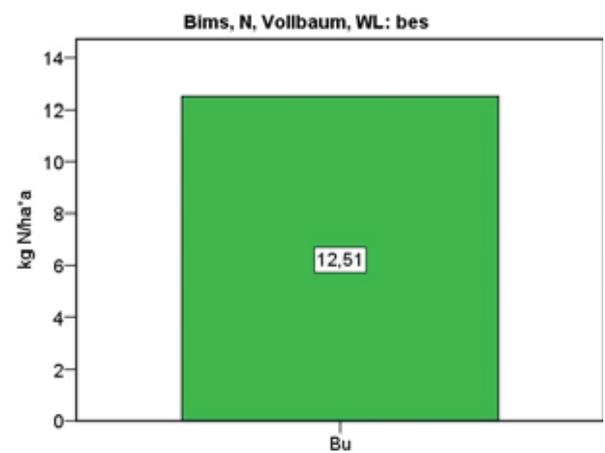
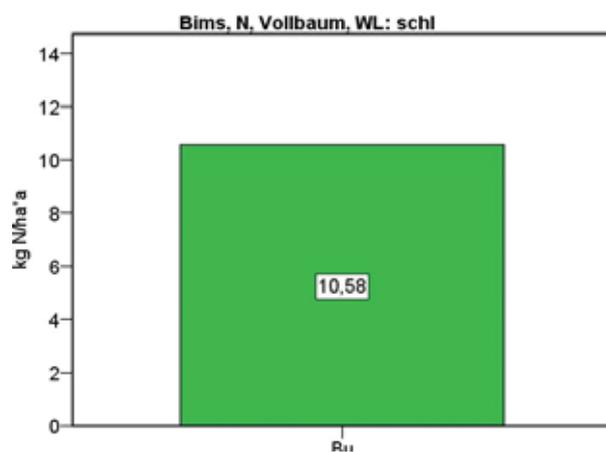
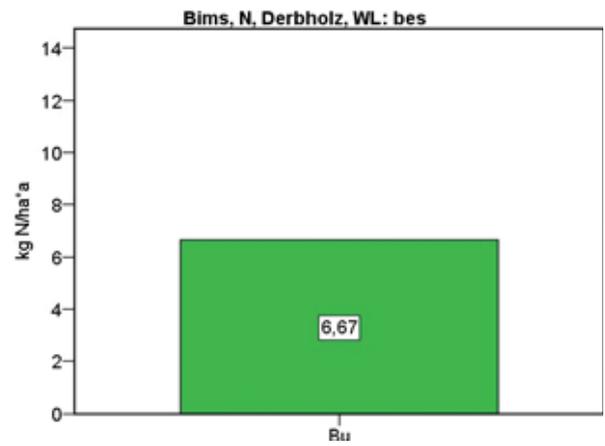
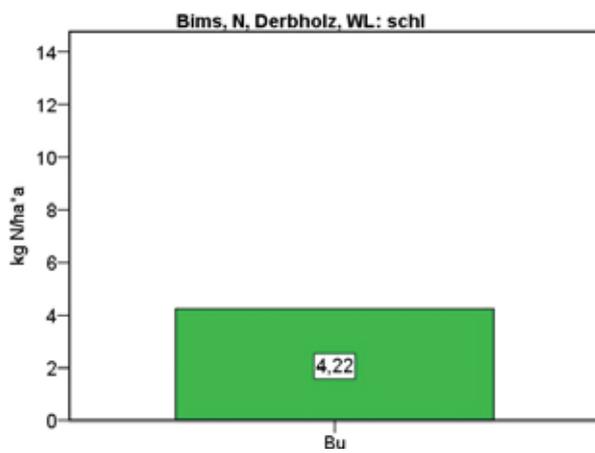
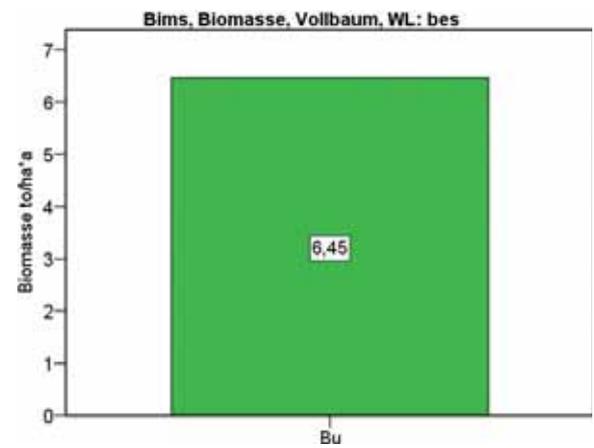
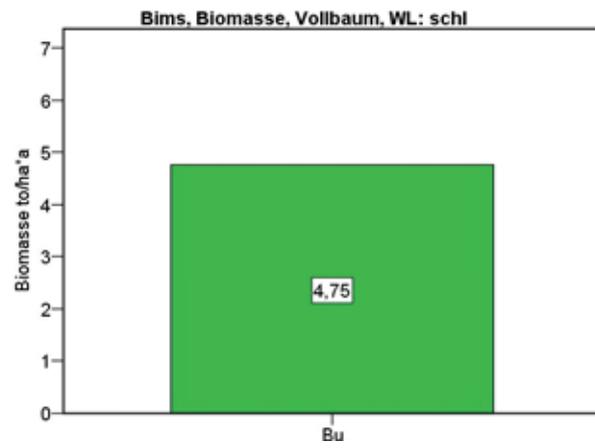
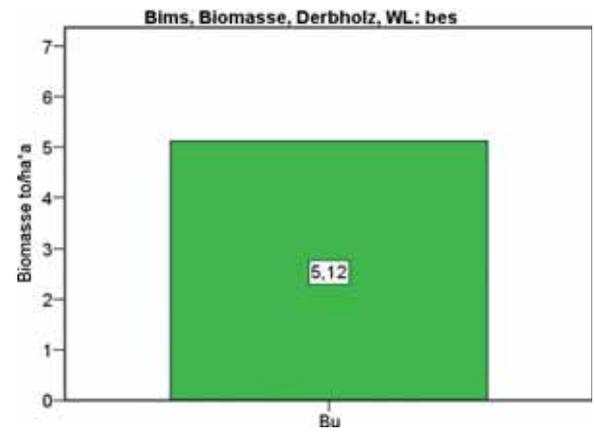
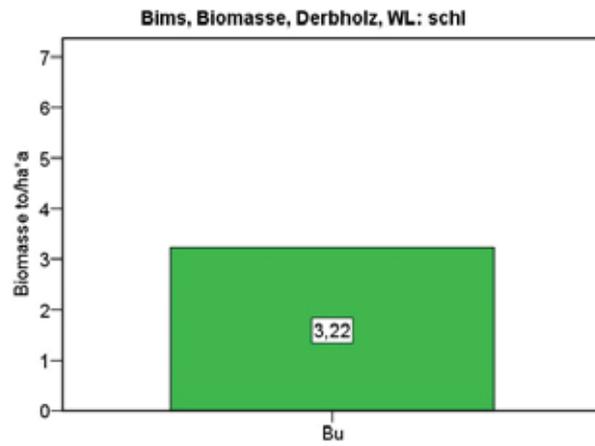


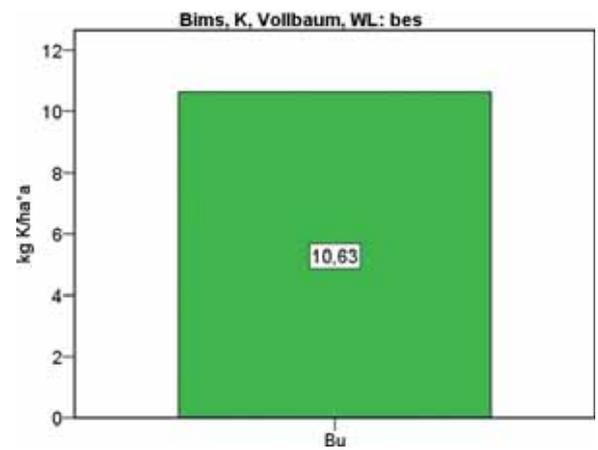
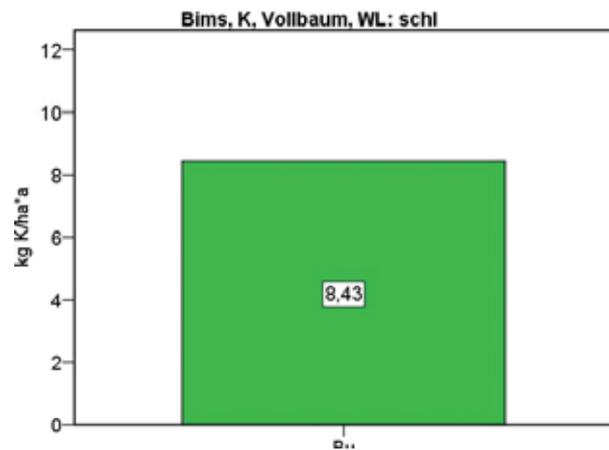
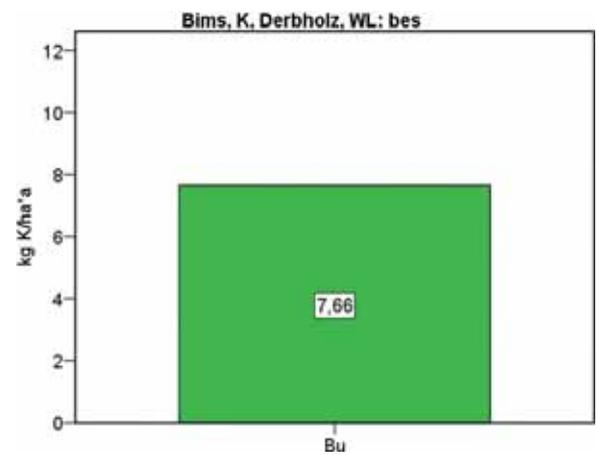
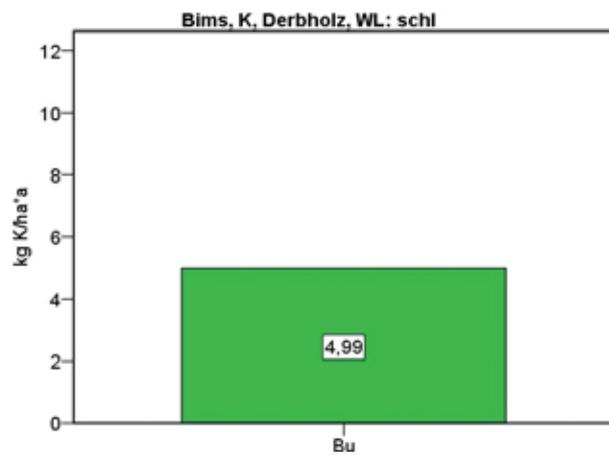
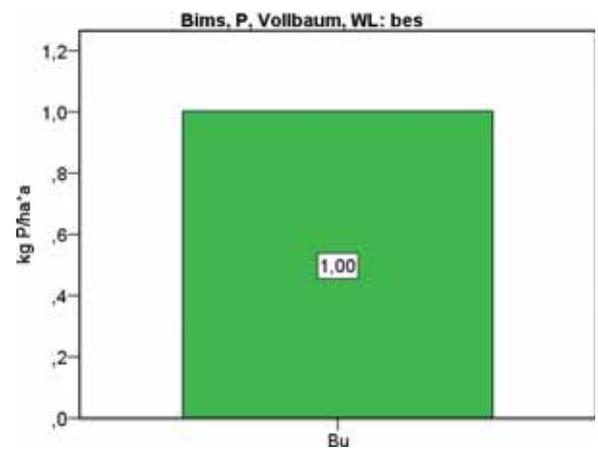
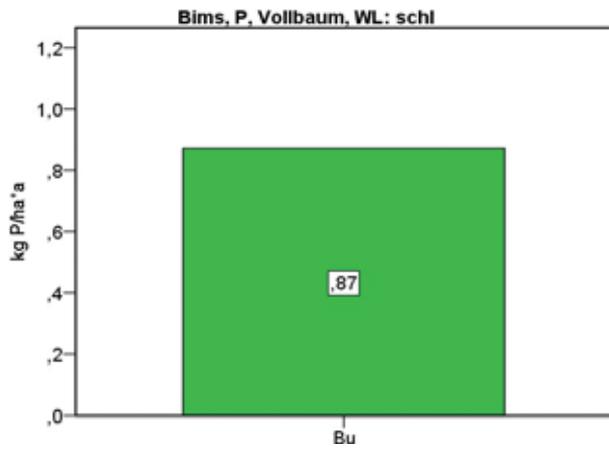
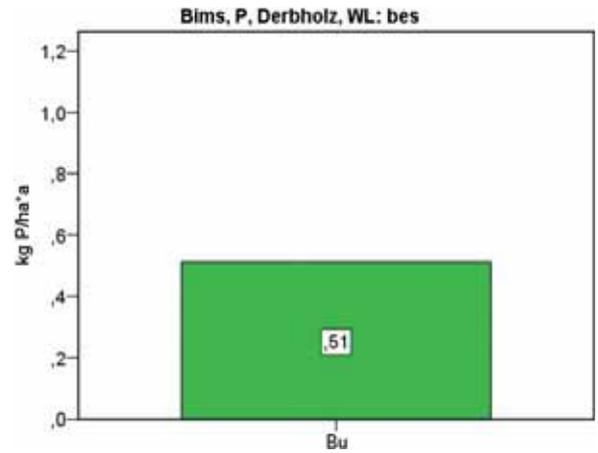
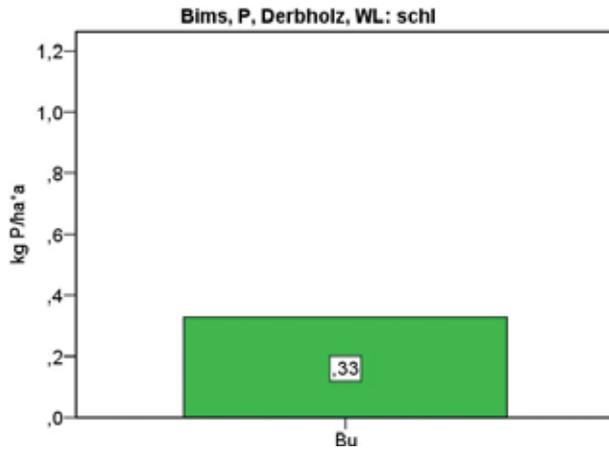


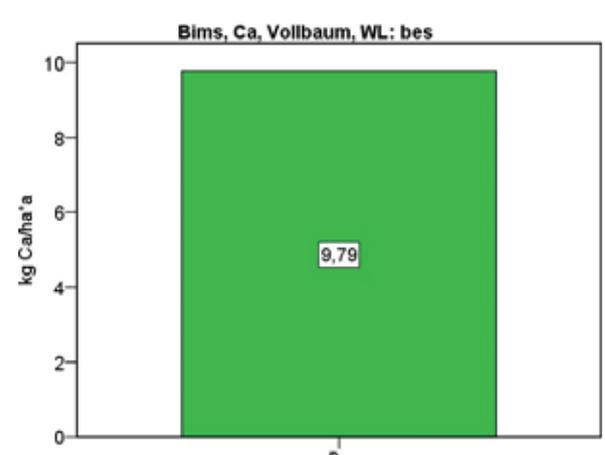
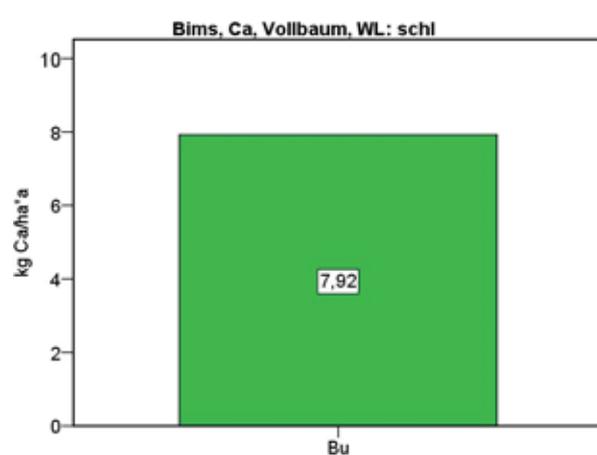
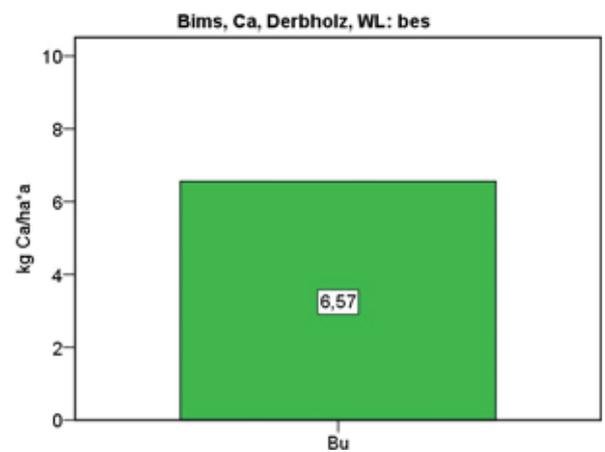
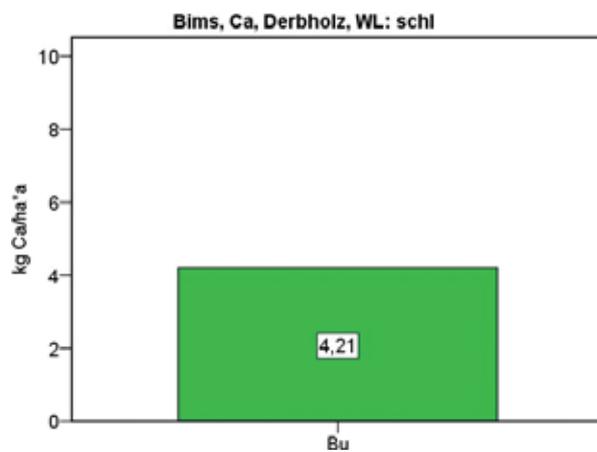
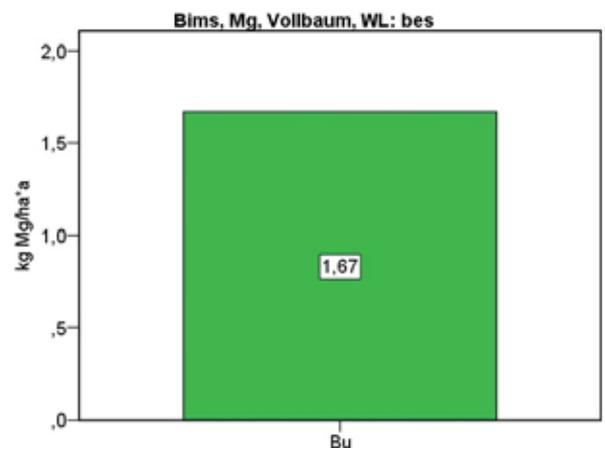
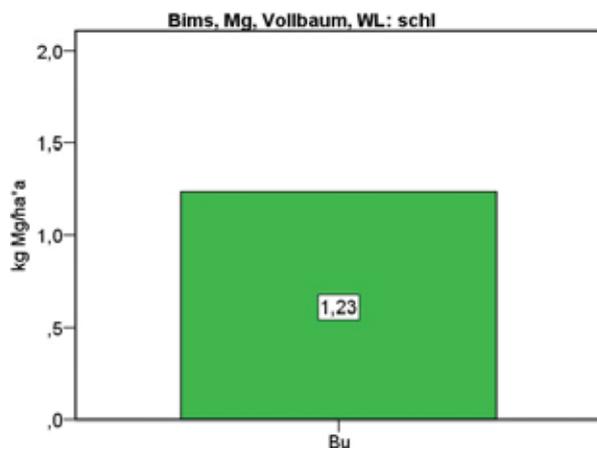
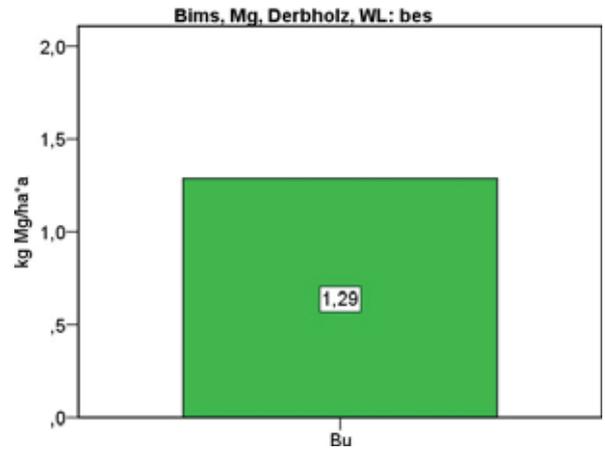
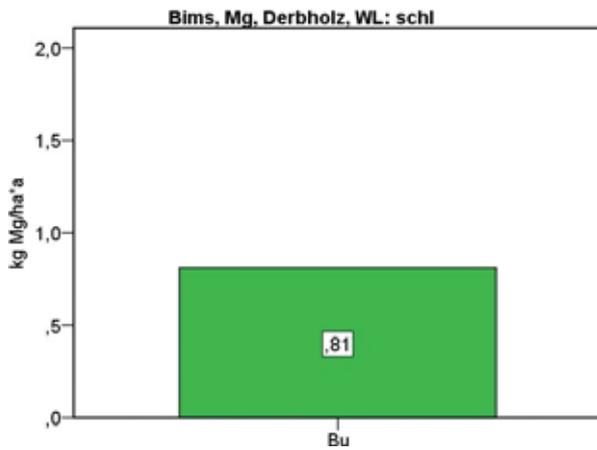


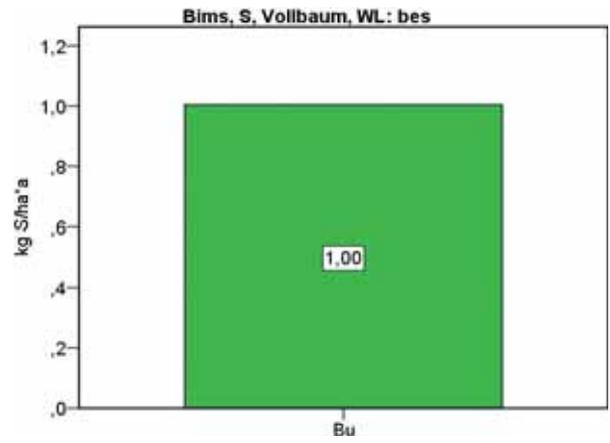
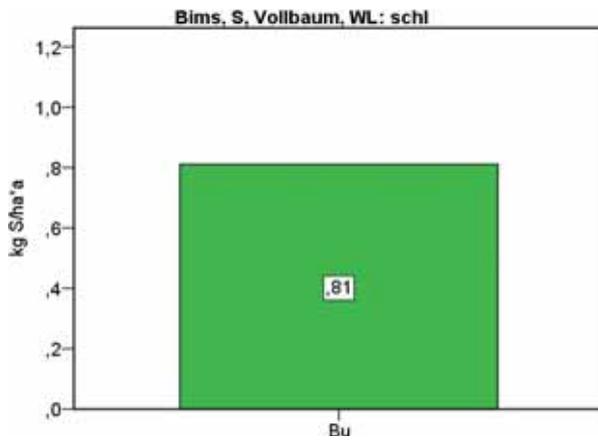
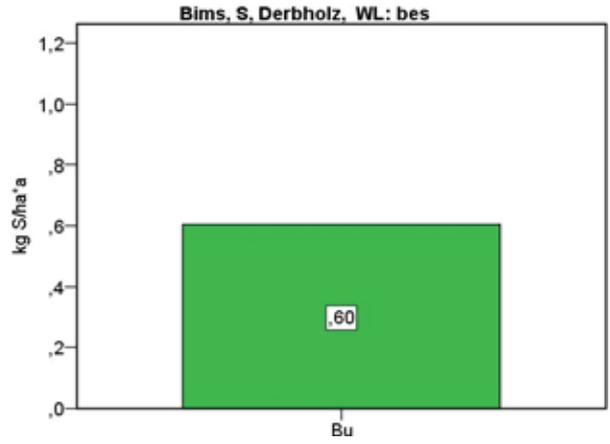
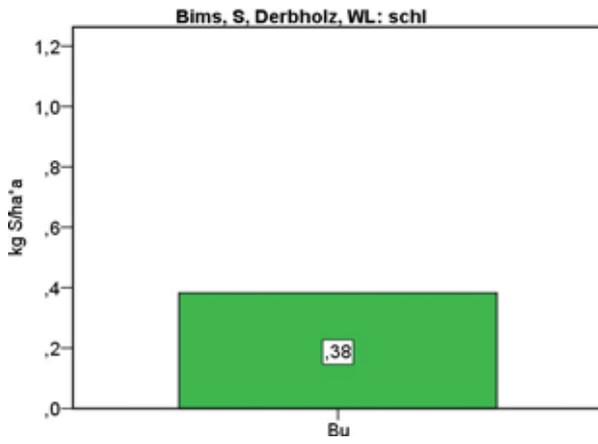


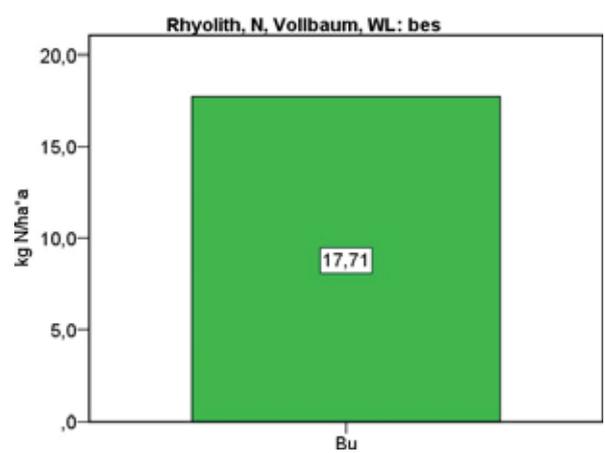
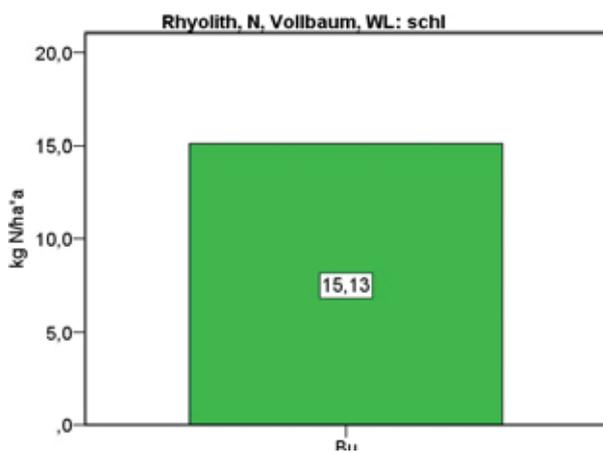
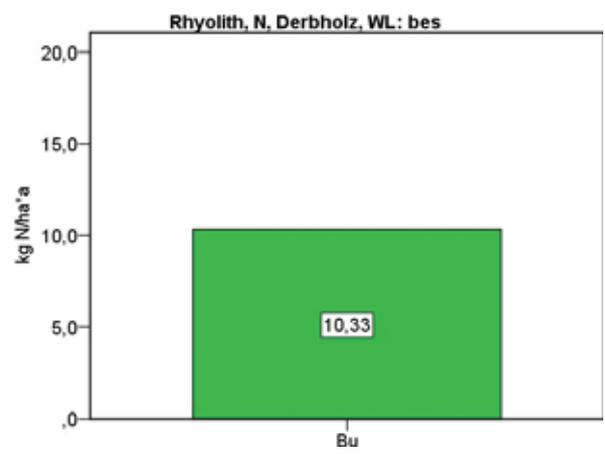
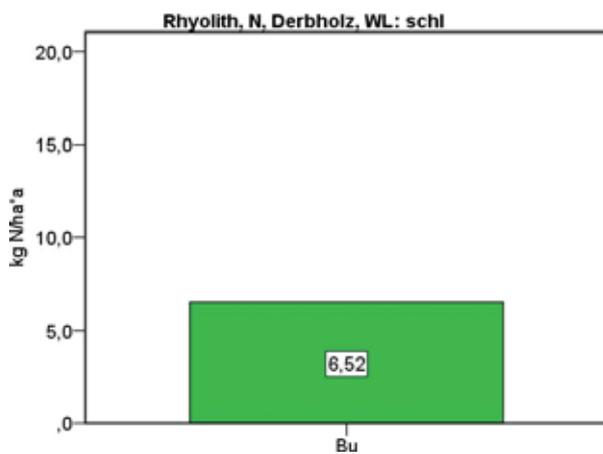
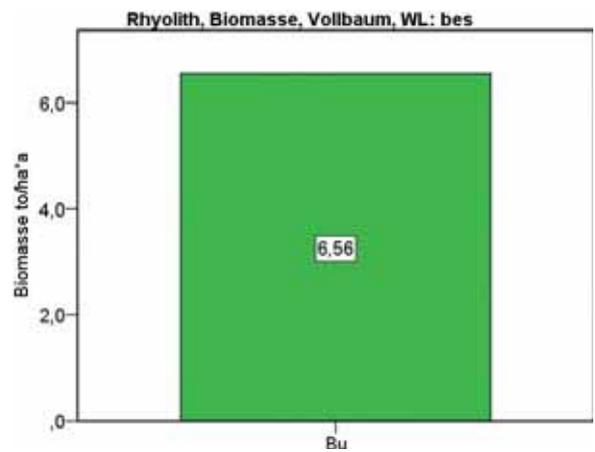
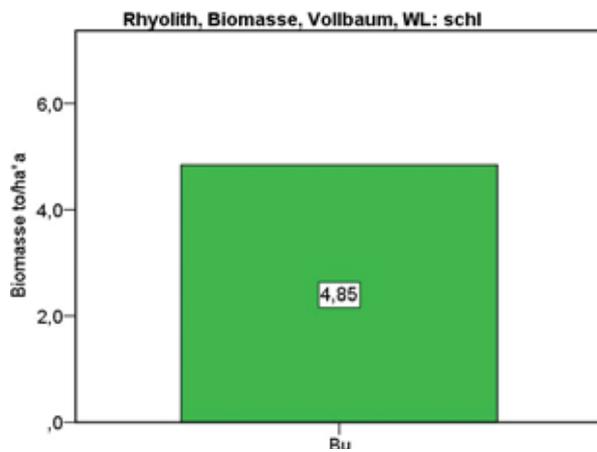
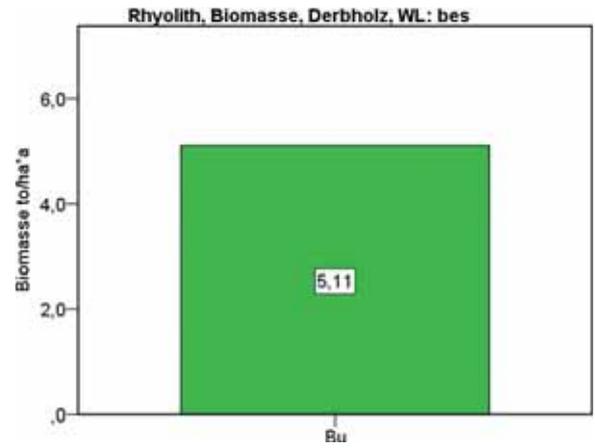
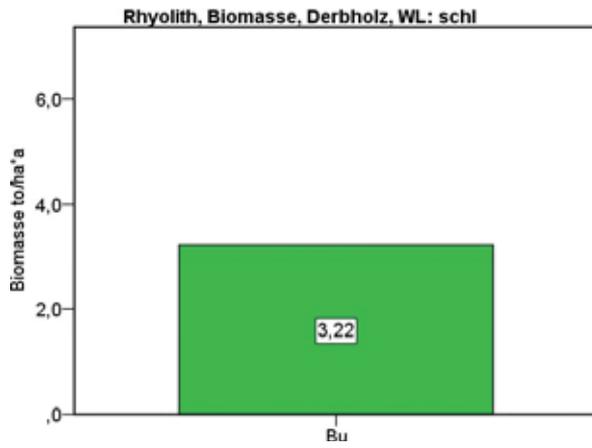


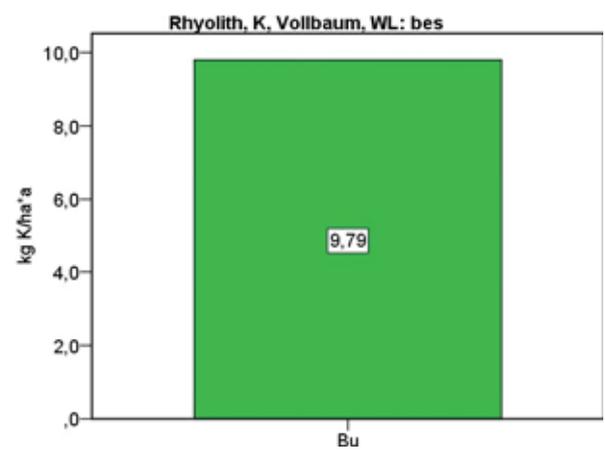
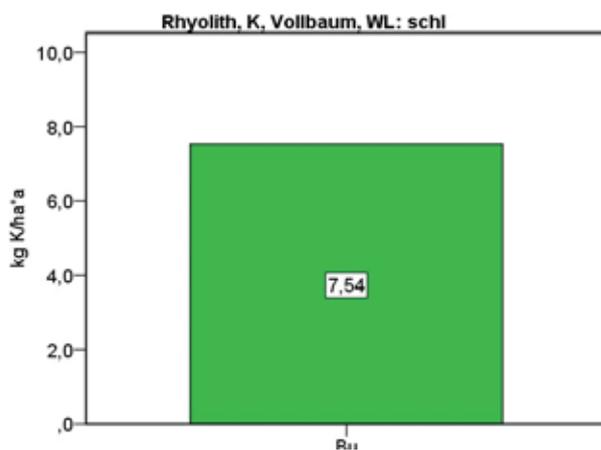
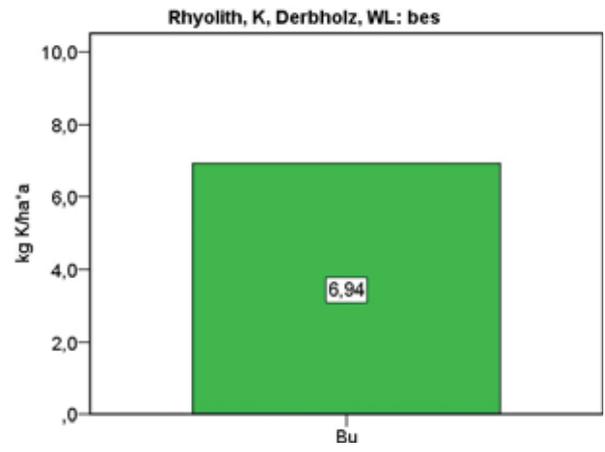
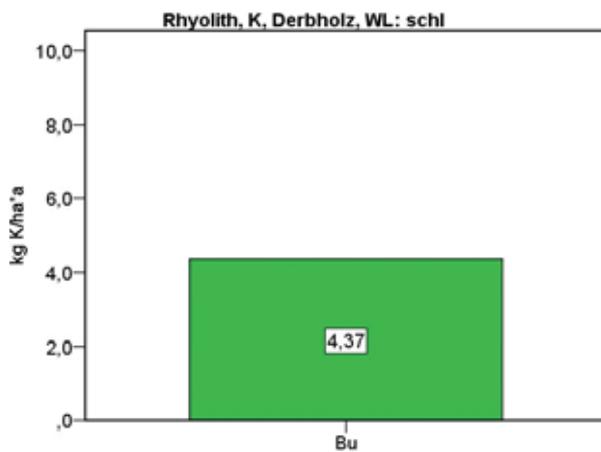
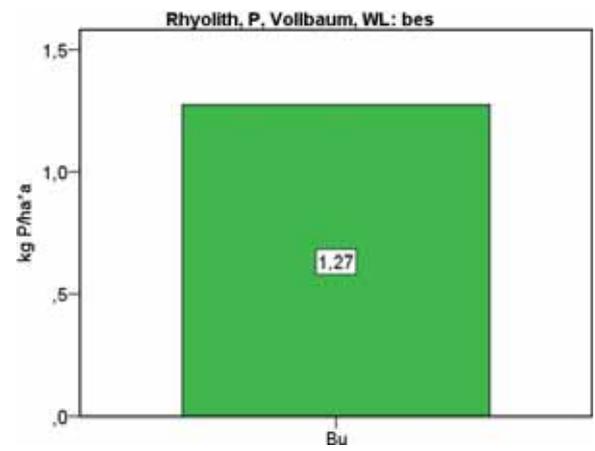
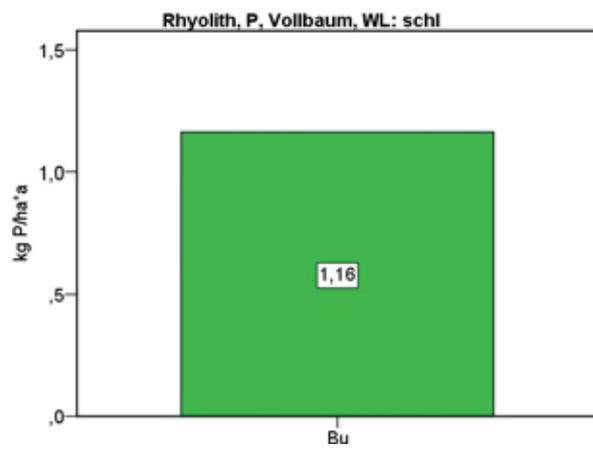
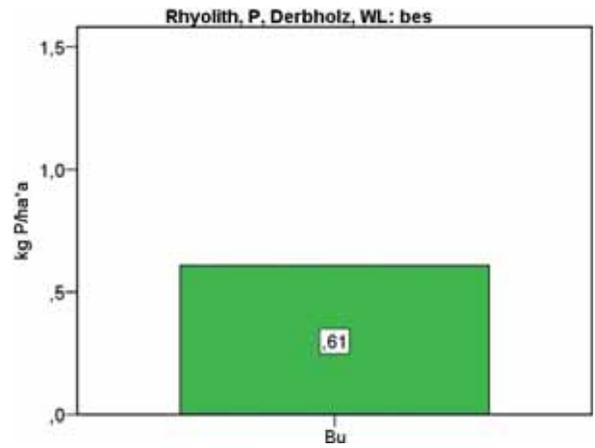
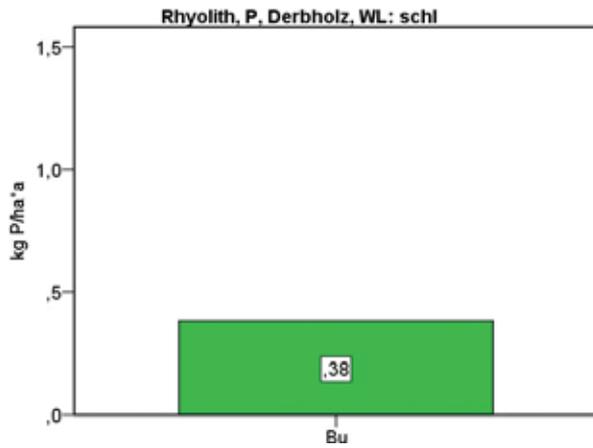


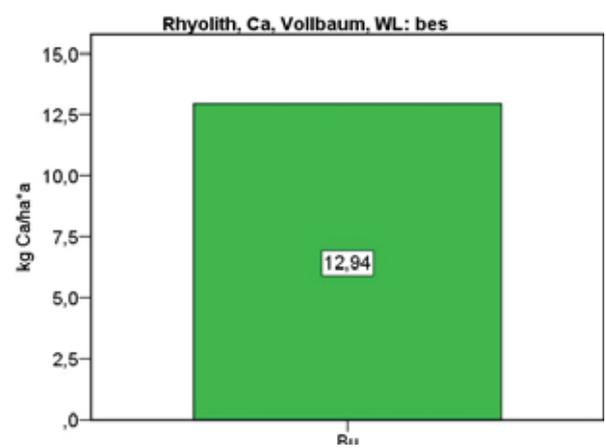
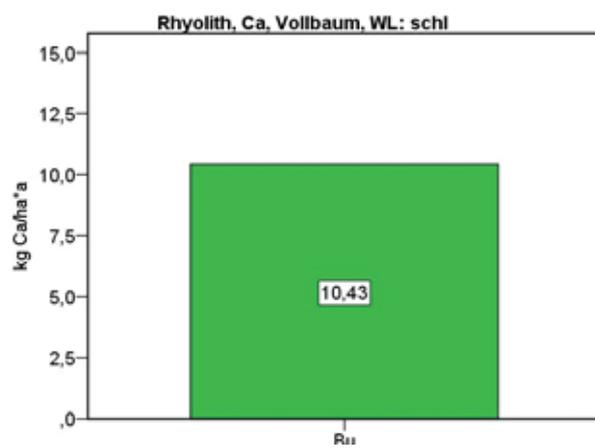
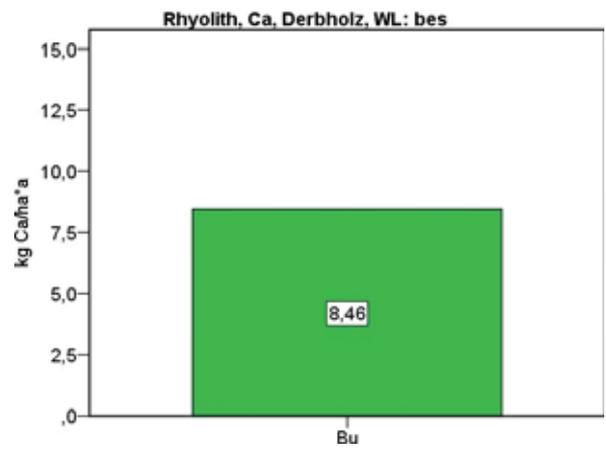
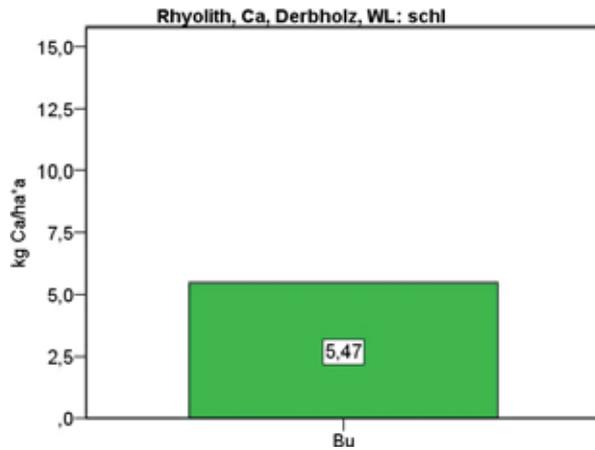
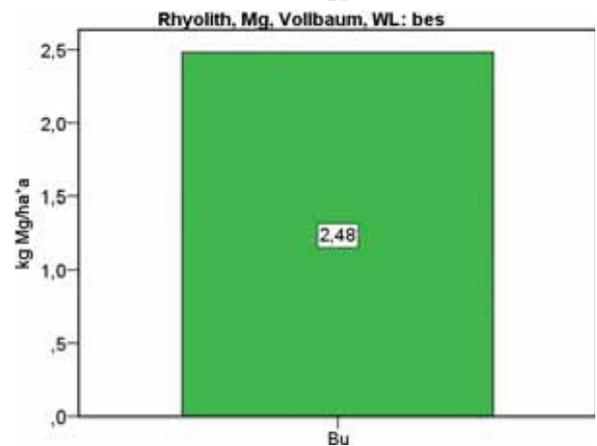
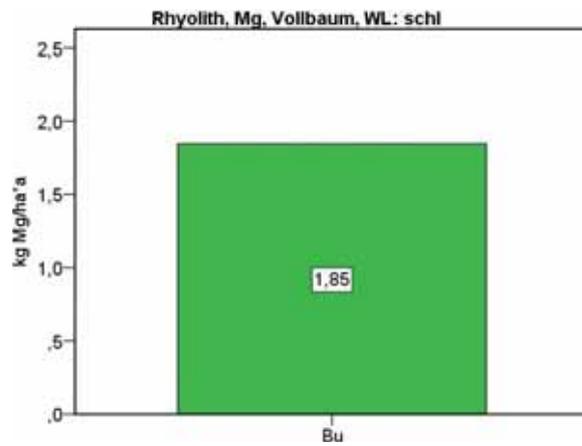
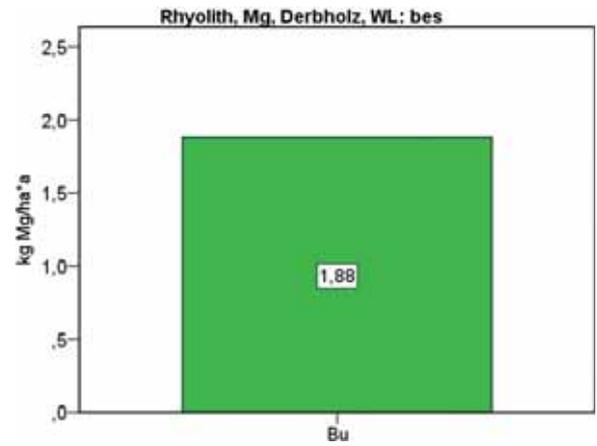
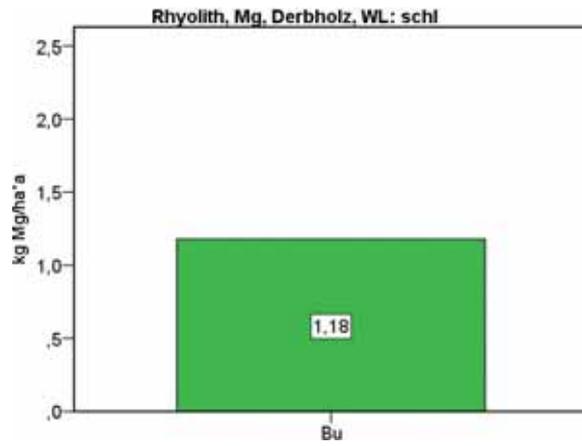


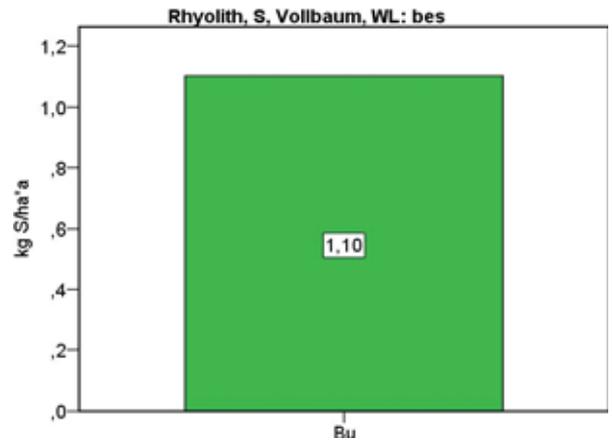
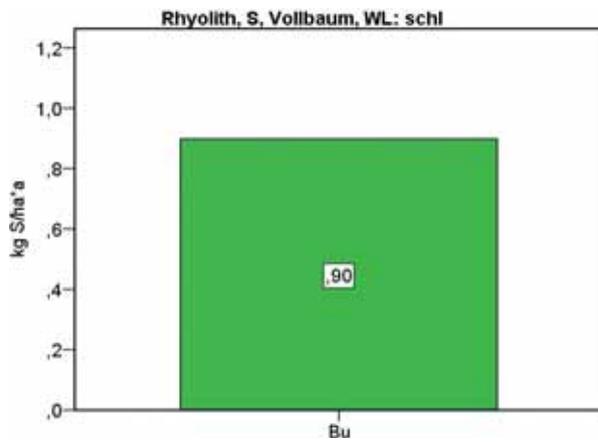
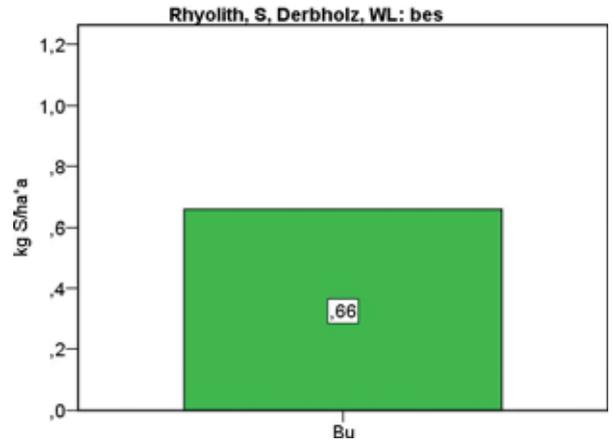
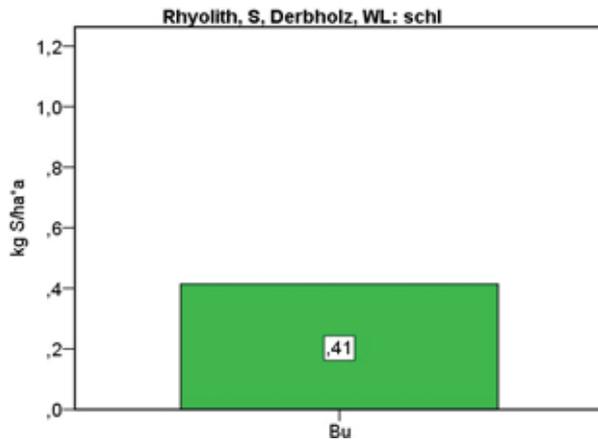






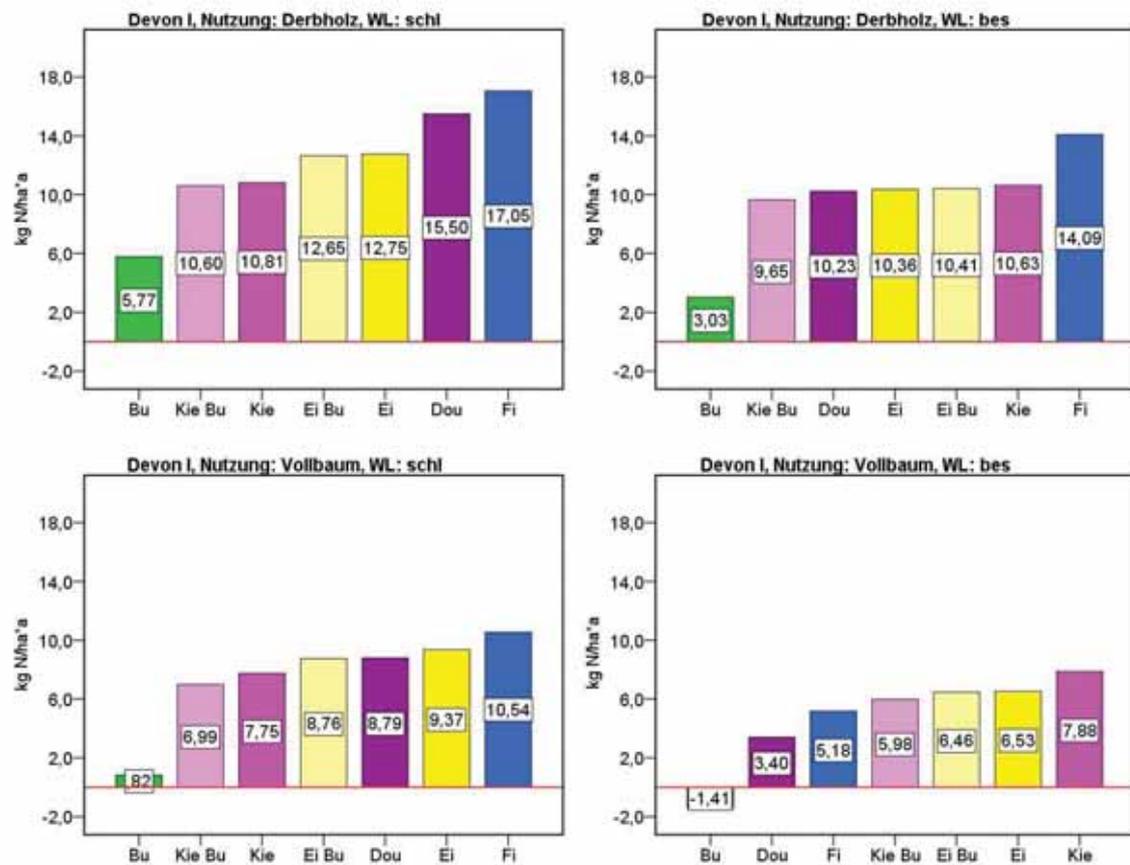


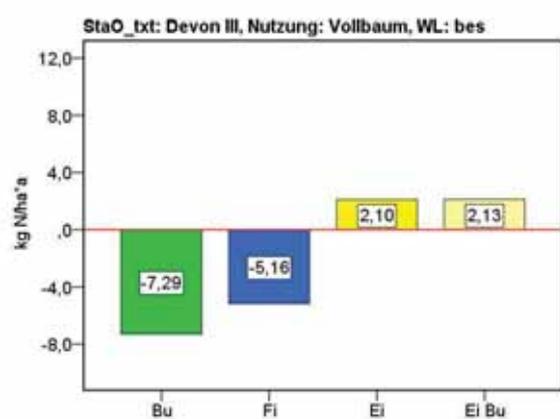
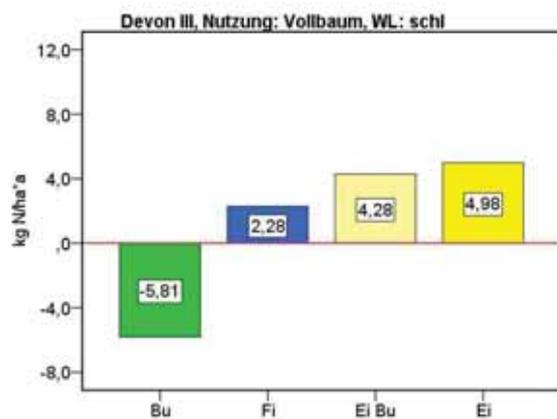
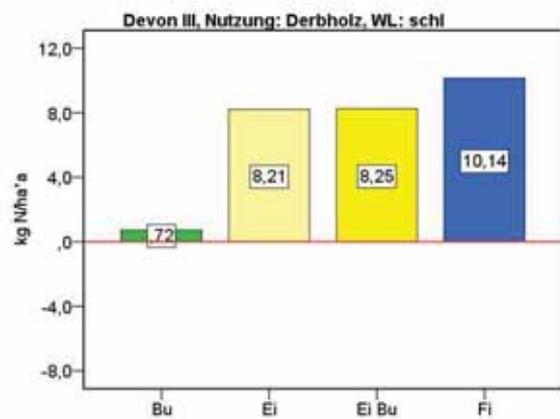
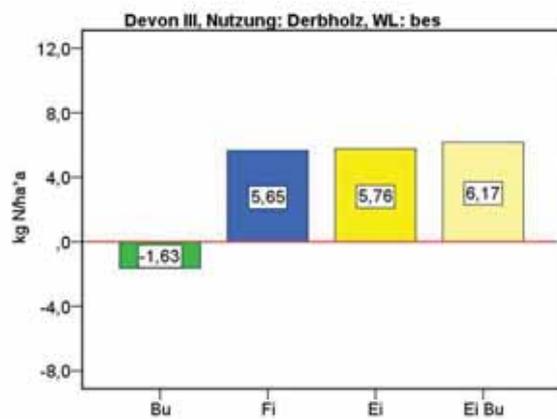
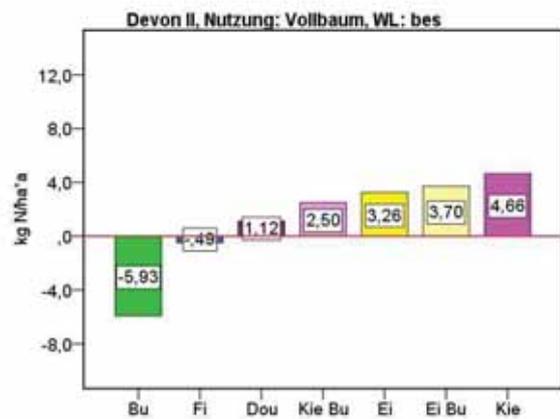
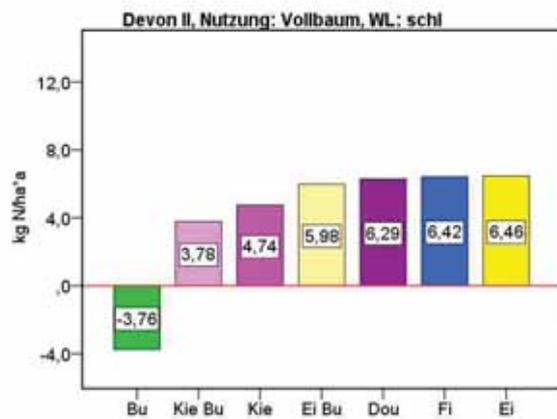
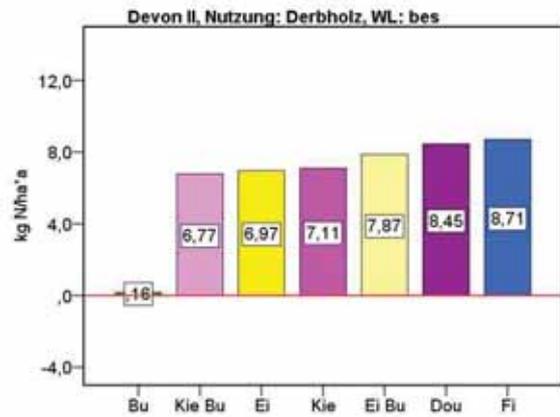
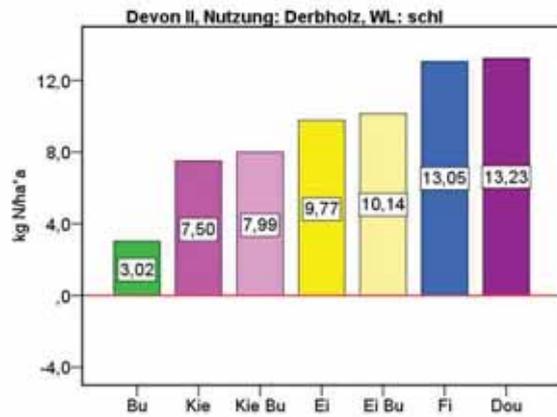


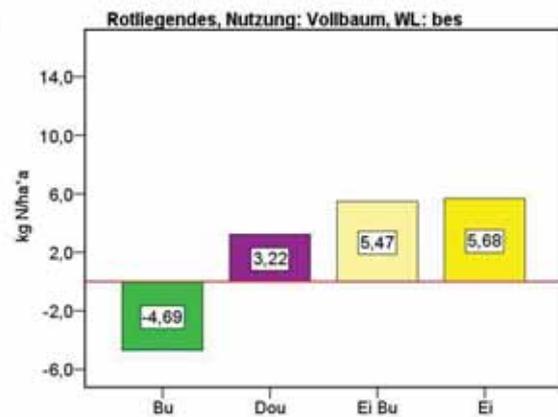
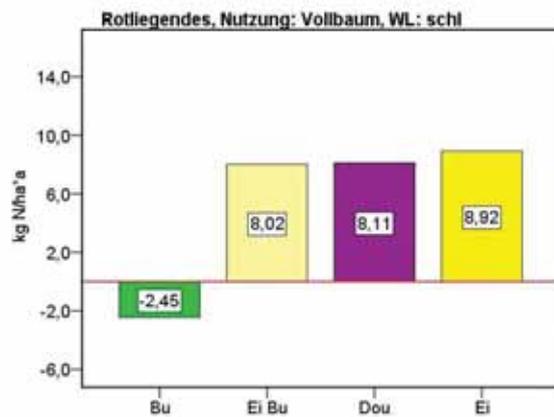
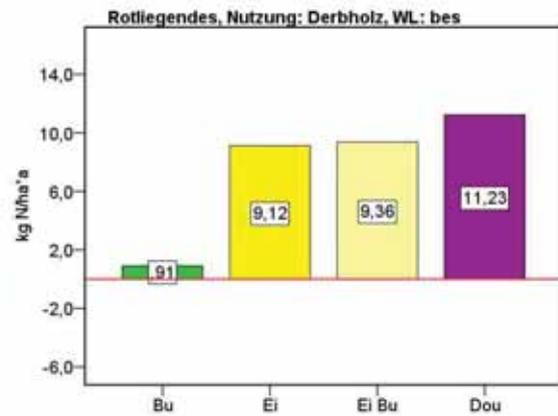
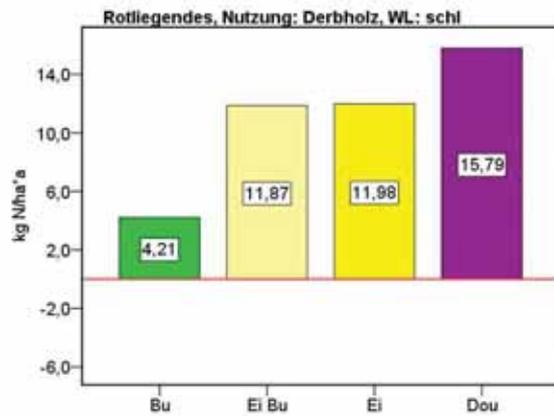
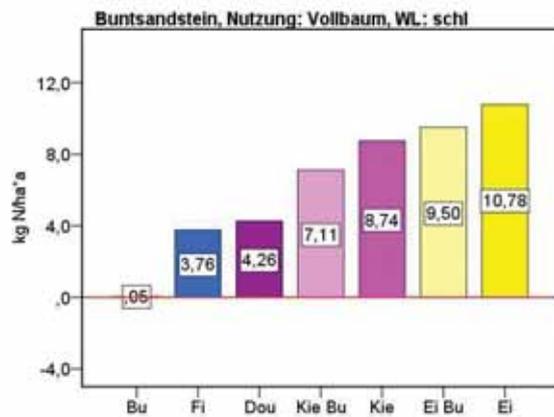
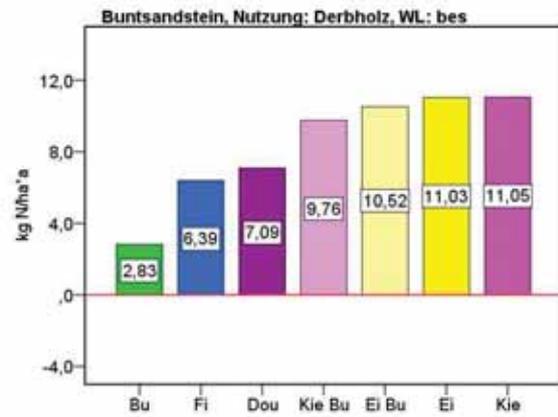
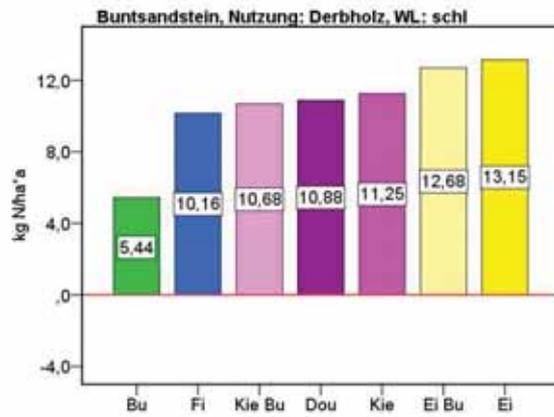


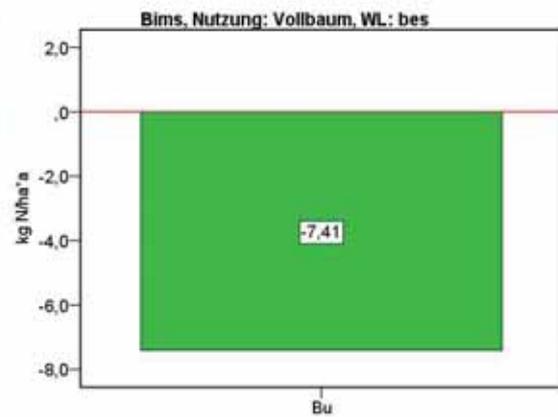
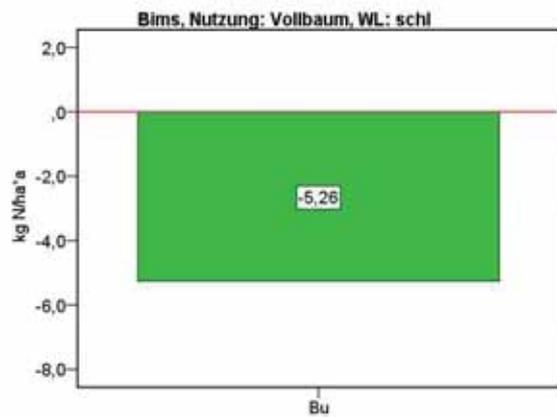
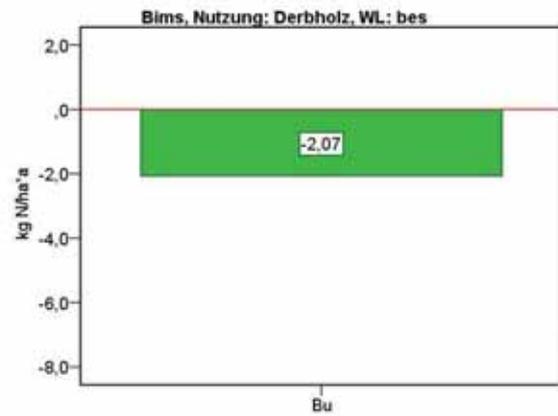
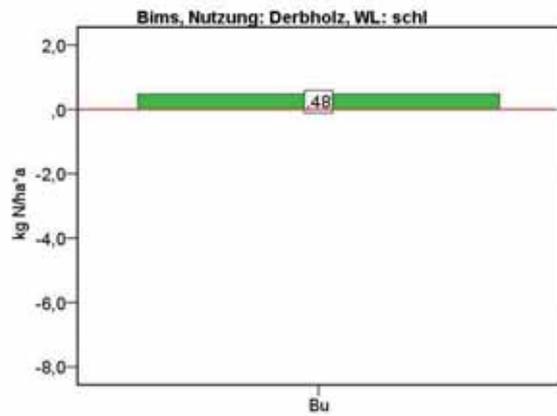
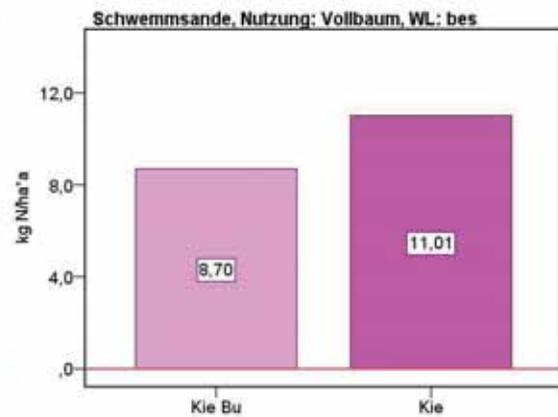
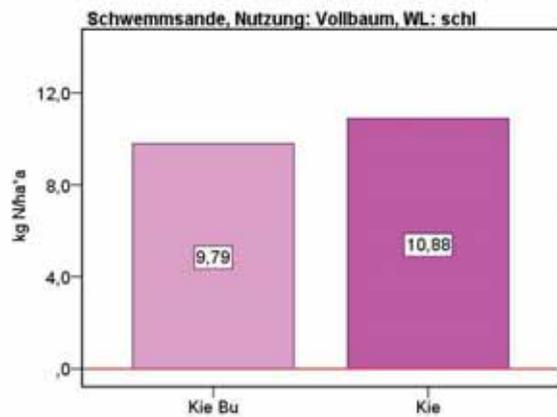
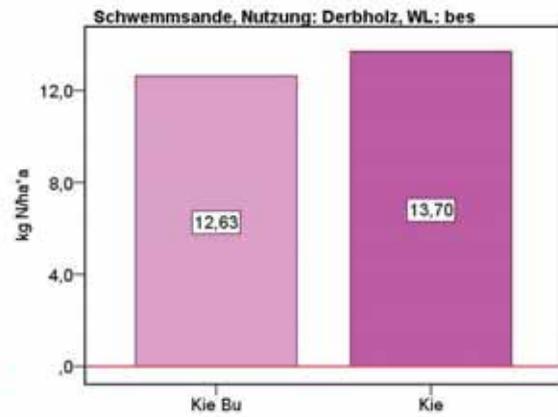
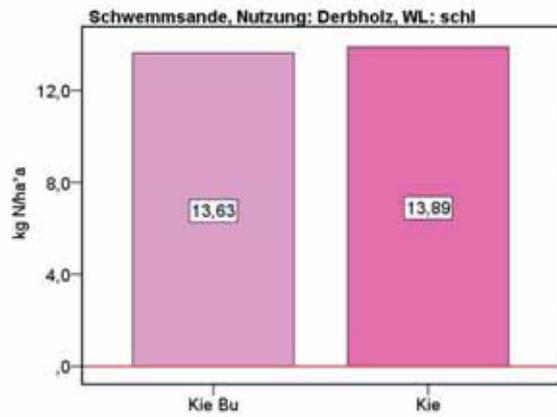
Anhang 3: Nährstoffbilanzen bei unterschiedlicher Bestockung in Rheinland-Pfalz

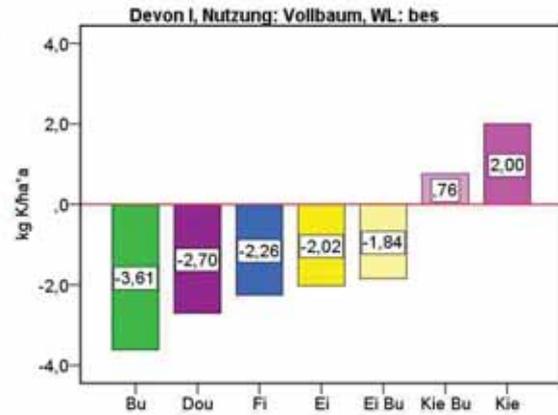
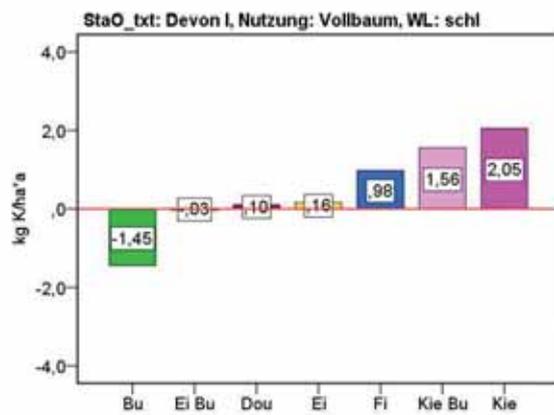
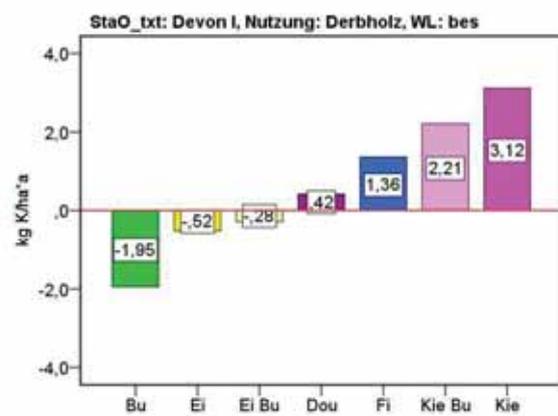
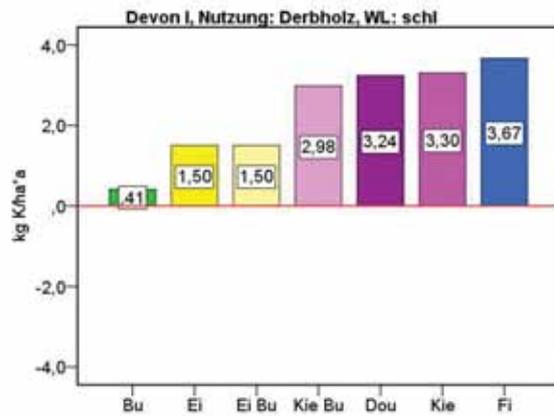
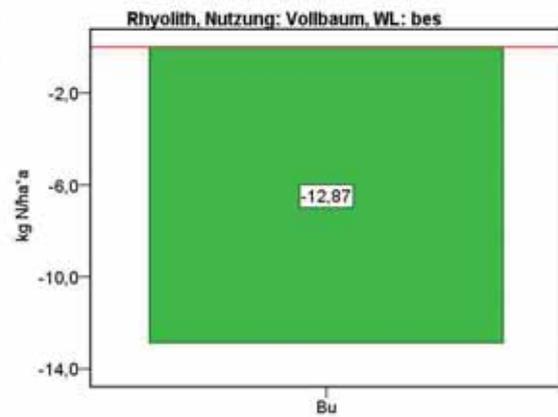
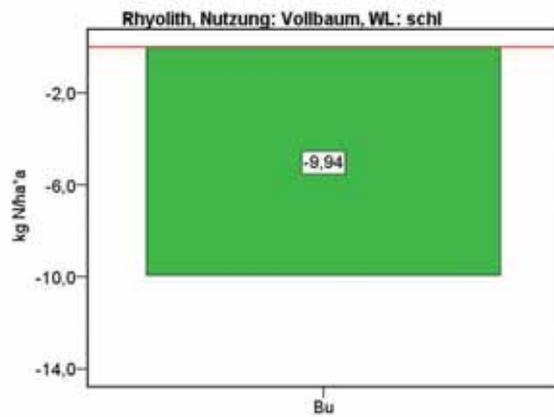
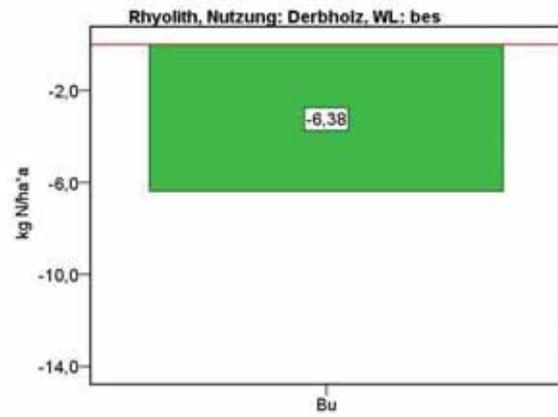
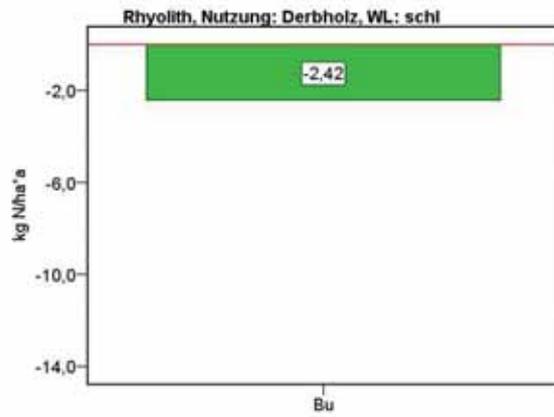
Nährstoffbilanzen bei unterschiedlicher Bestockung auf den jeweils untersuchten Substraten in Rheinland-Pfalz differenziert nach Derbholznutzung (mit Rinde) - Vollbaumnutzung sowie bessere Wuchsleistung (WL: bes) - schwächere Wuchsleistung (WL: schl); Die Kalkulationen beziehen sich auf „mittlere“ Verhältnisse in Rheinland-Pfalz (vgl. Kap. 3.8.4.1)

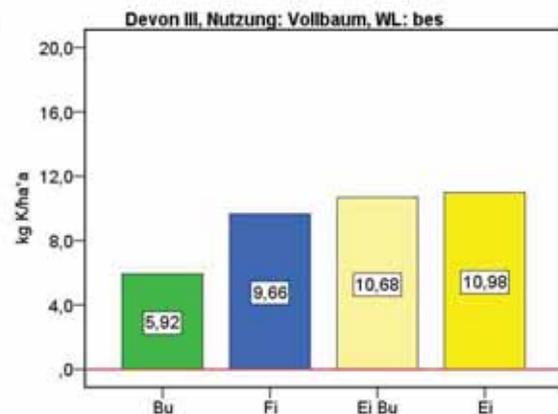
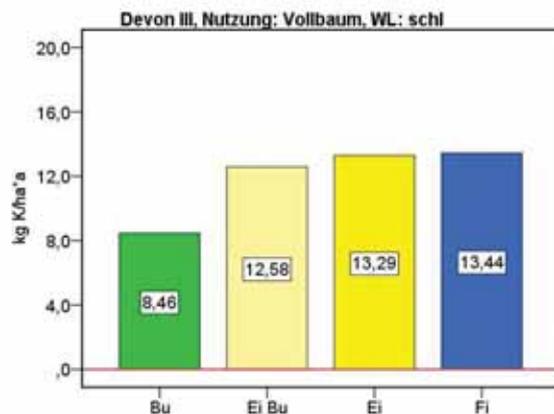
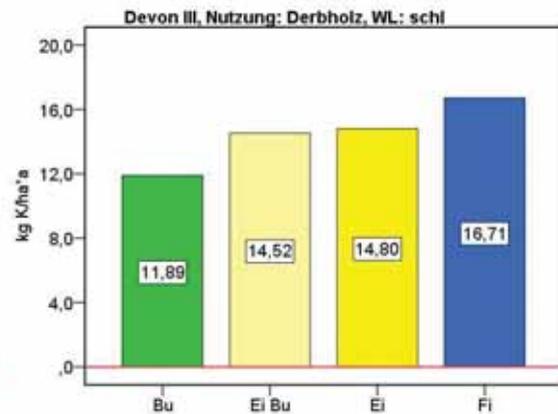
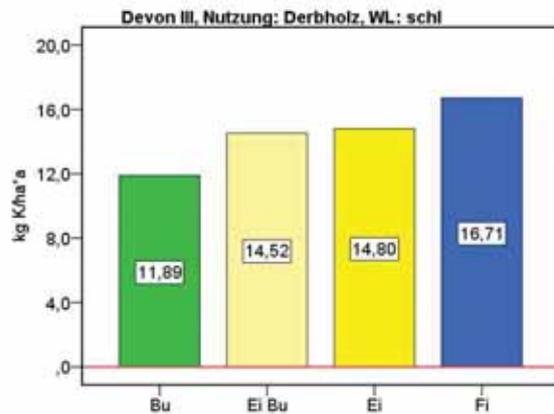
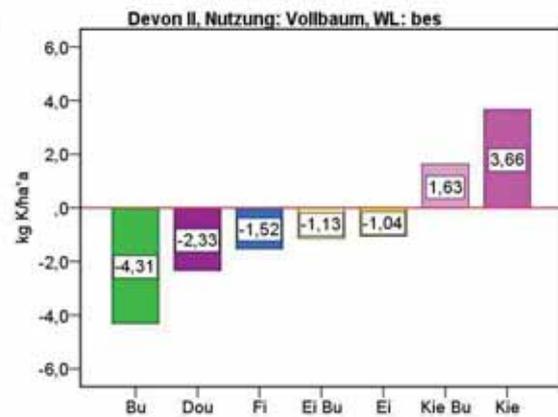
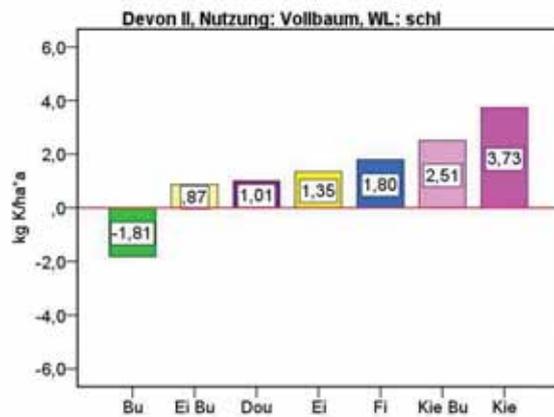
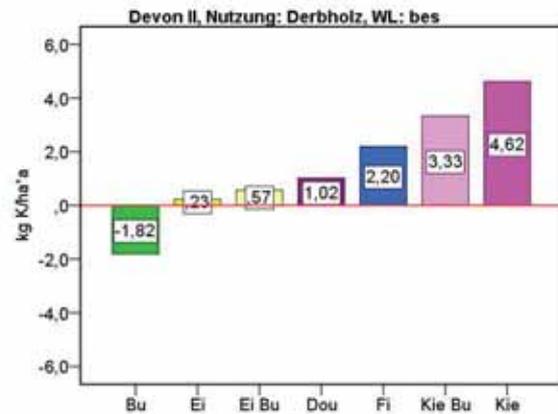
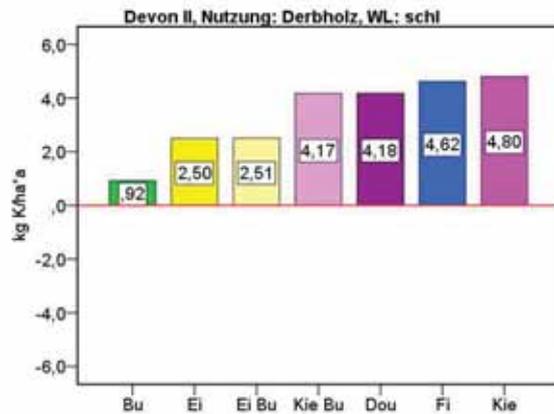


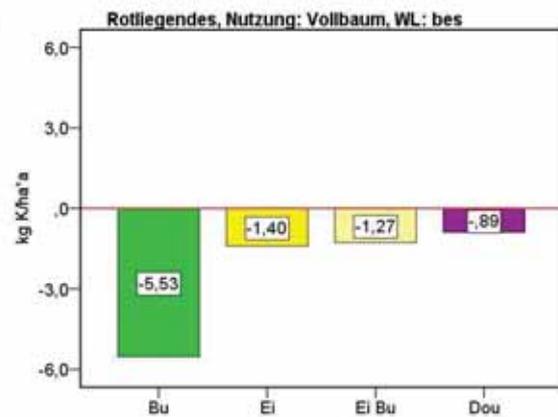
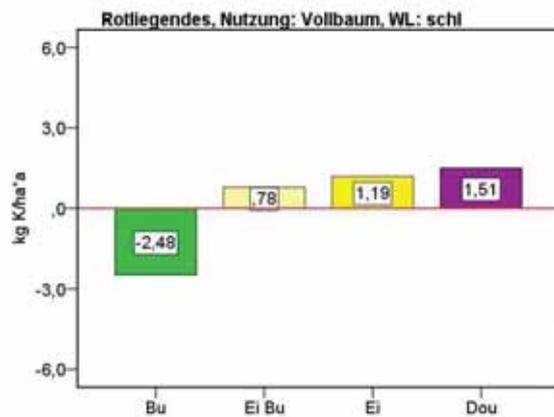
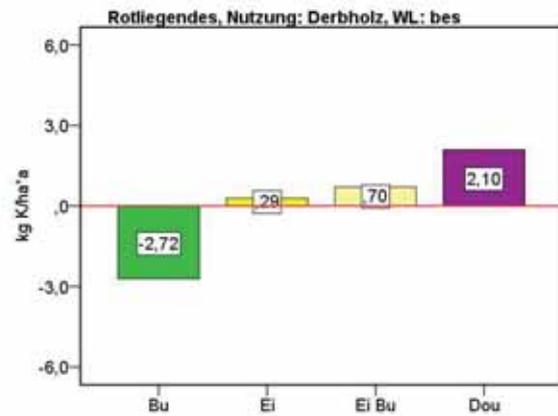
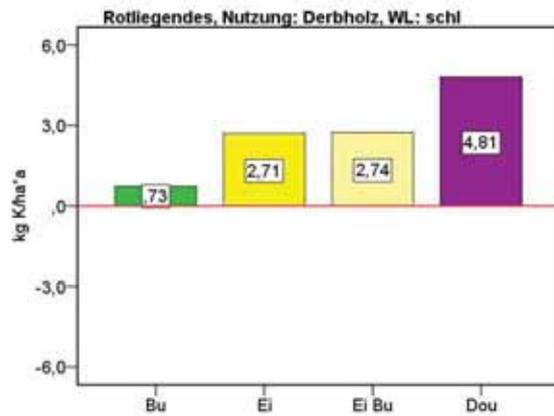
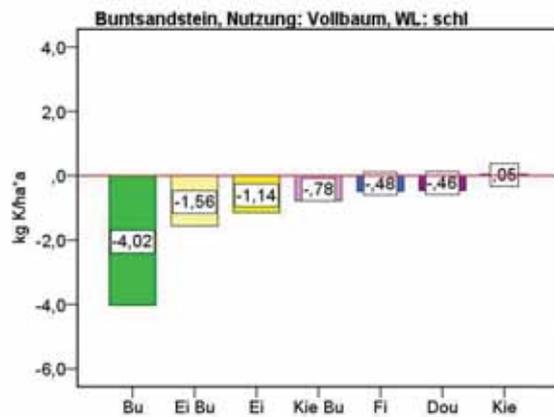
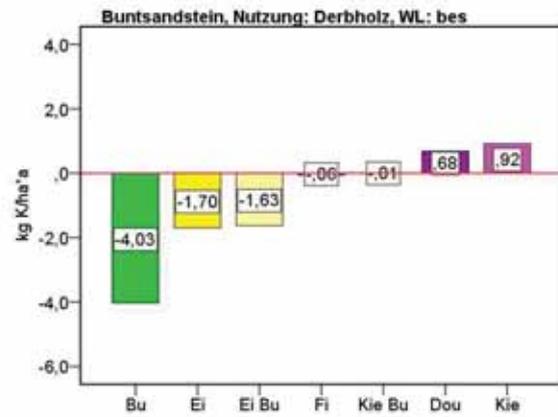
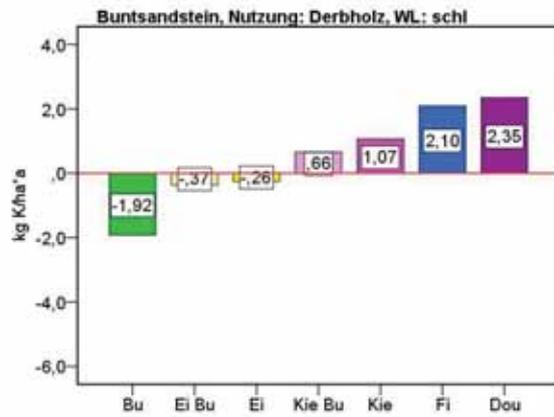


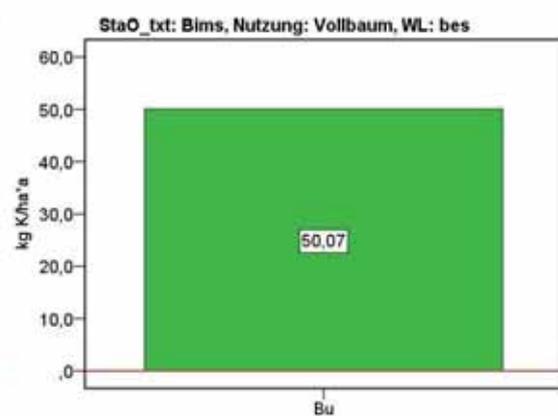
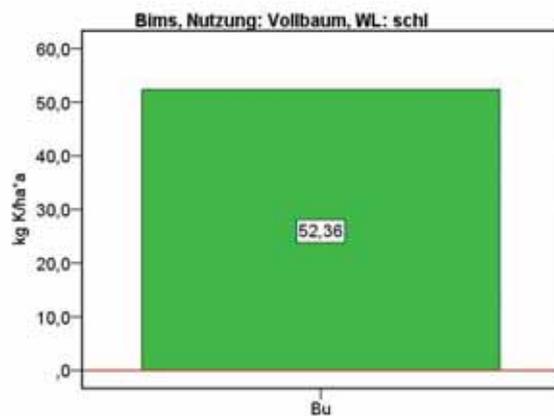
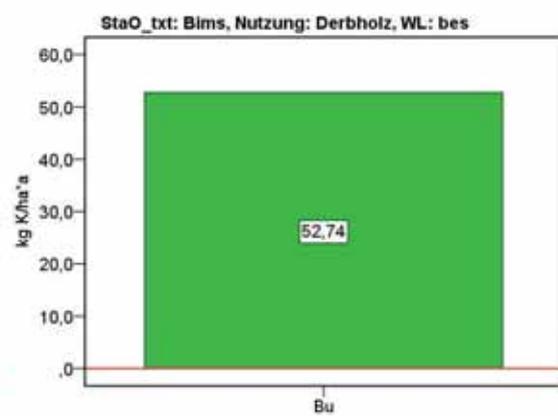
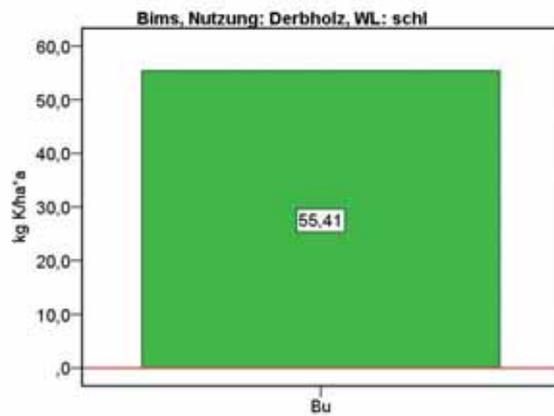
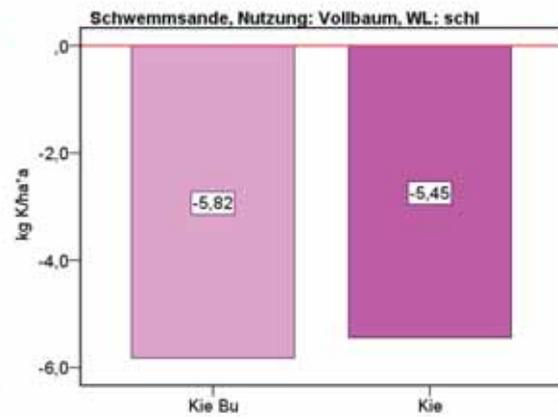
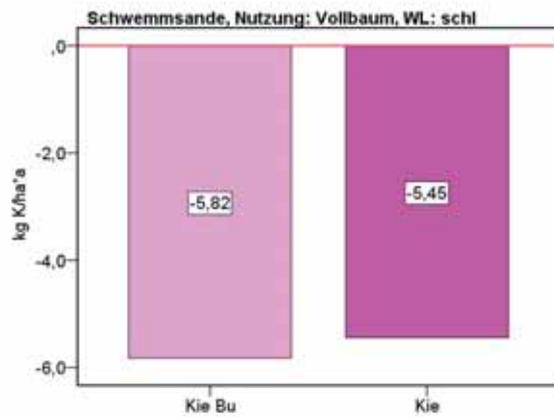
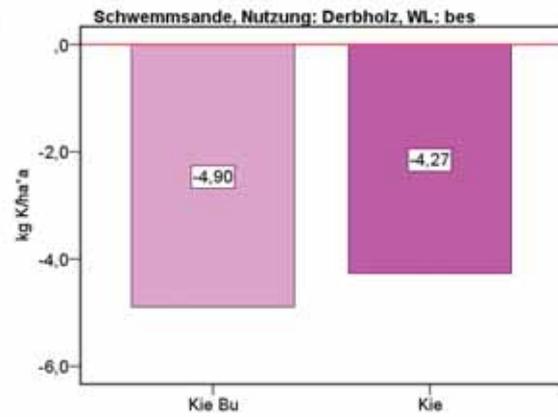
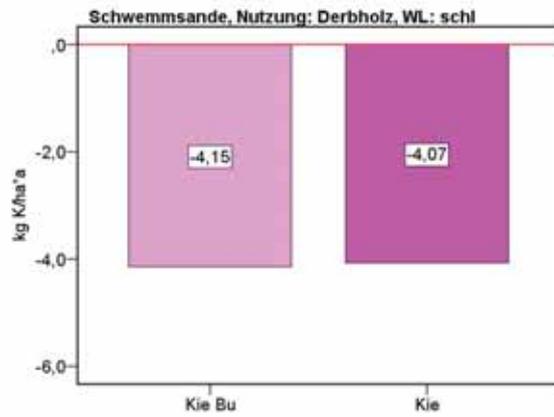


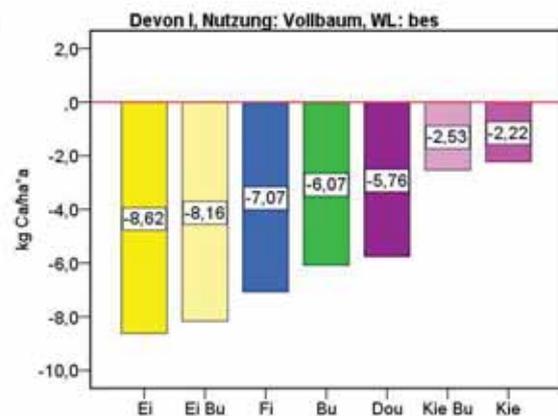
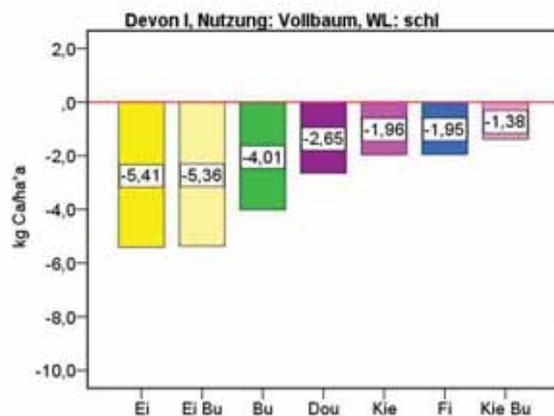
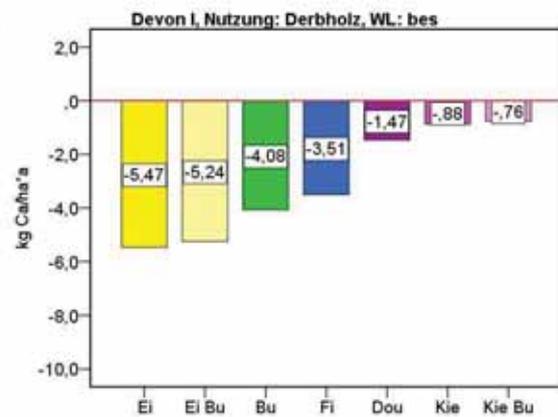
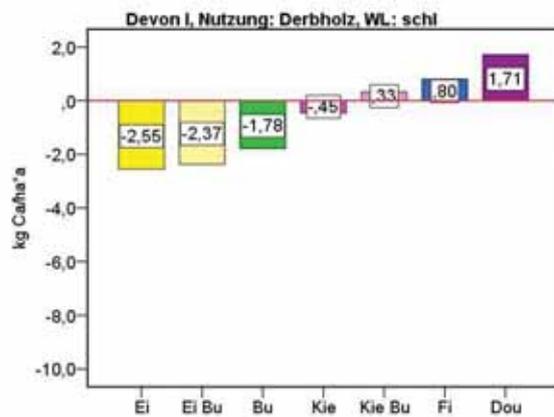
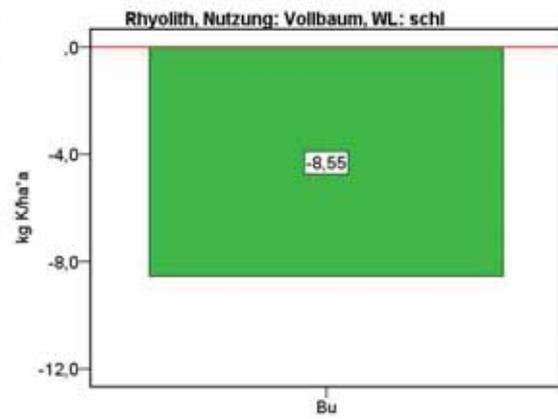
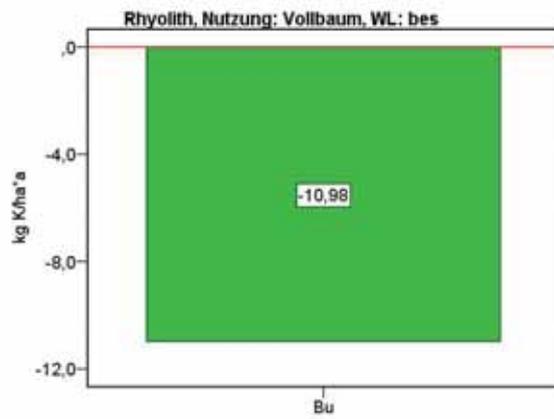
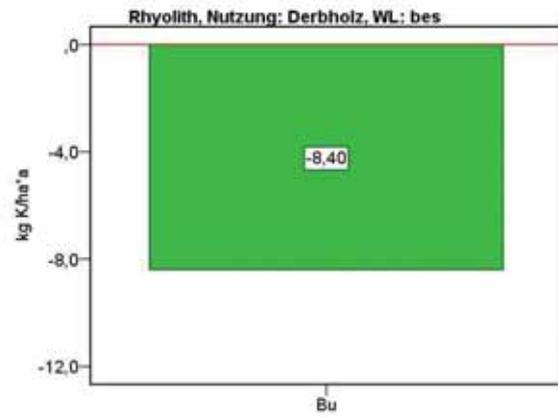
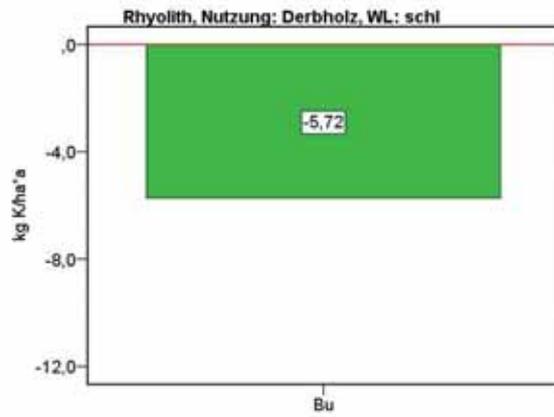


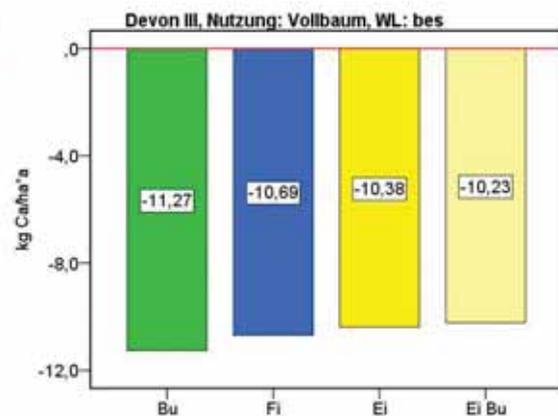
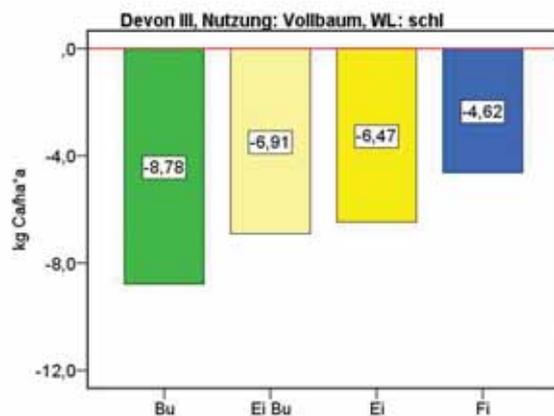
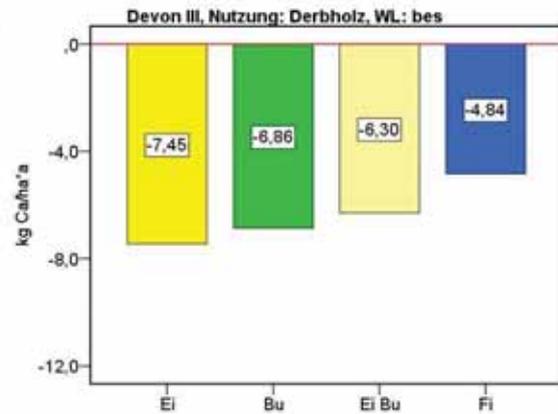
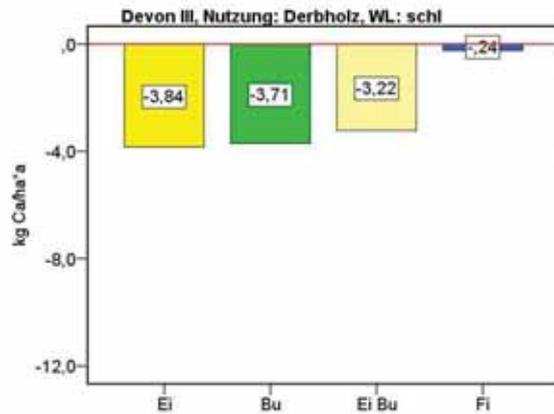
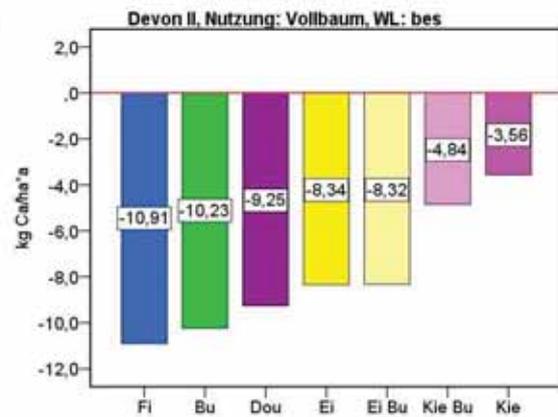
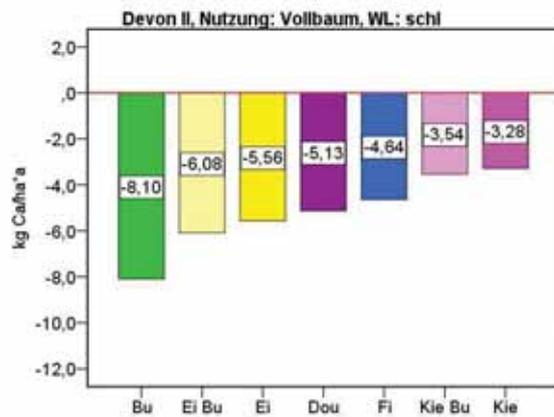
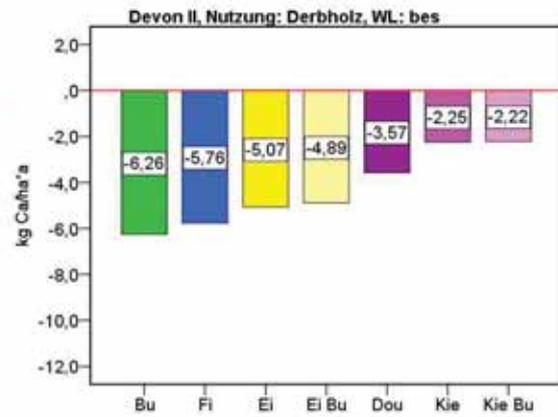
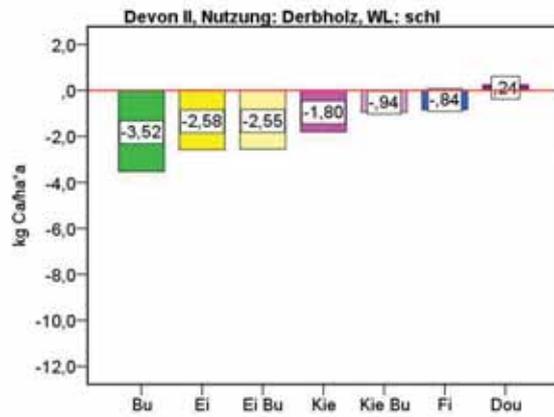


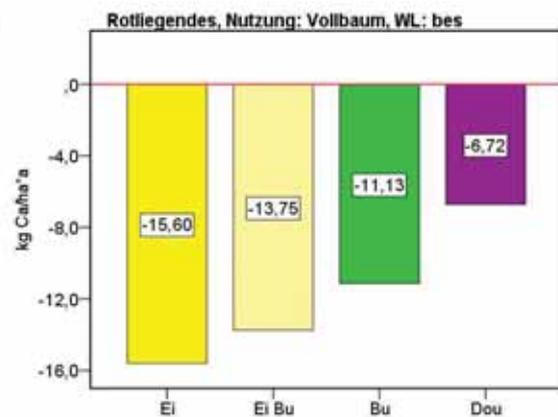
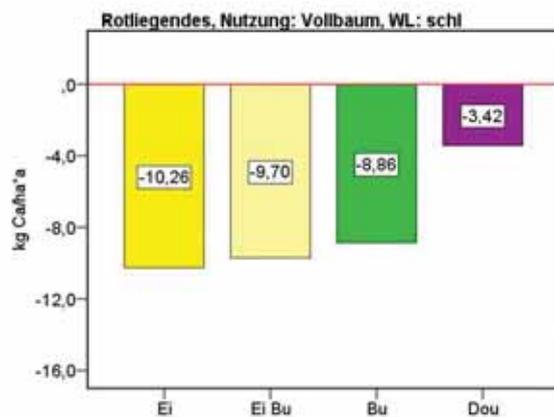
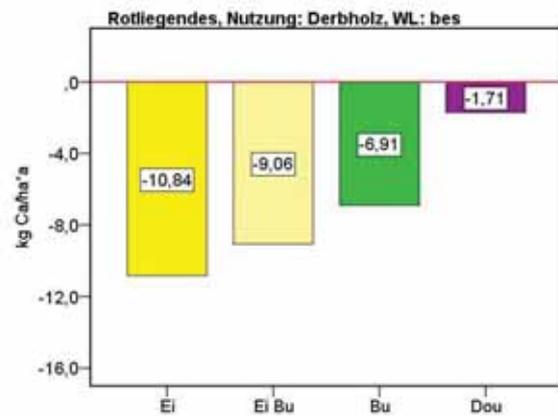
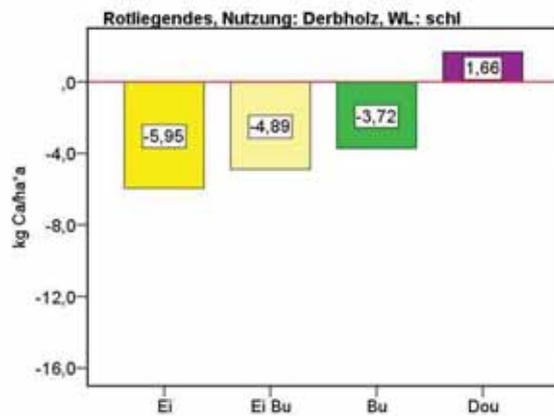
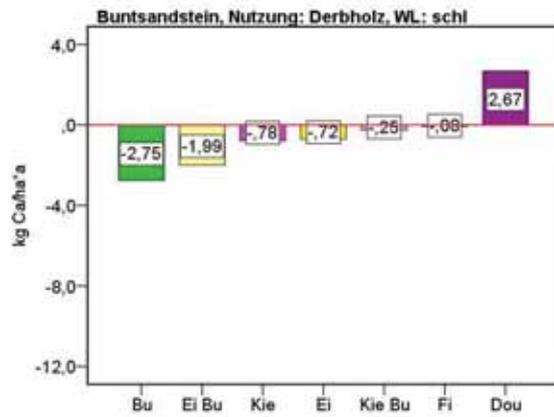


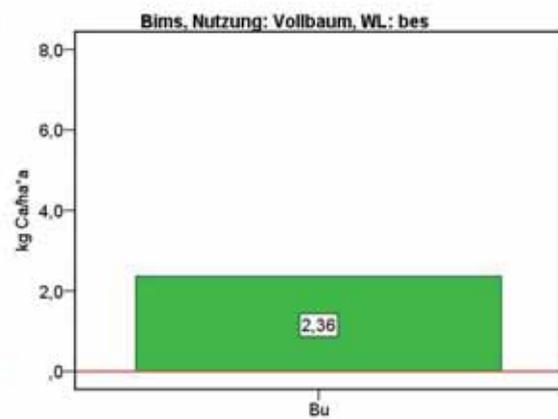
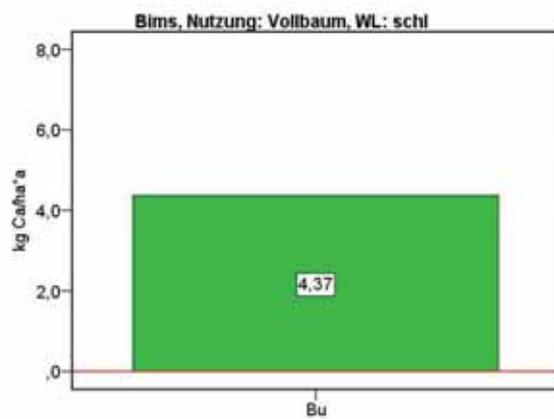
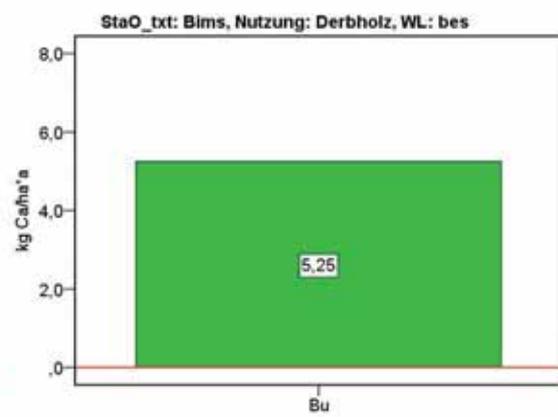
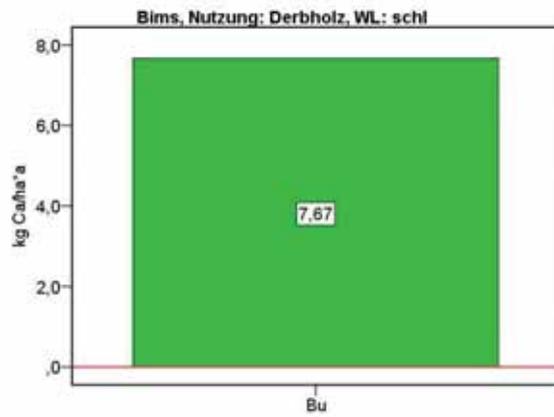
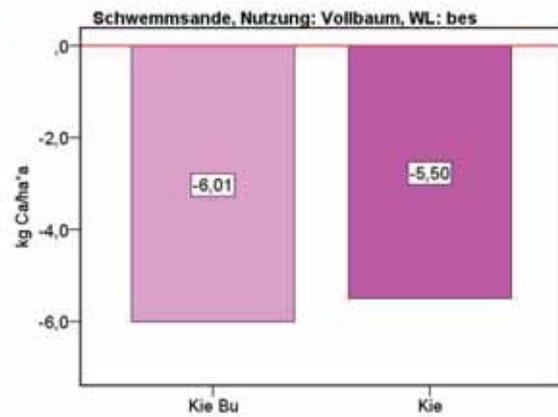
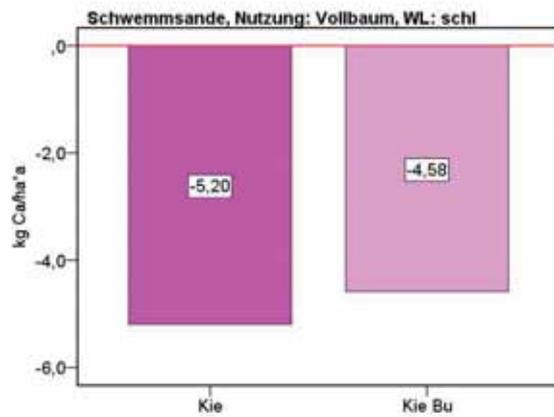
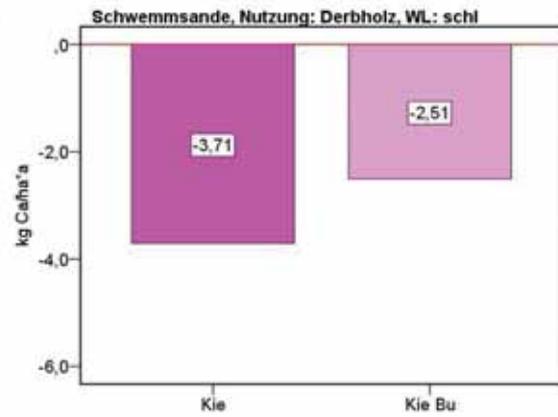
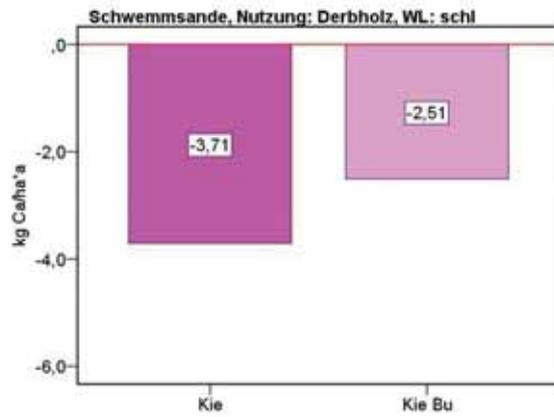


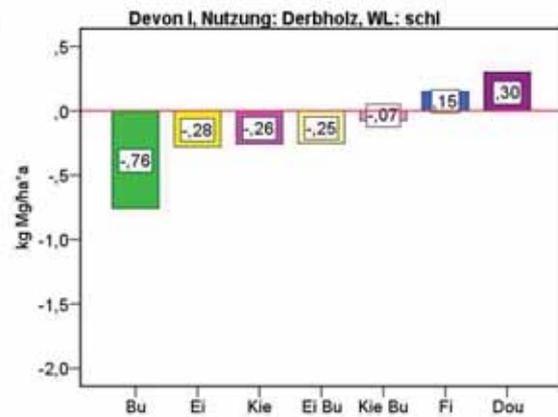
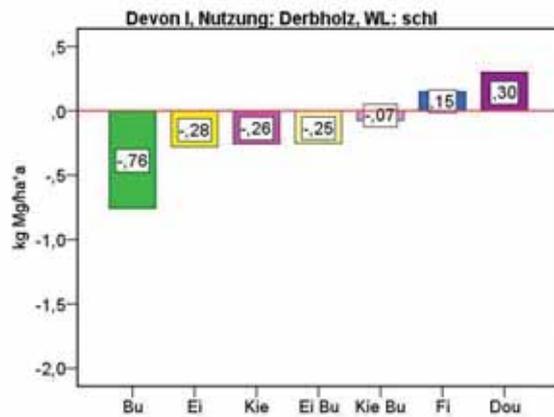
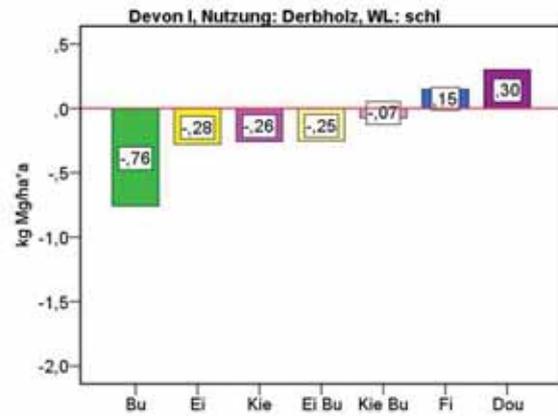
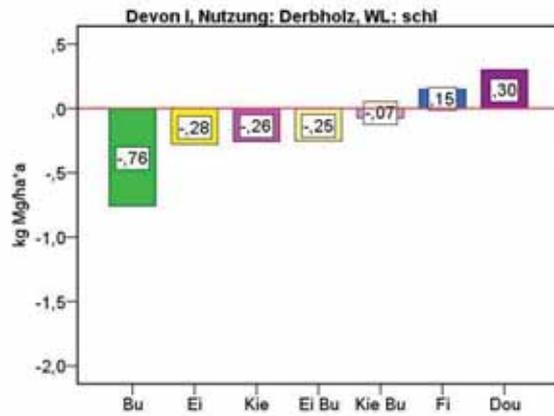
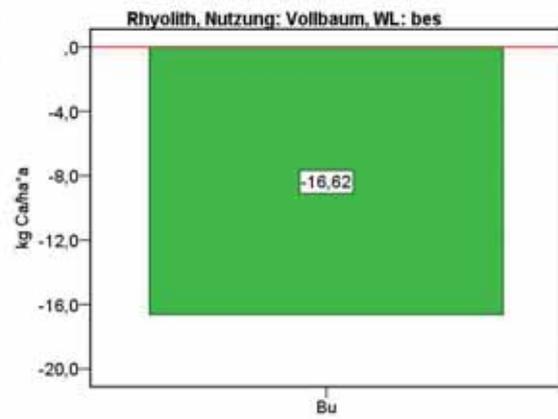
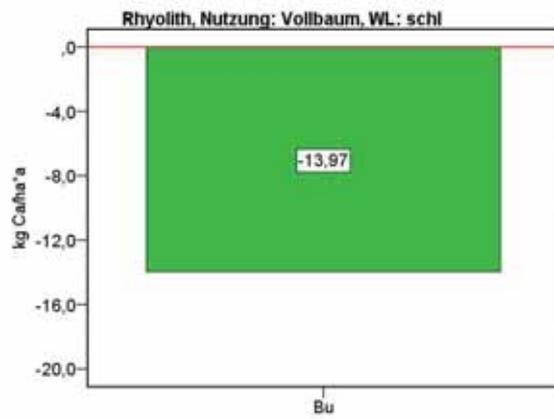
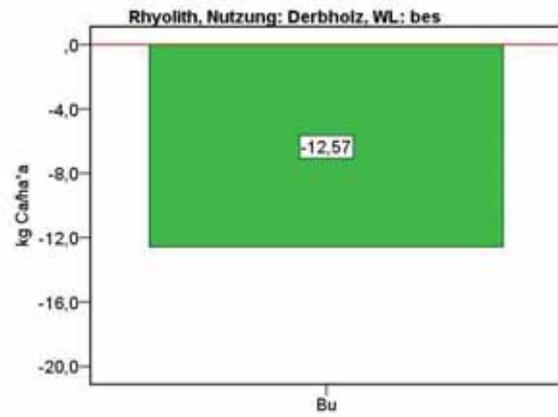
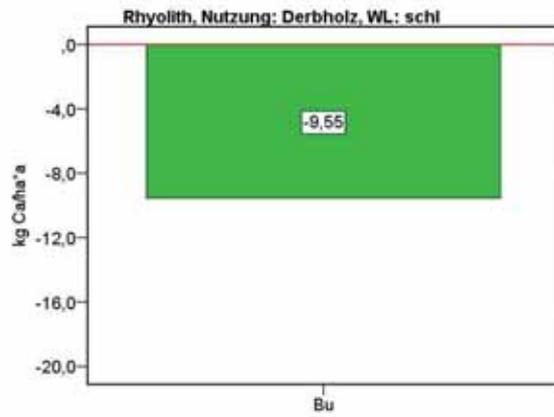


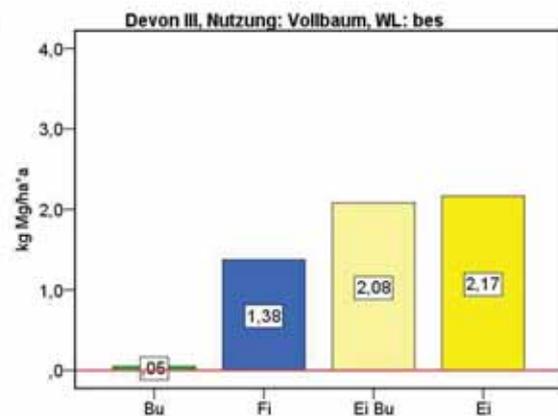
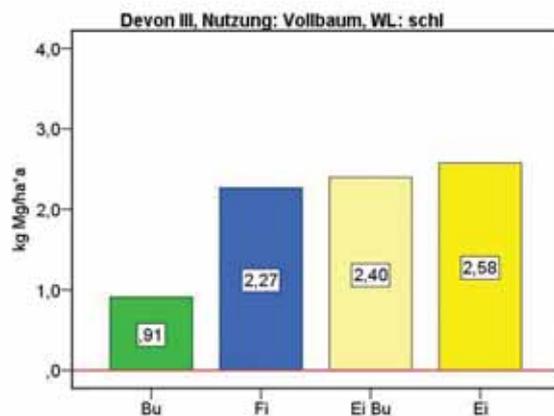
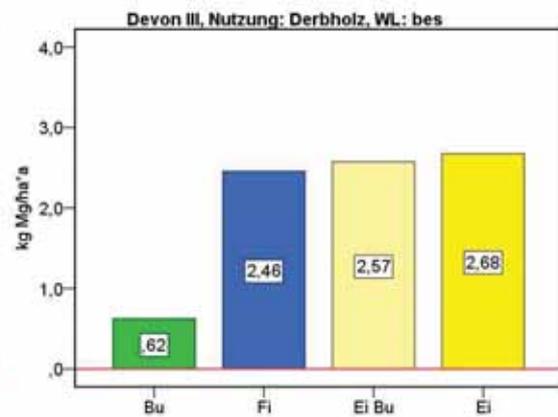
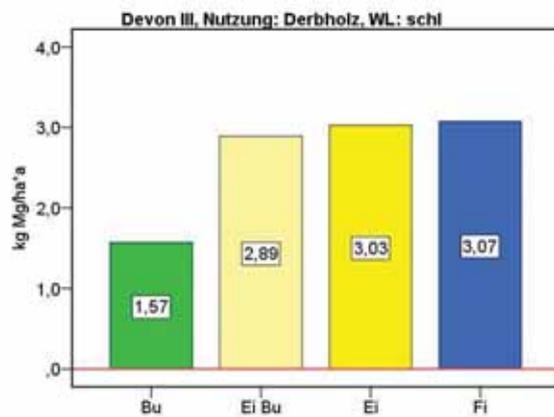
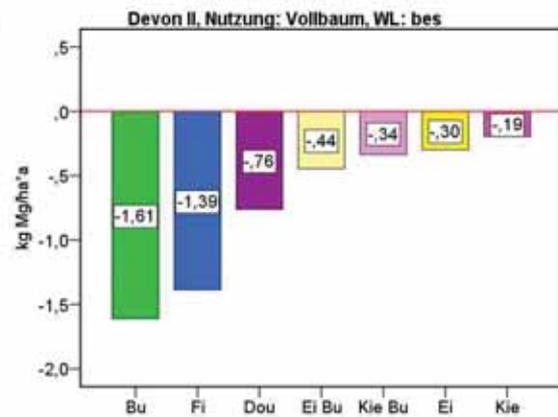
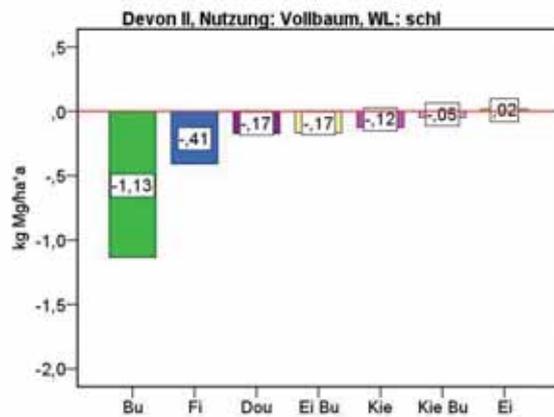
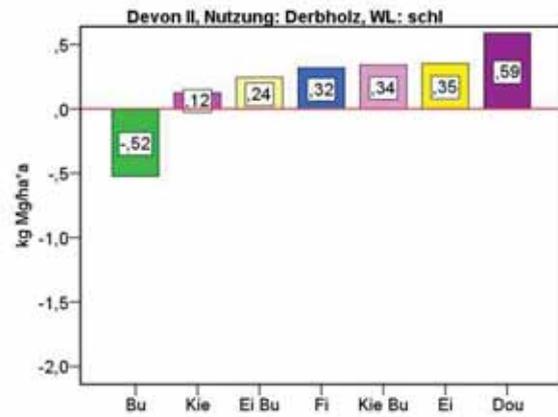
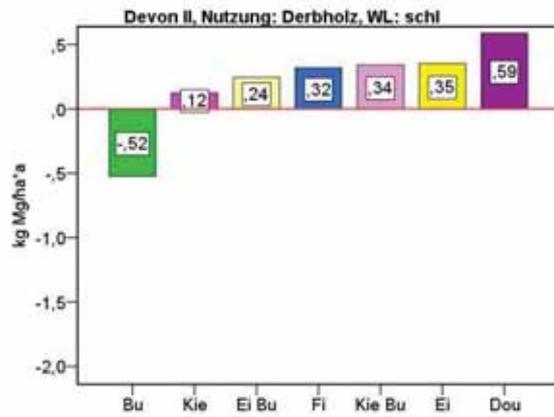


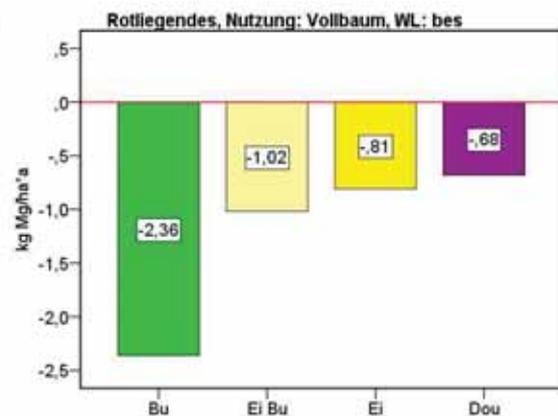
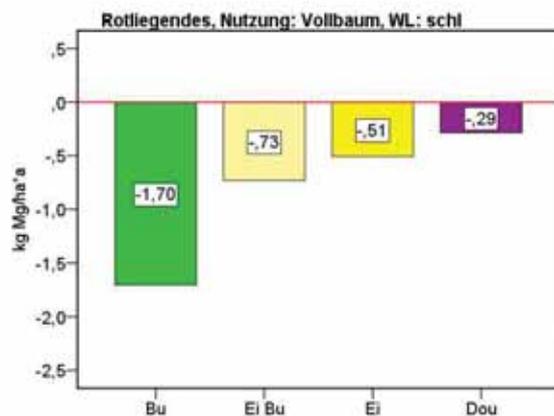
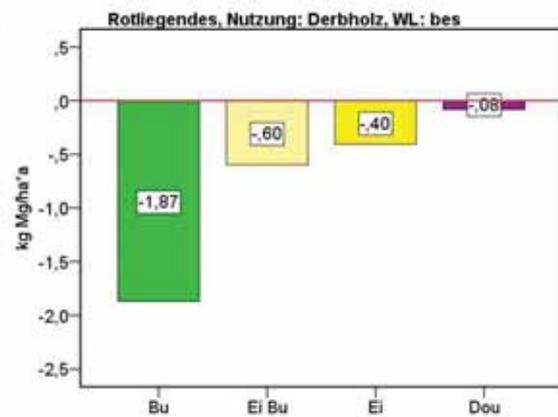
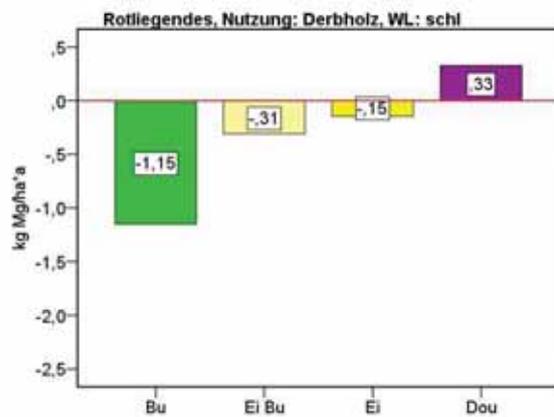
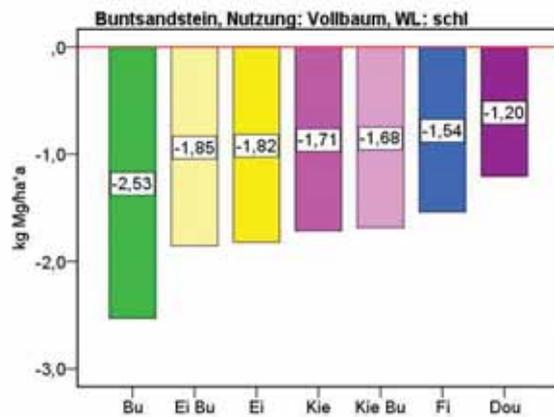
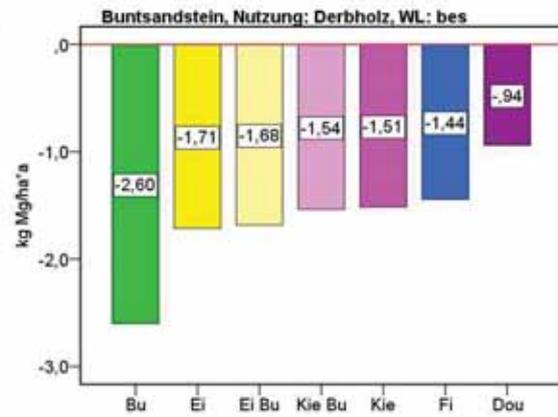
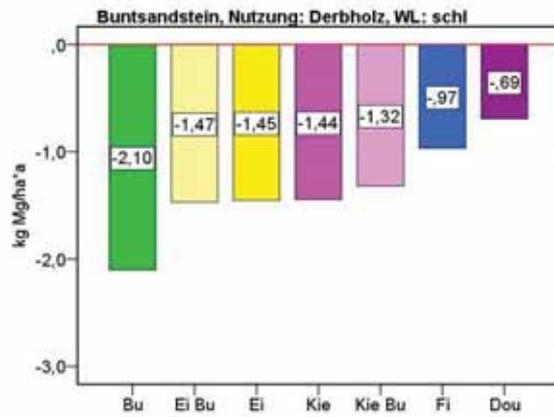


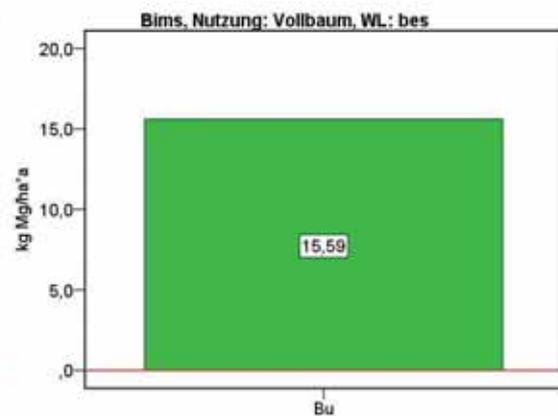
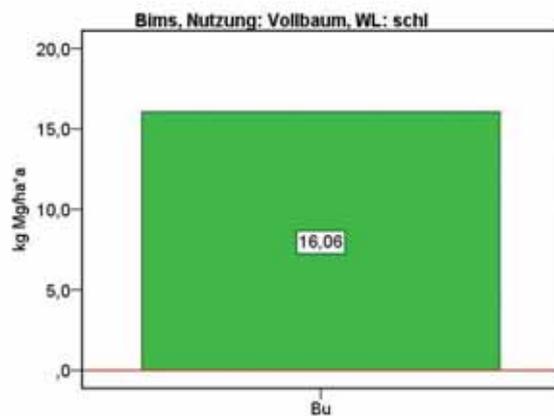
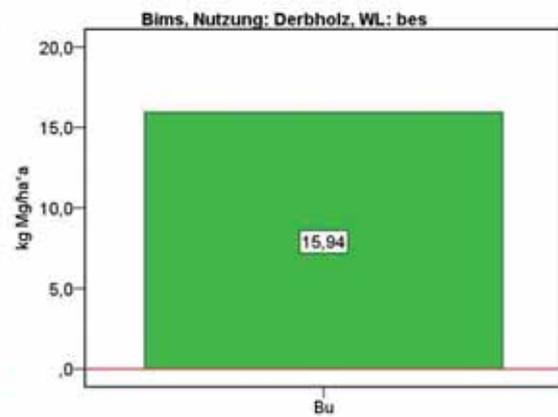
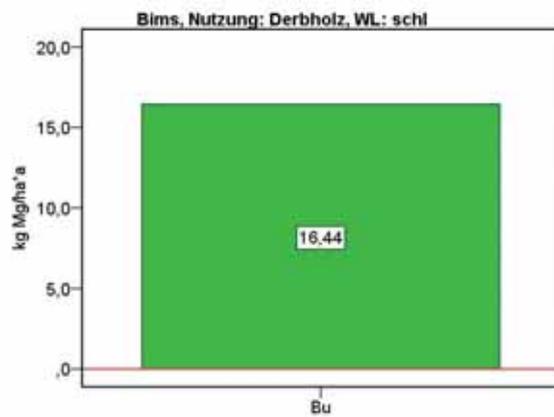
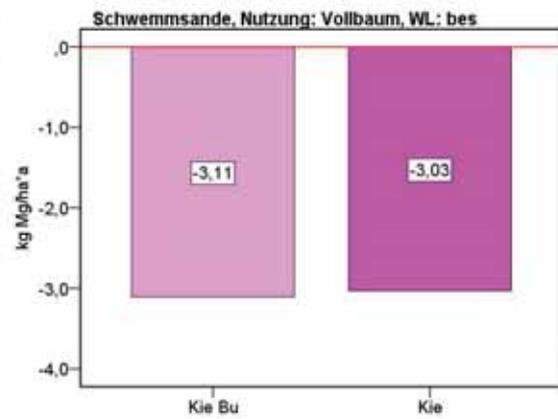
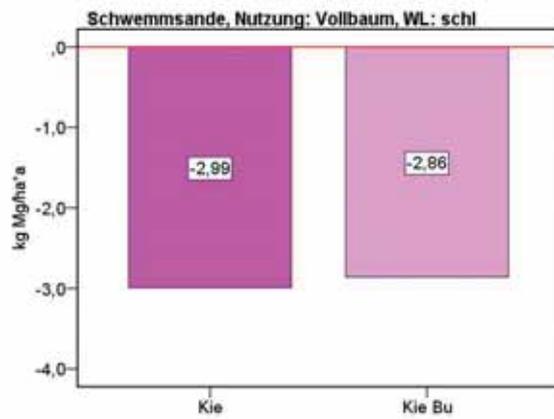
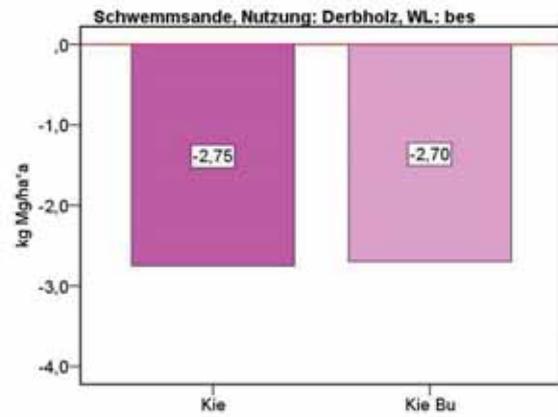
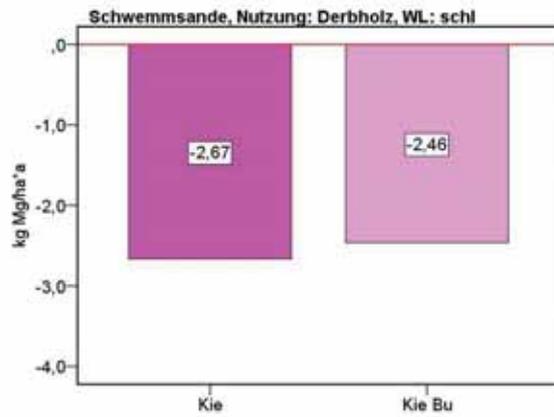


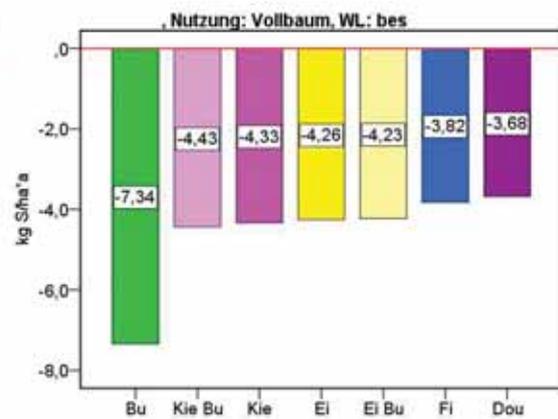
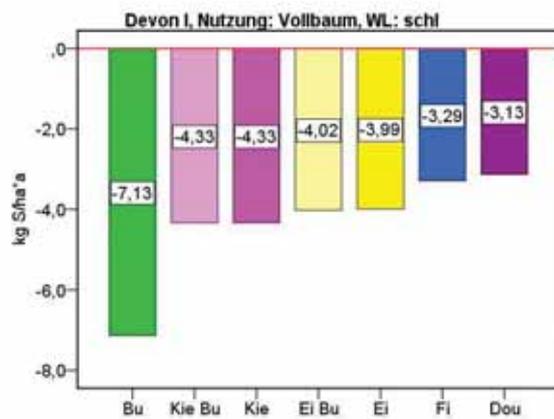
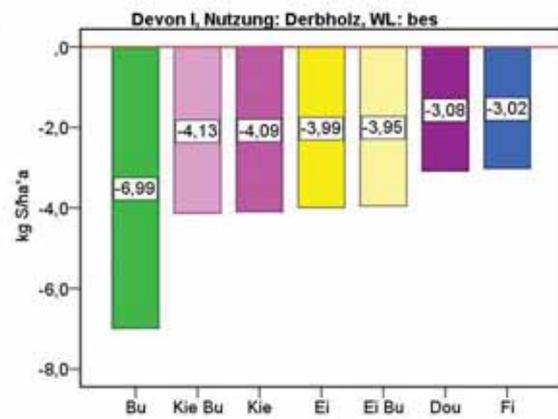
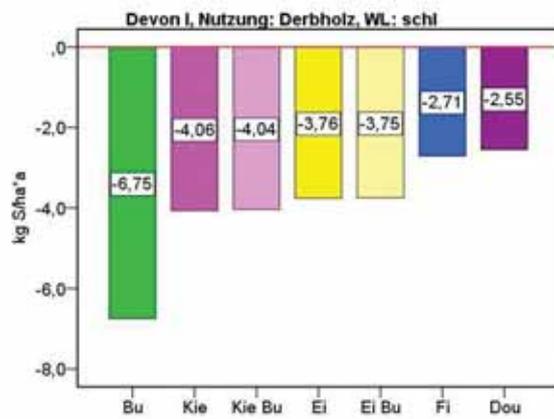
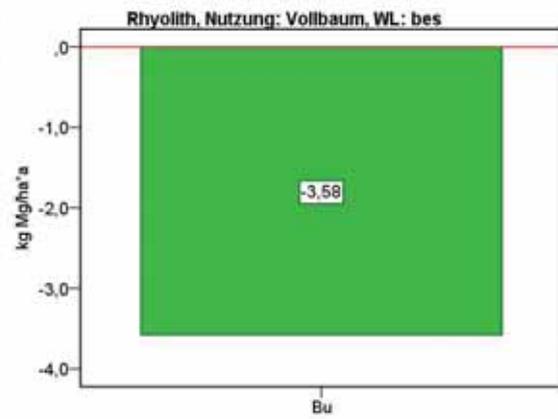
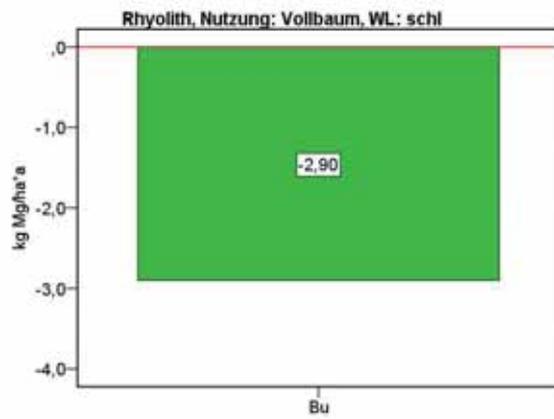
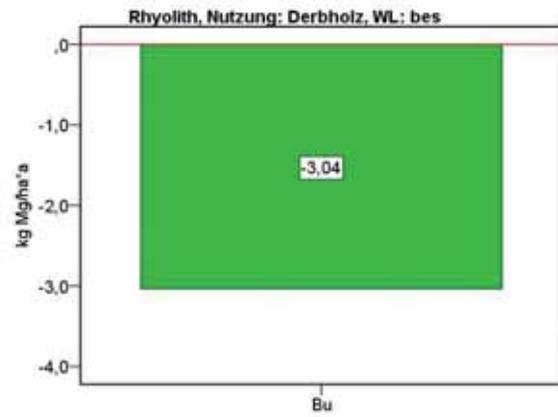
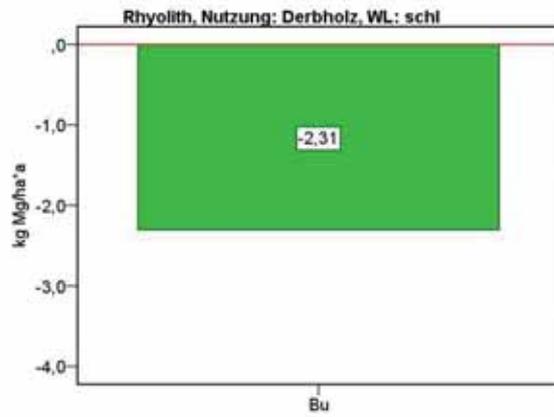


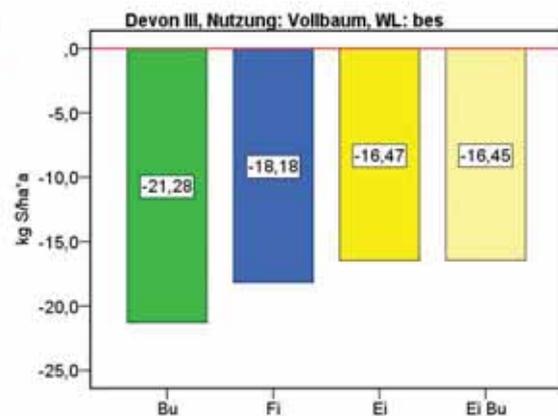
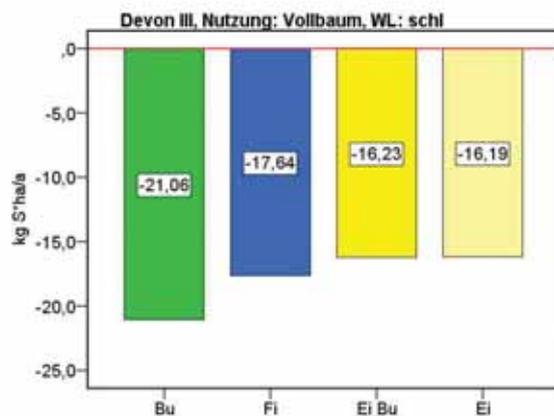
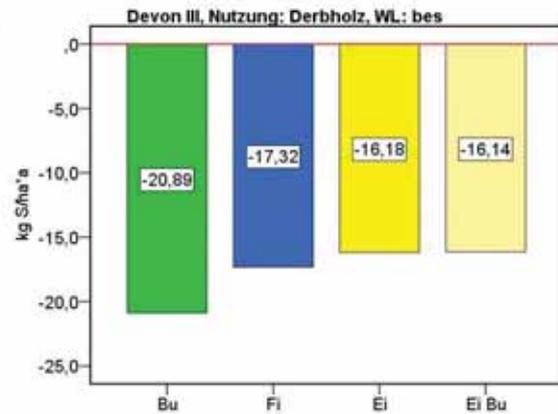
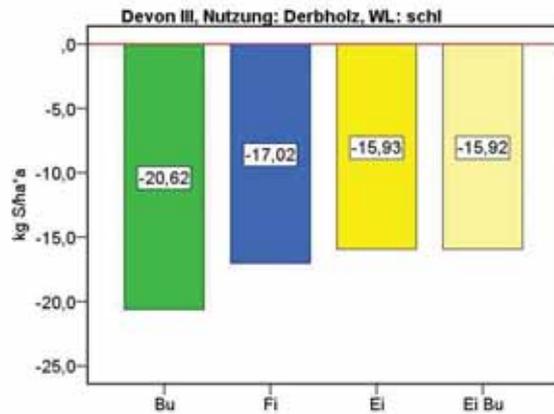
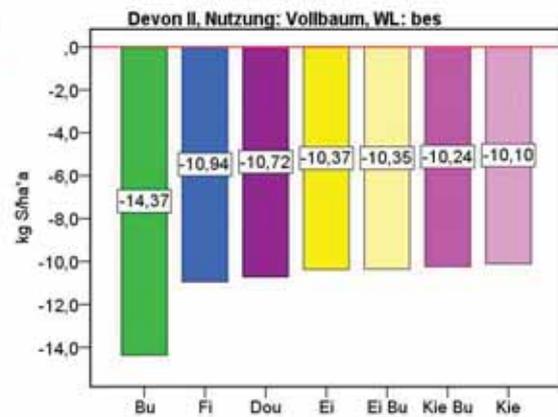
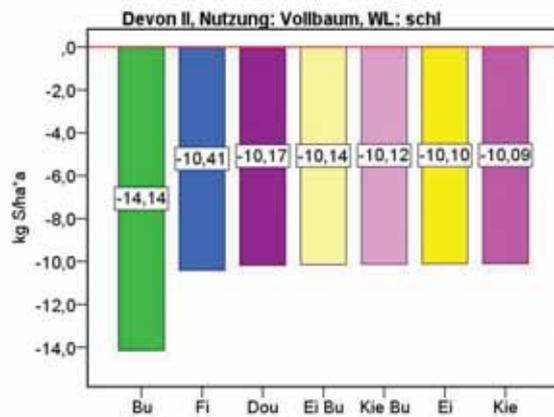
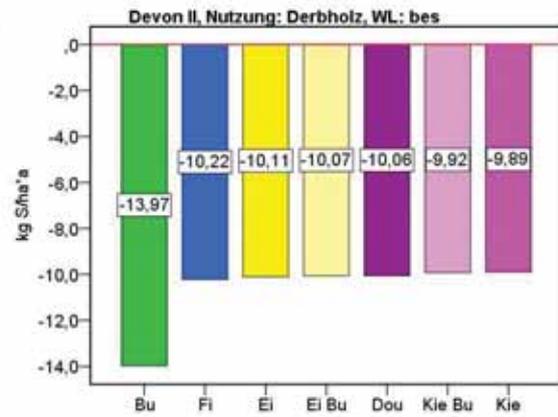
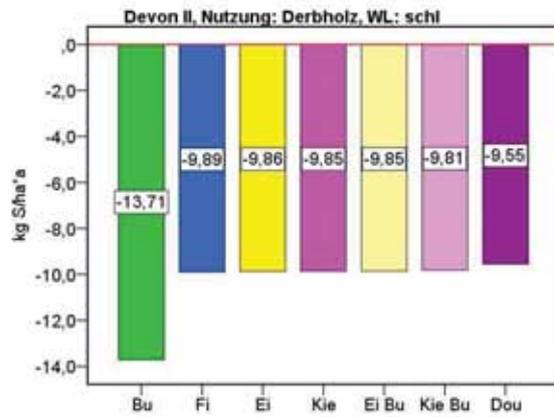


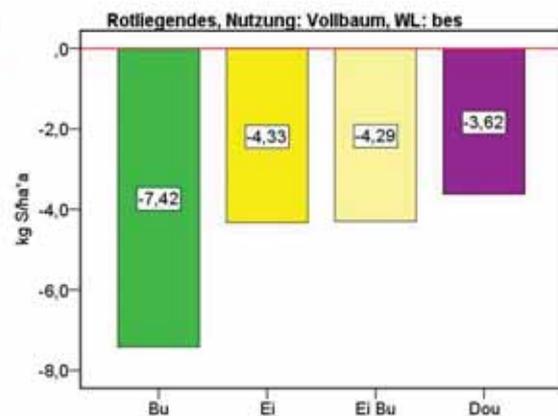
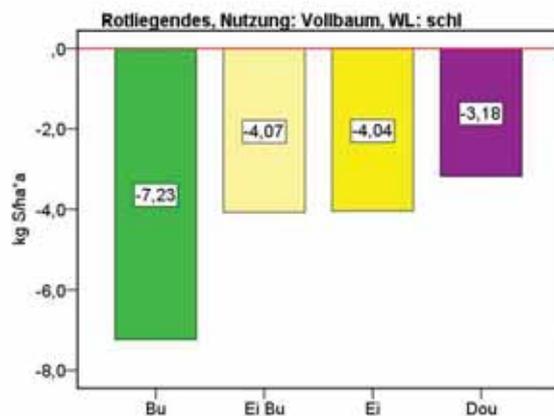
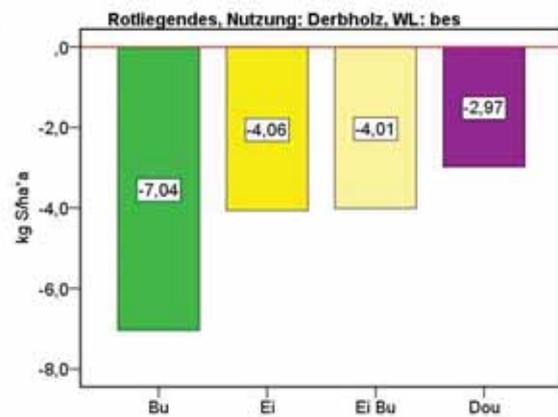
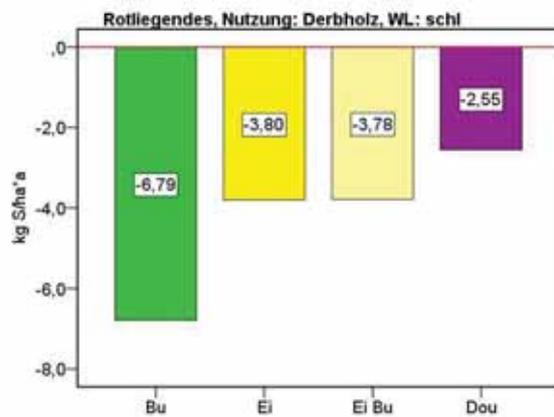
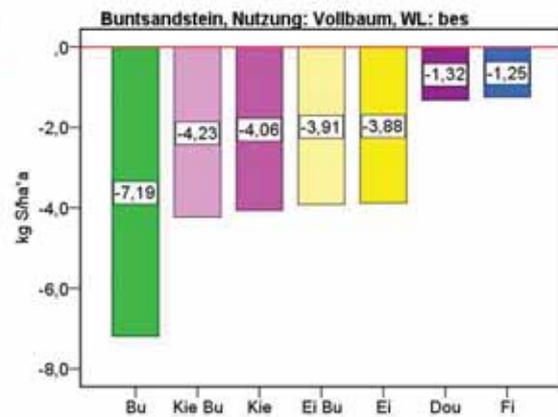
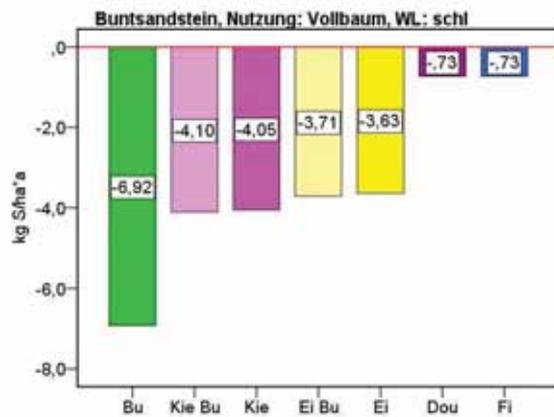
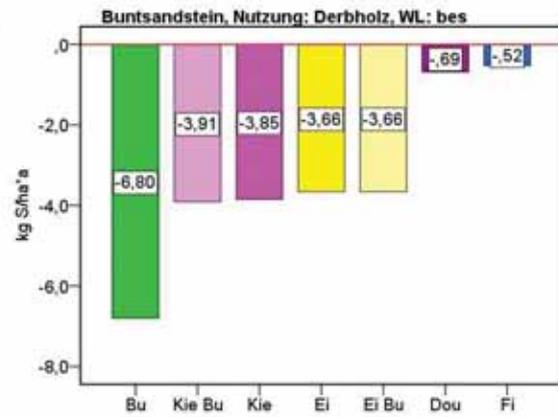
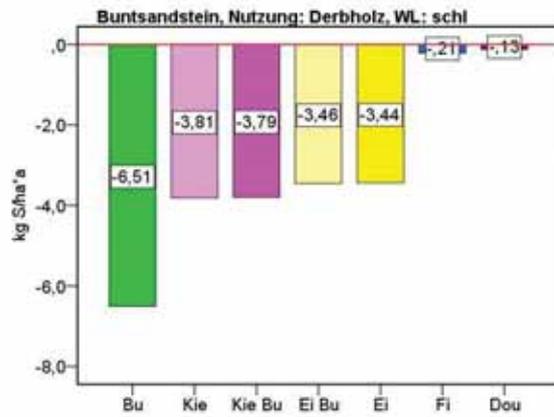


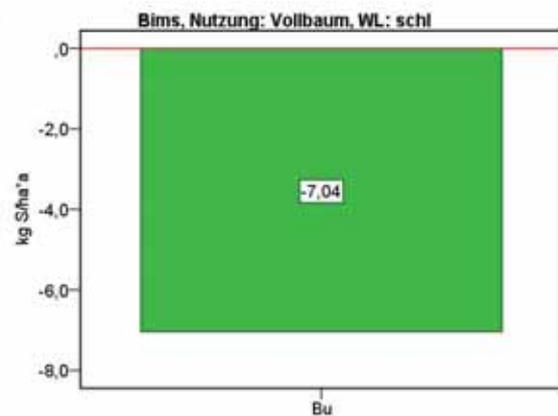
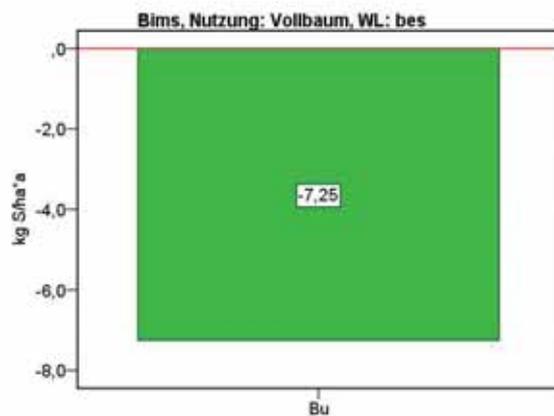
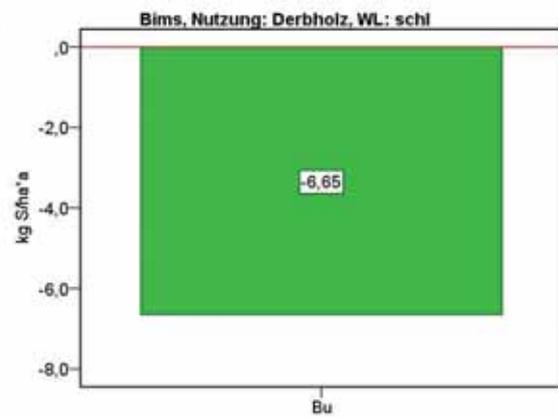
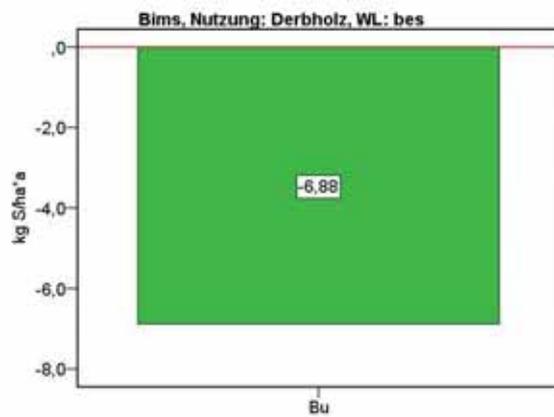
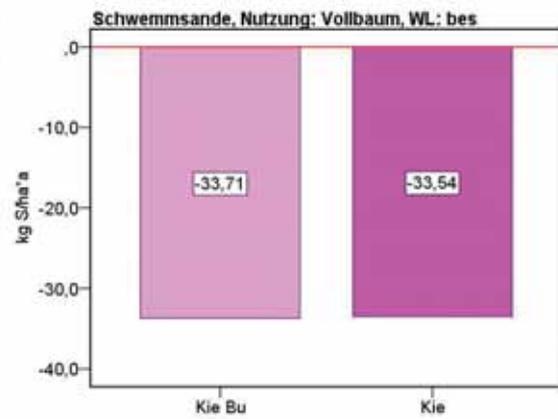
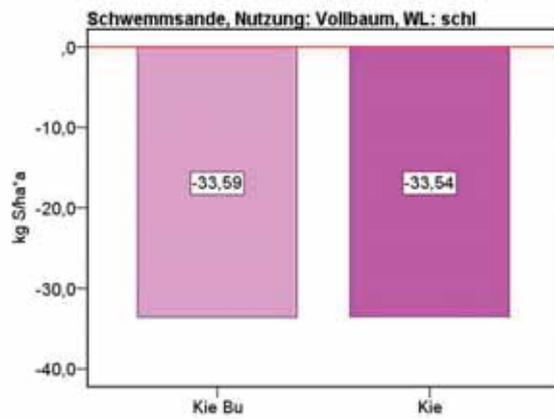
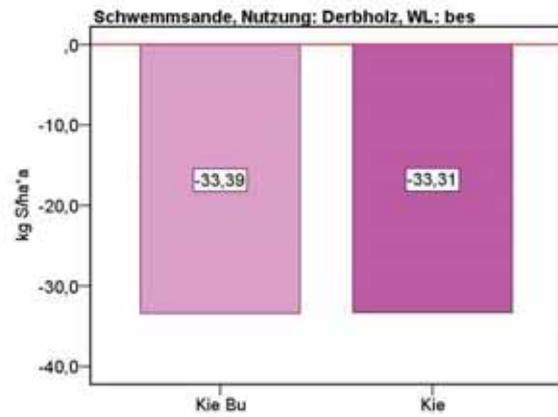
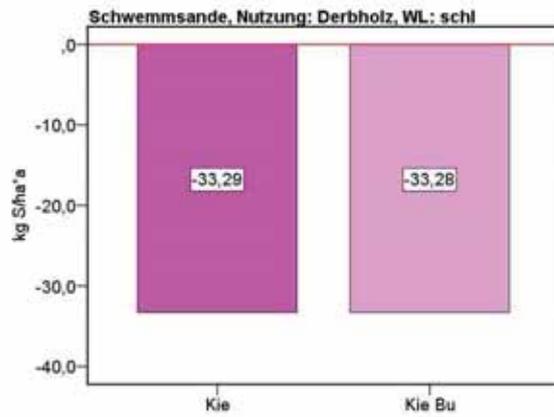


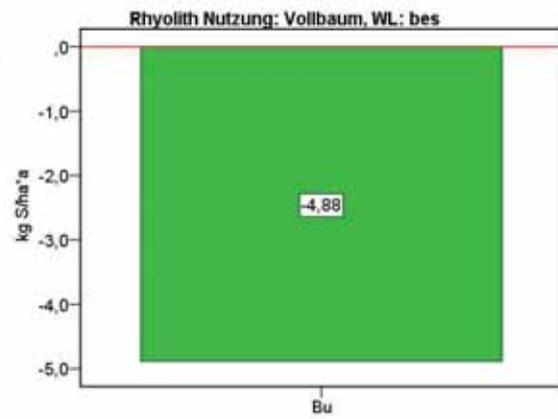
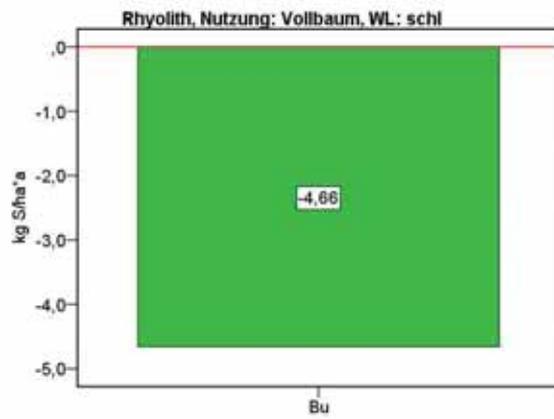
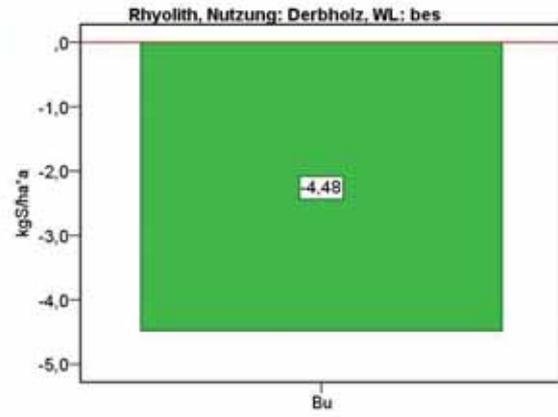
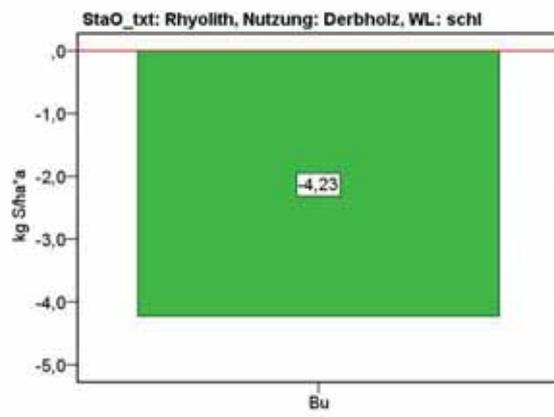






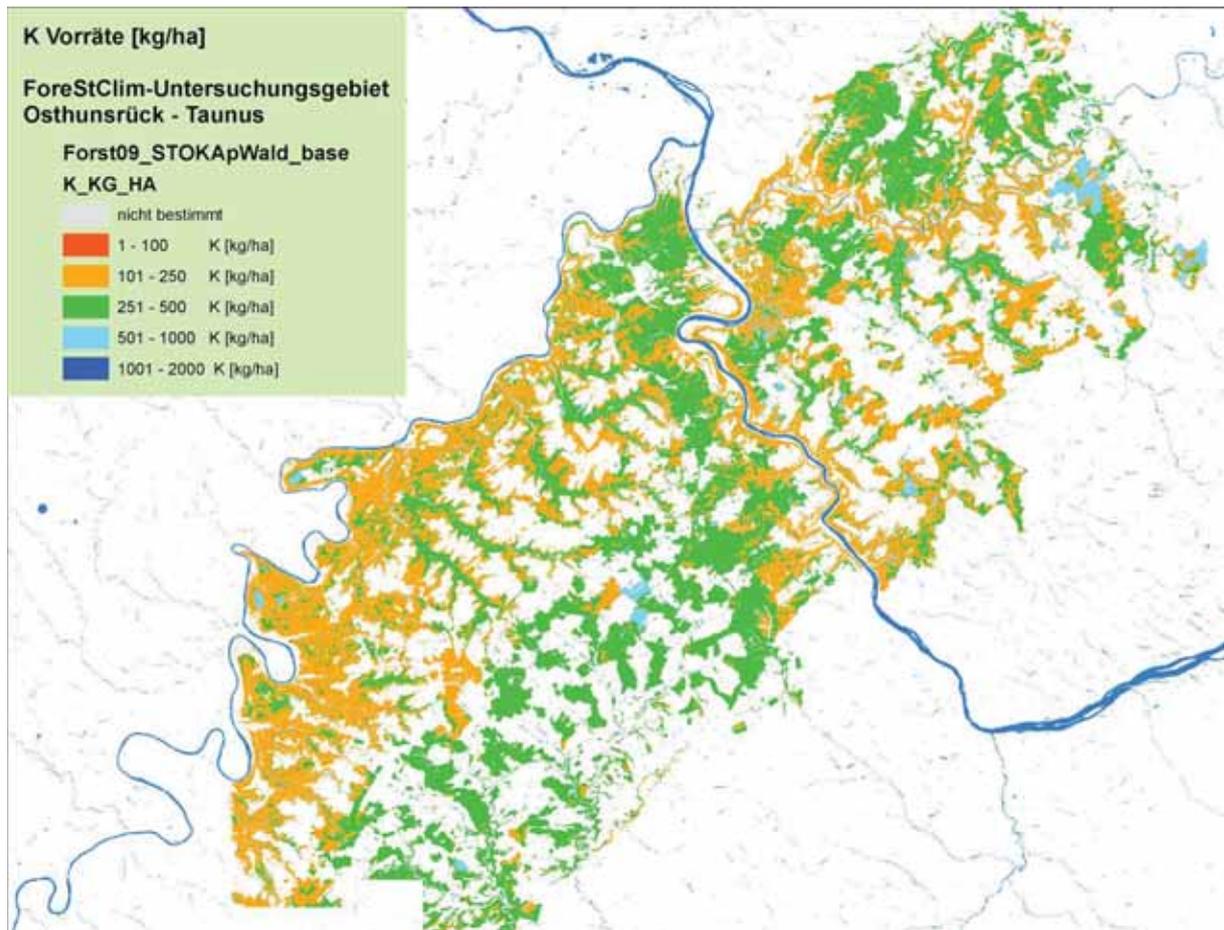


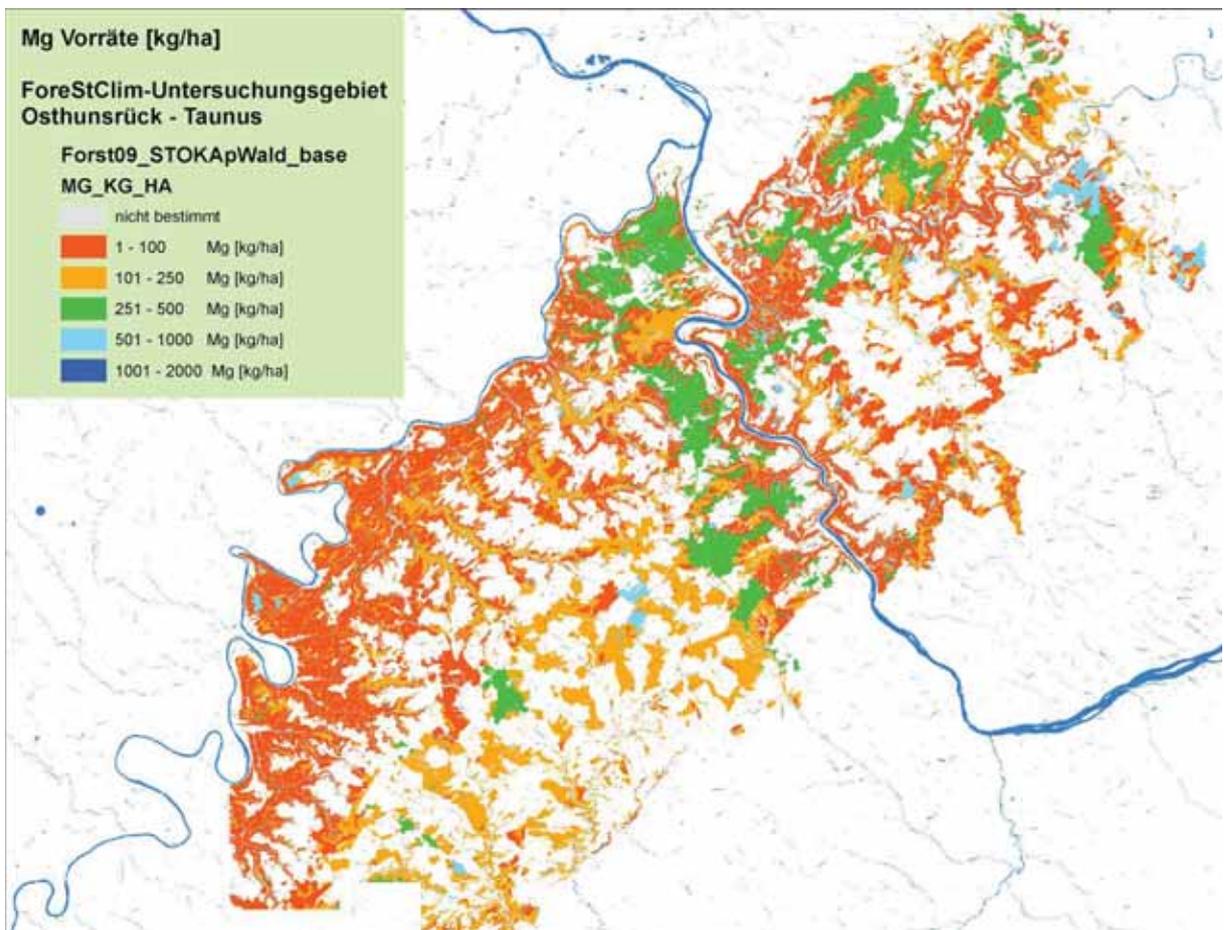
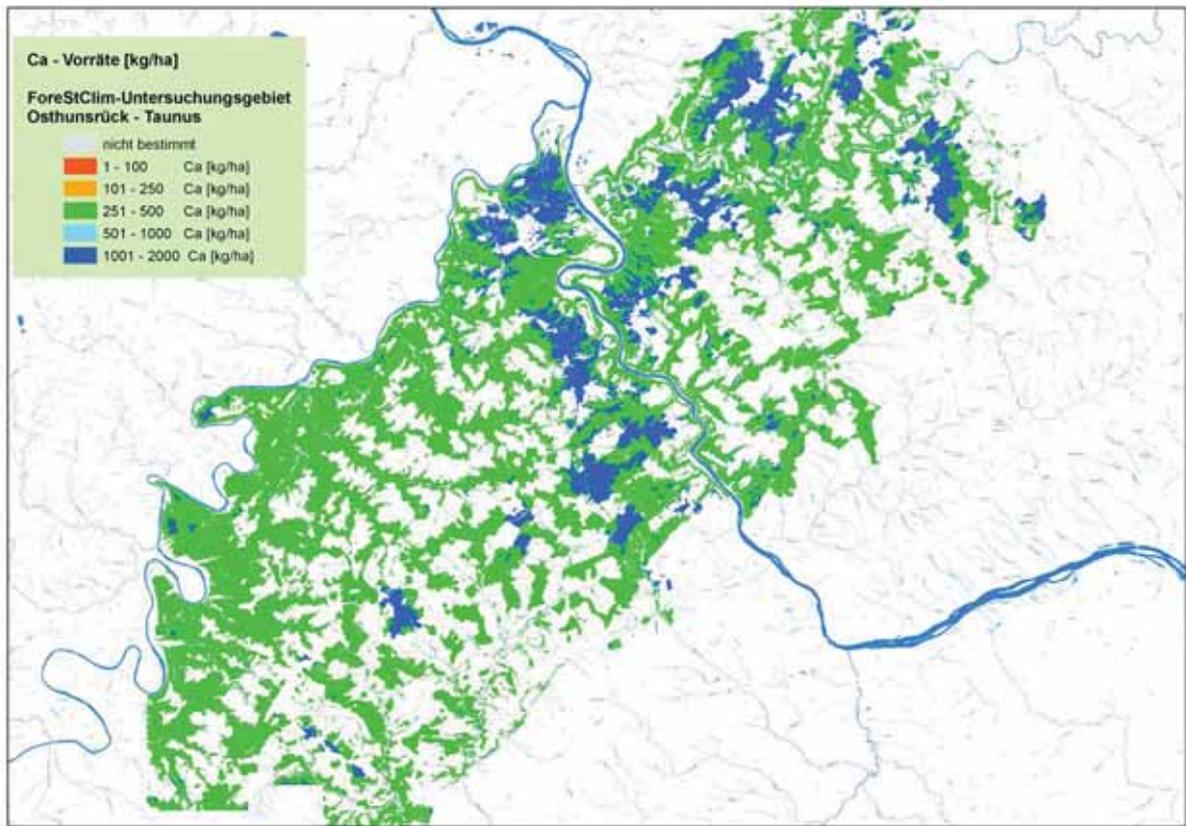


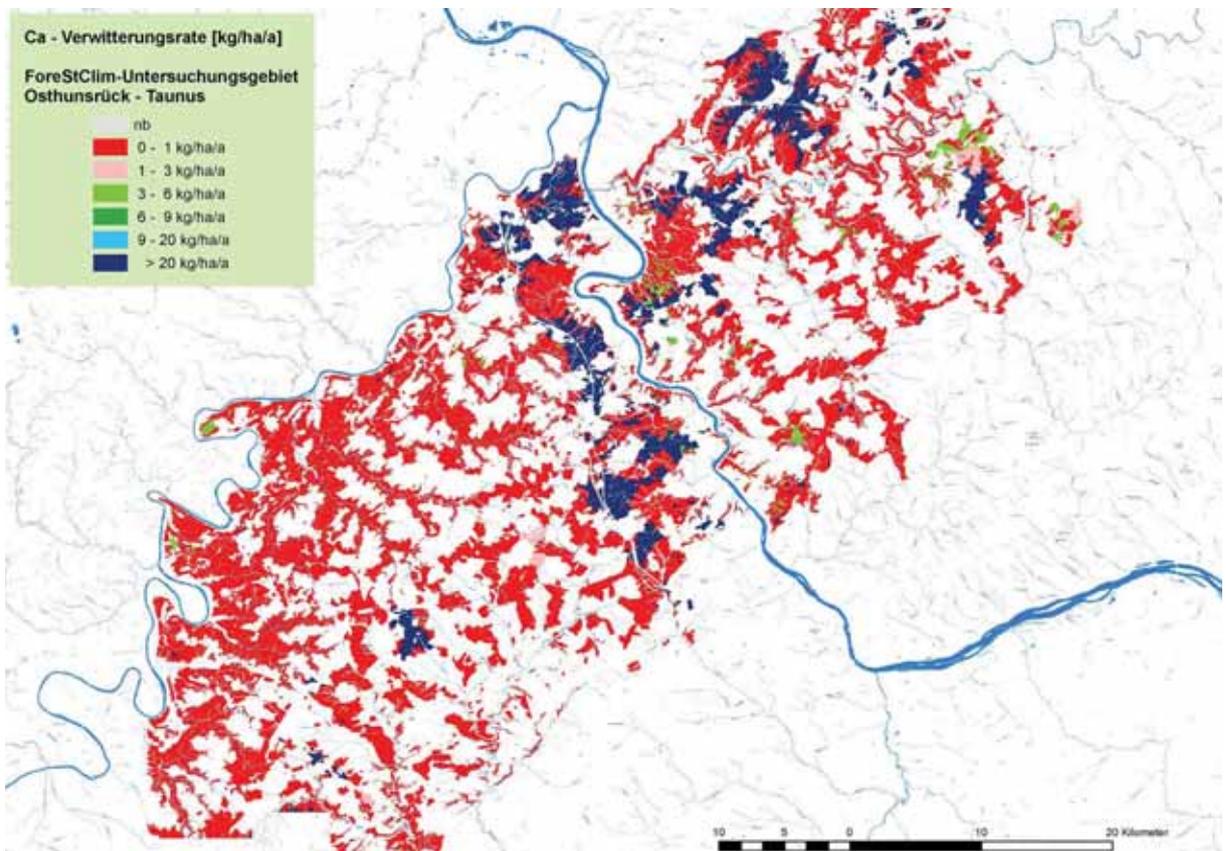
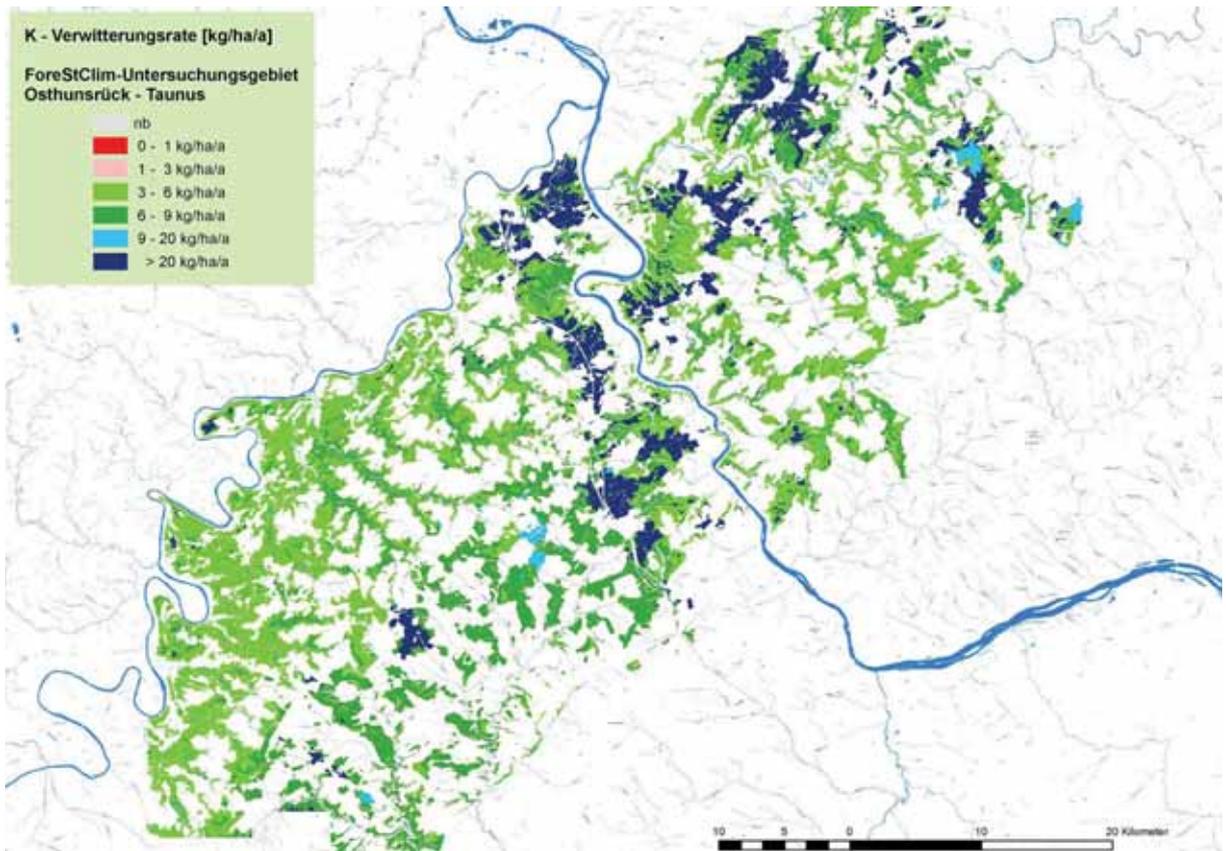


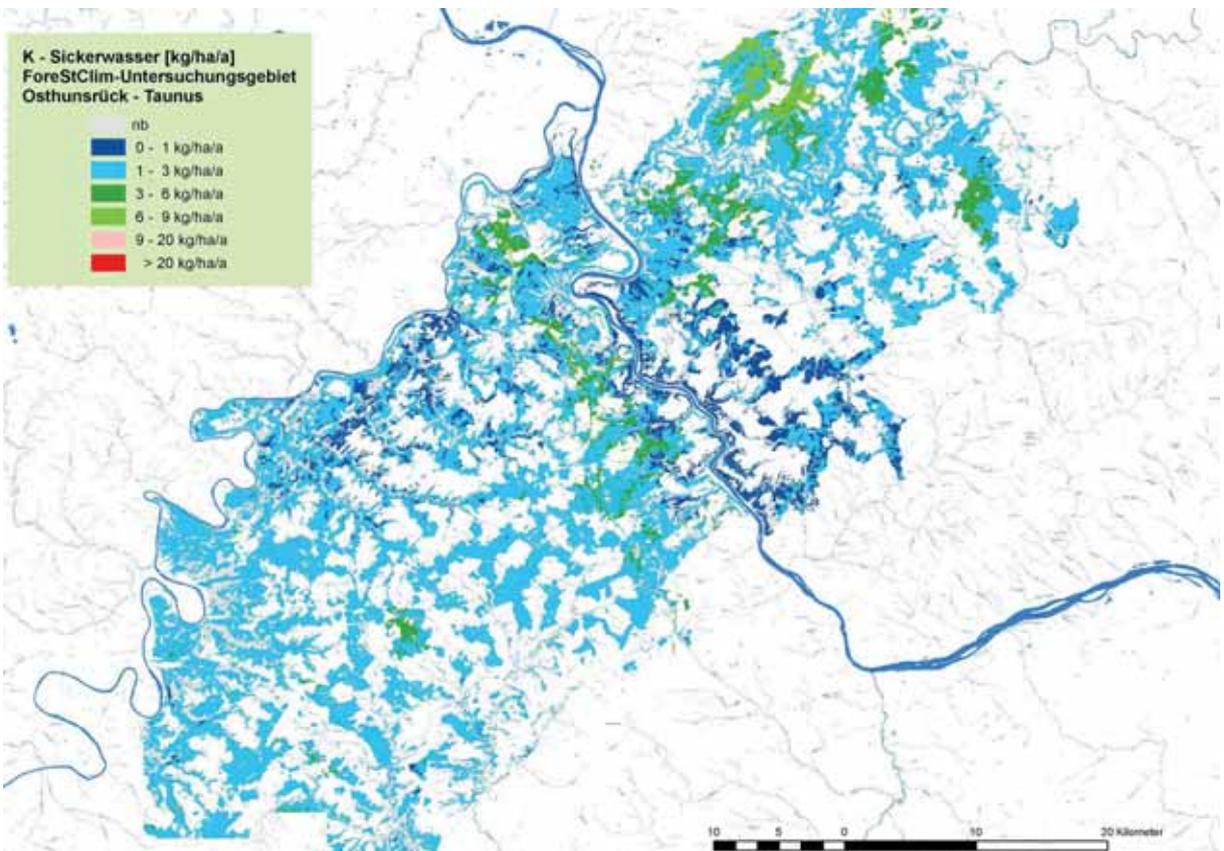
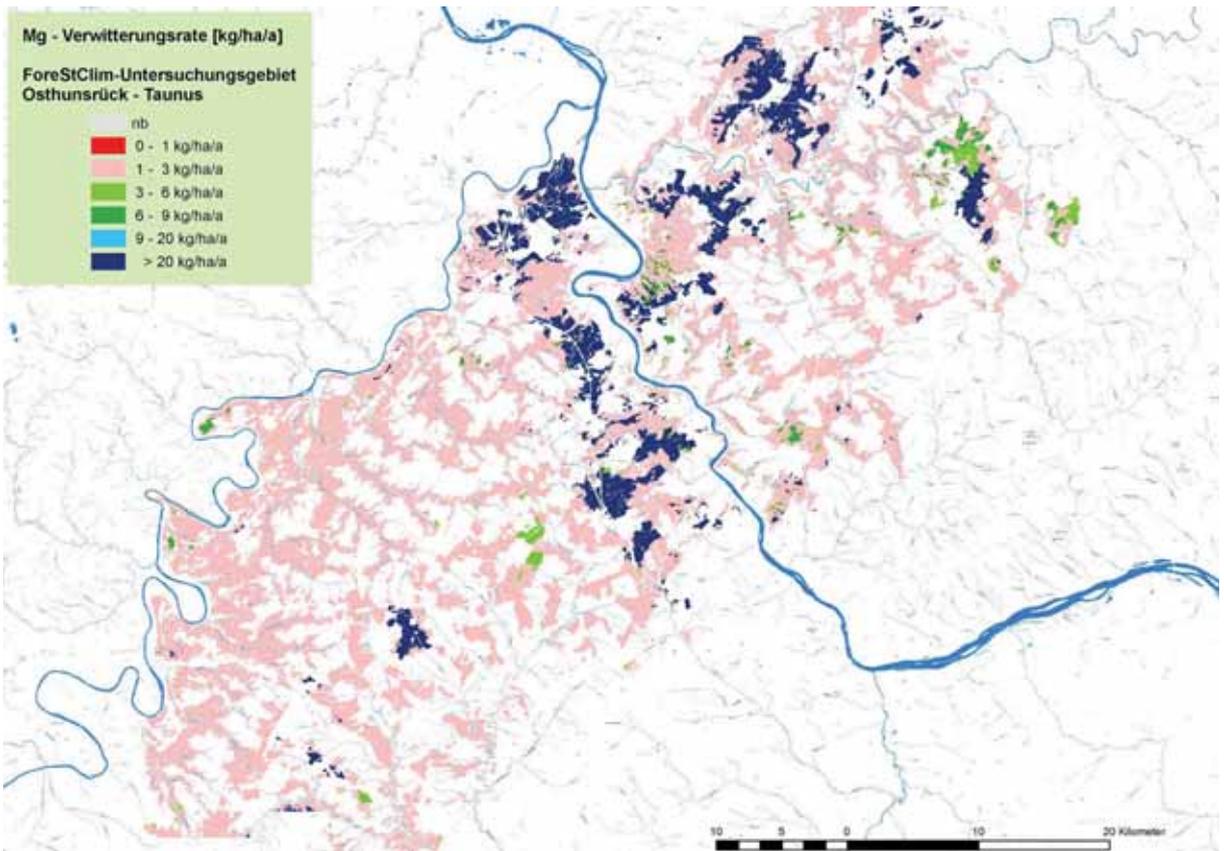
Anhang 4: Ergebnisdarstellungen auf Karten (Beispiele)

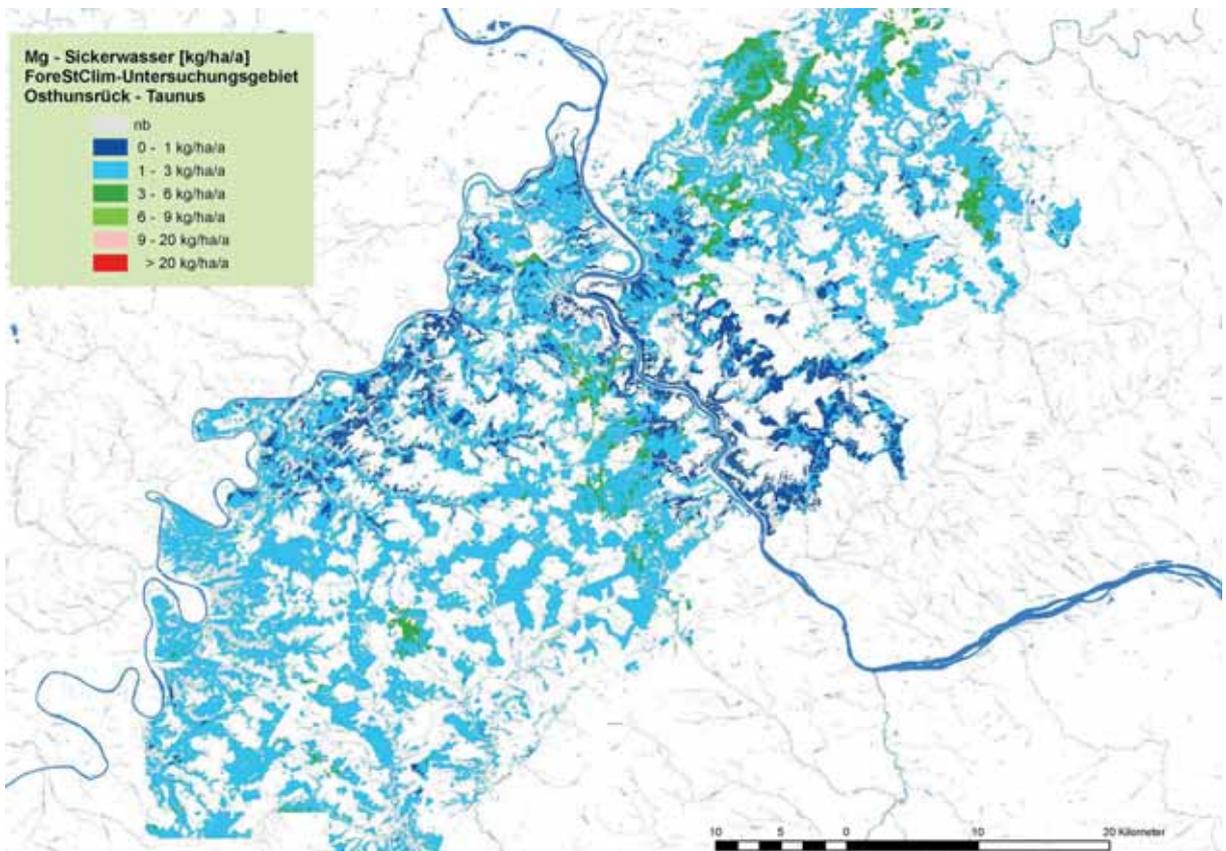
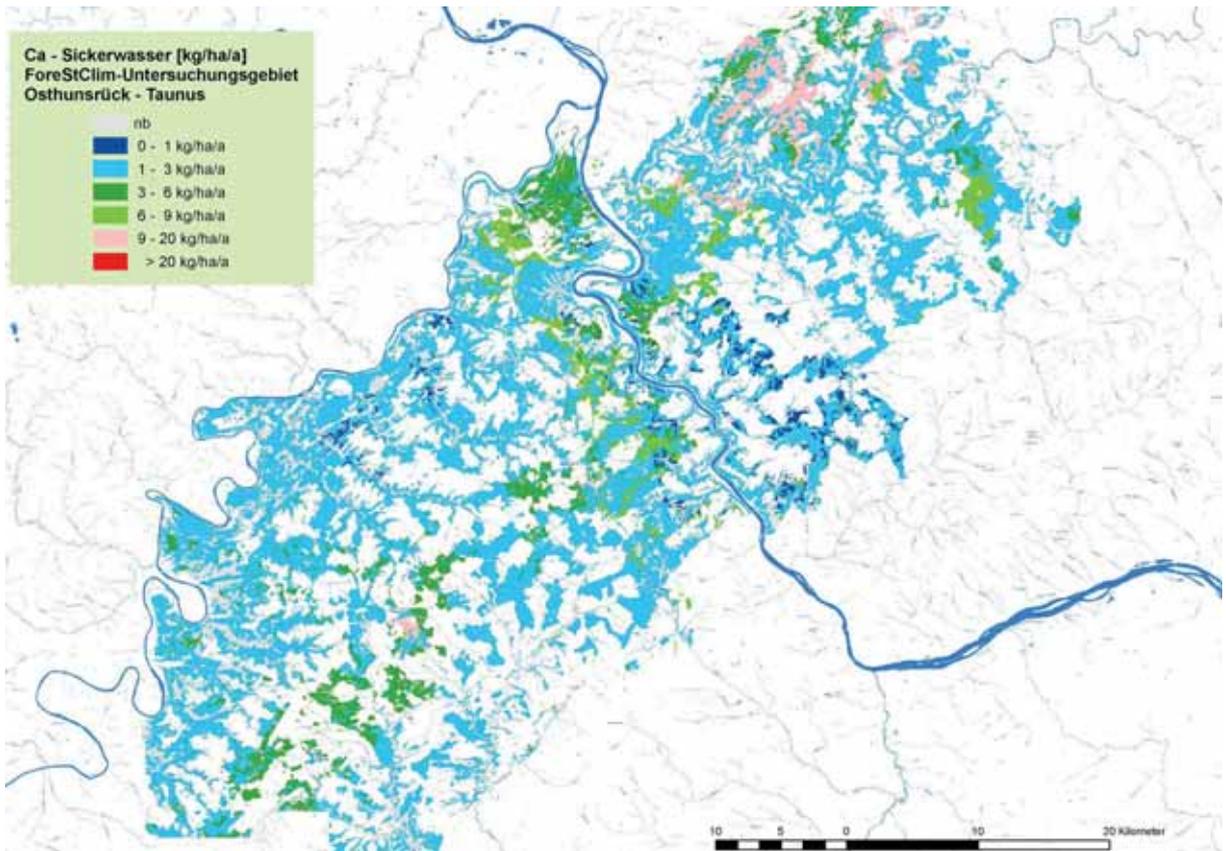
Anhang 4.1: Nährstoffübersichtskarten für das ForestClim-Untersuchungsgebiet Osthunsrück - Taunus

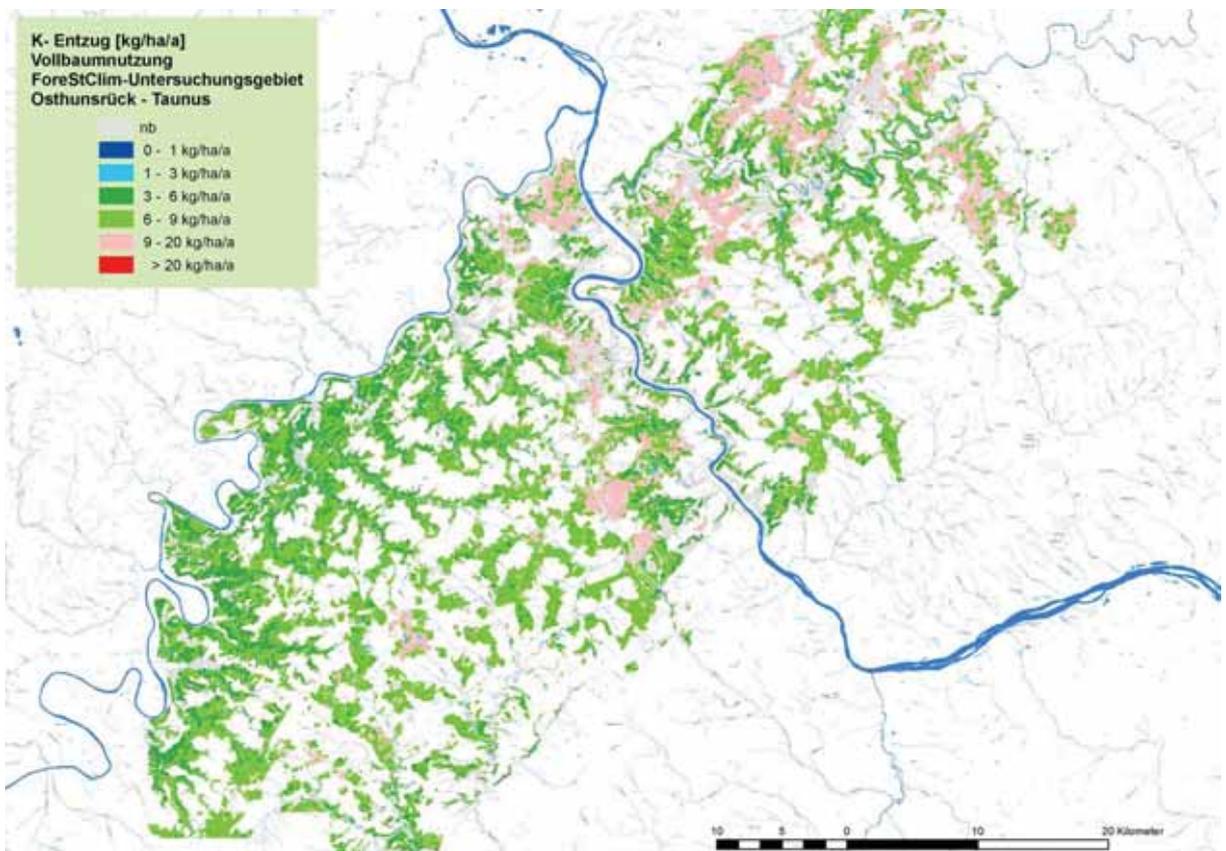
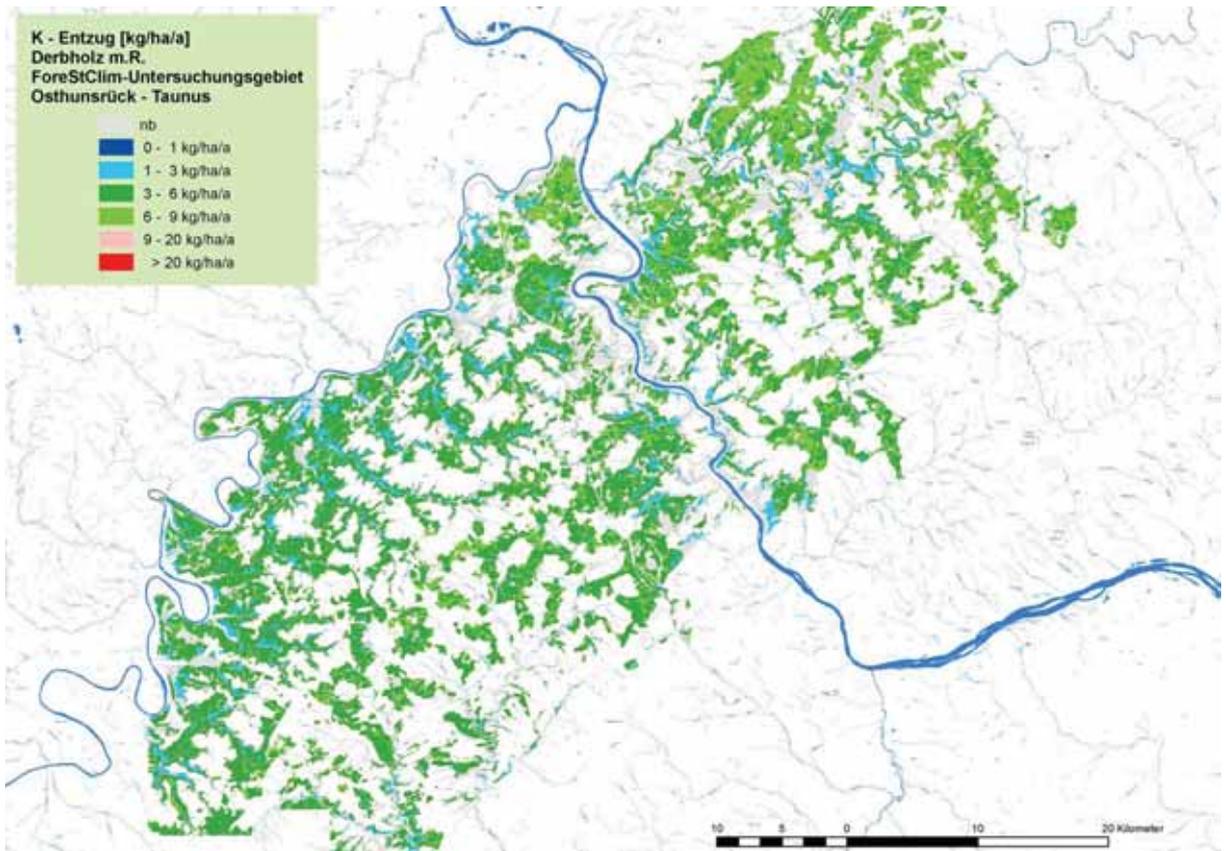


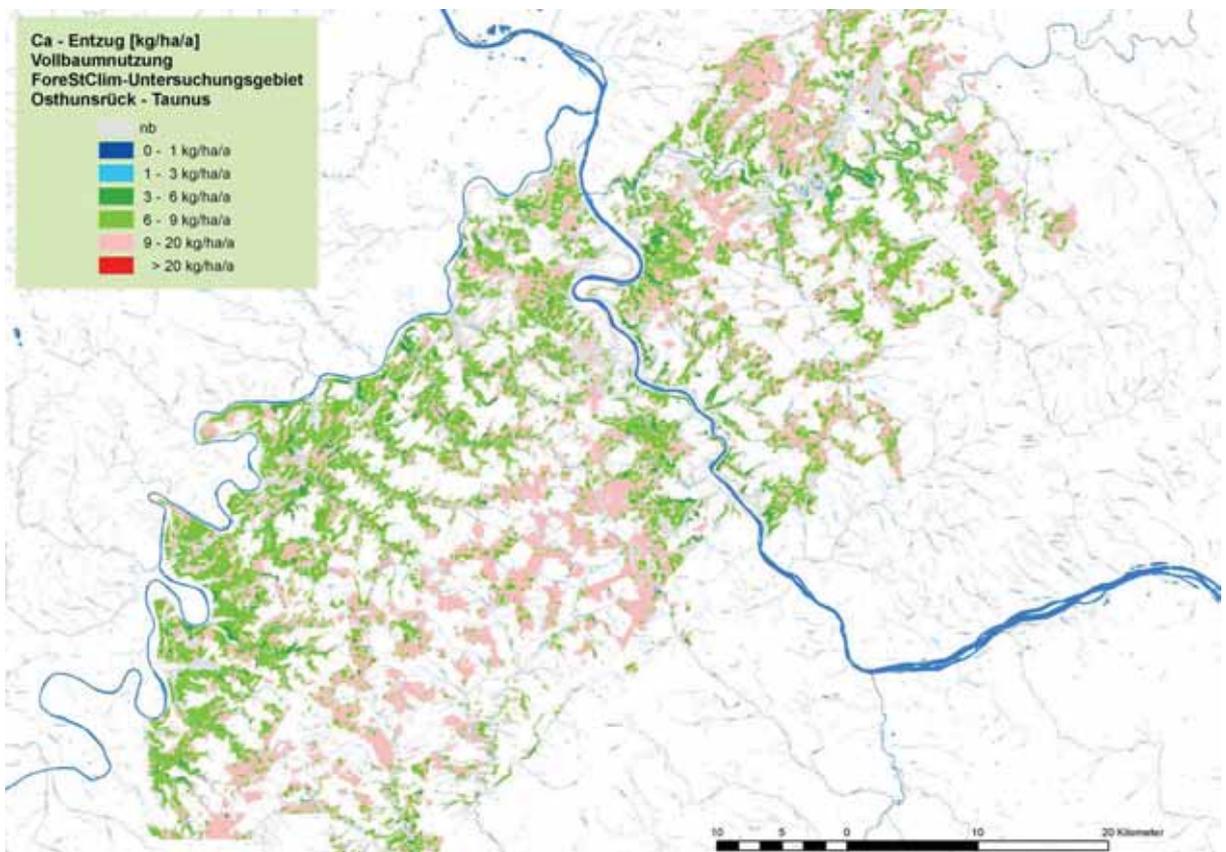
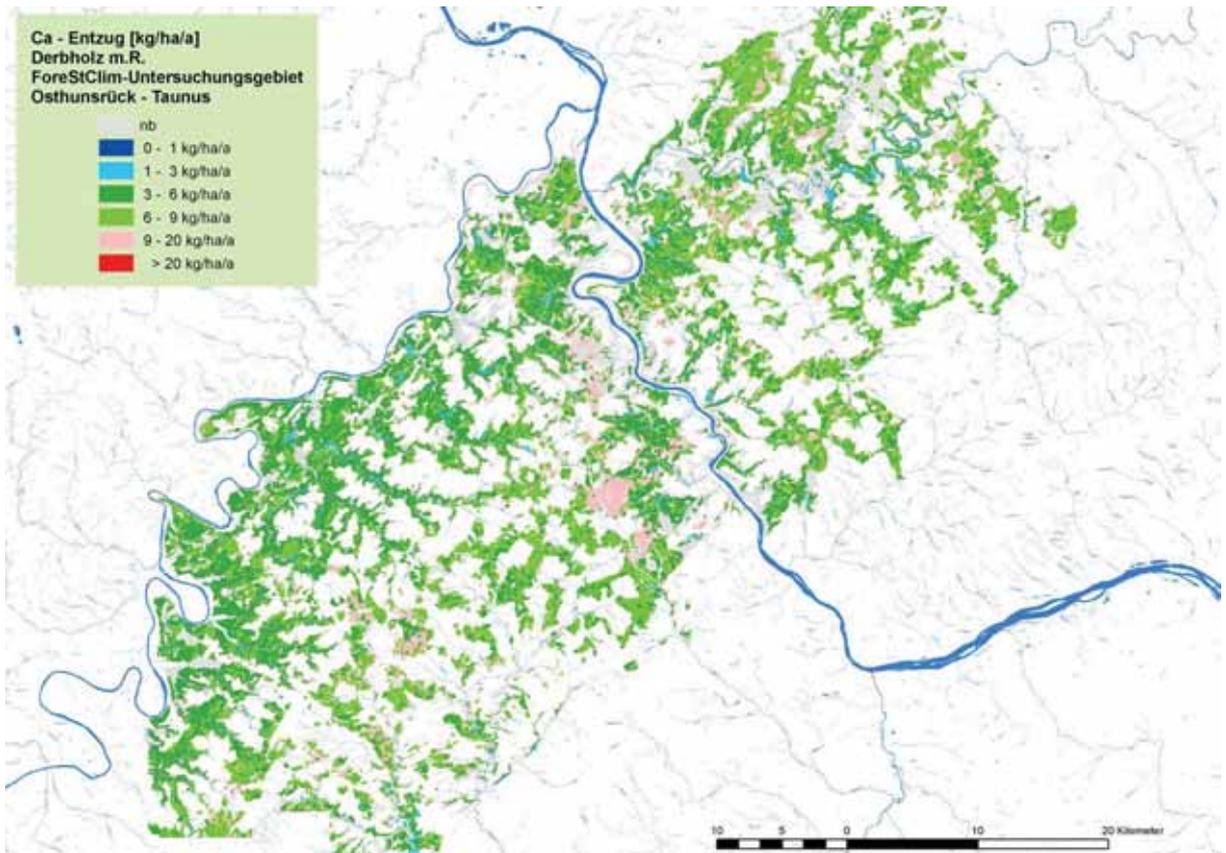


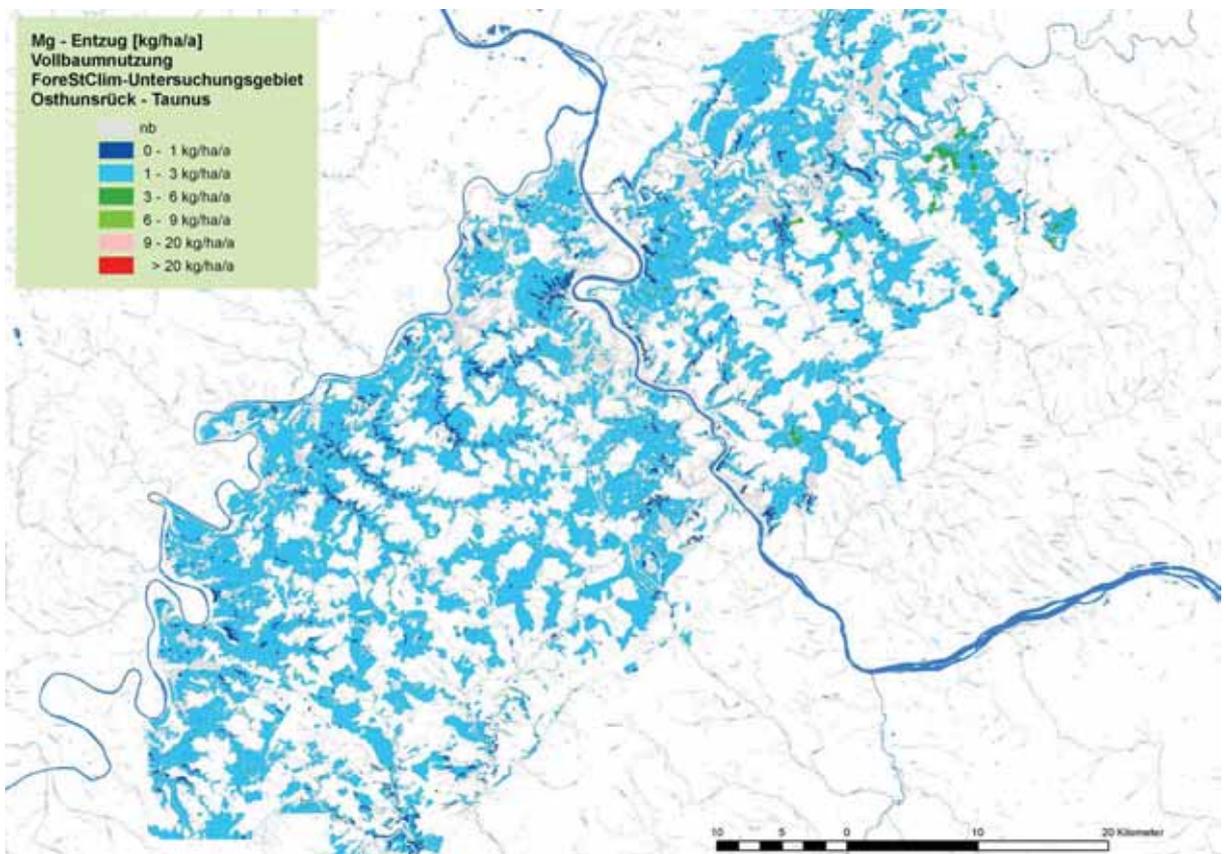
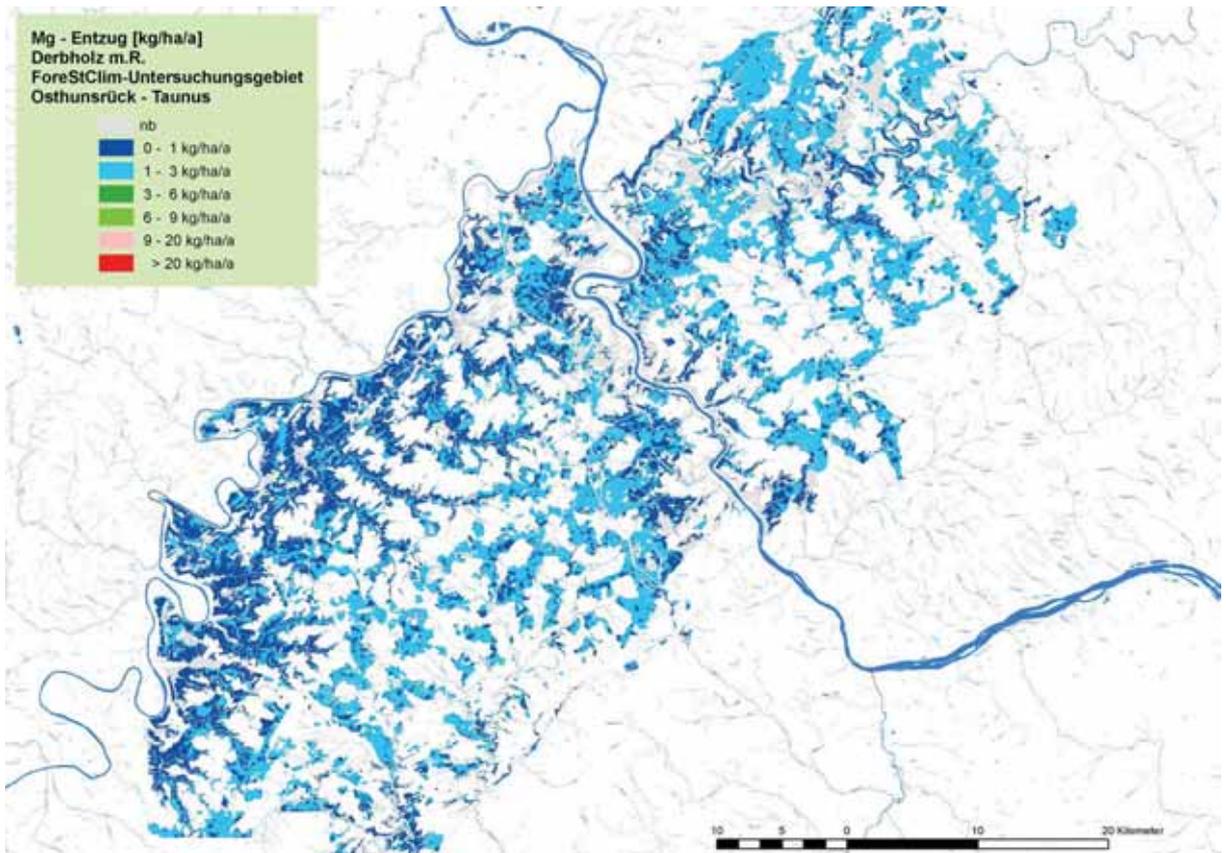


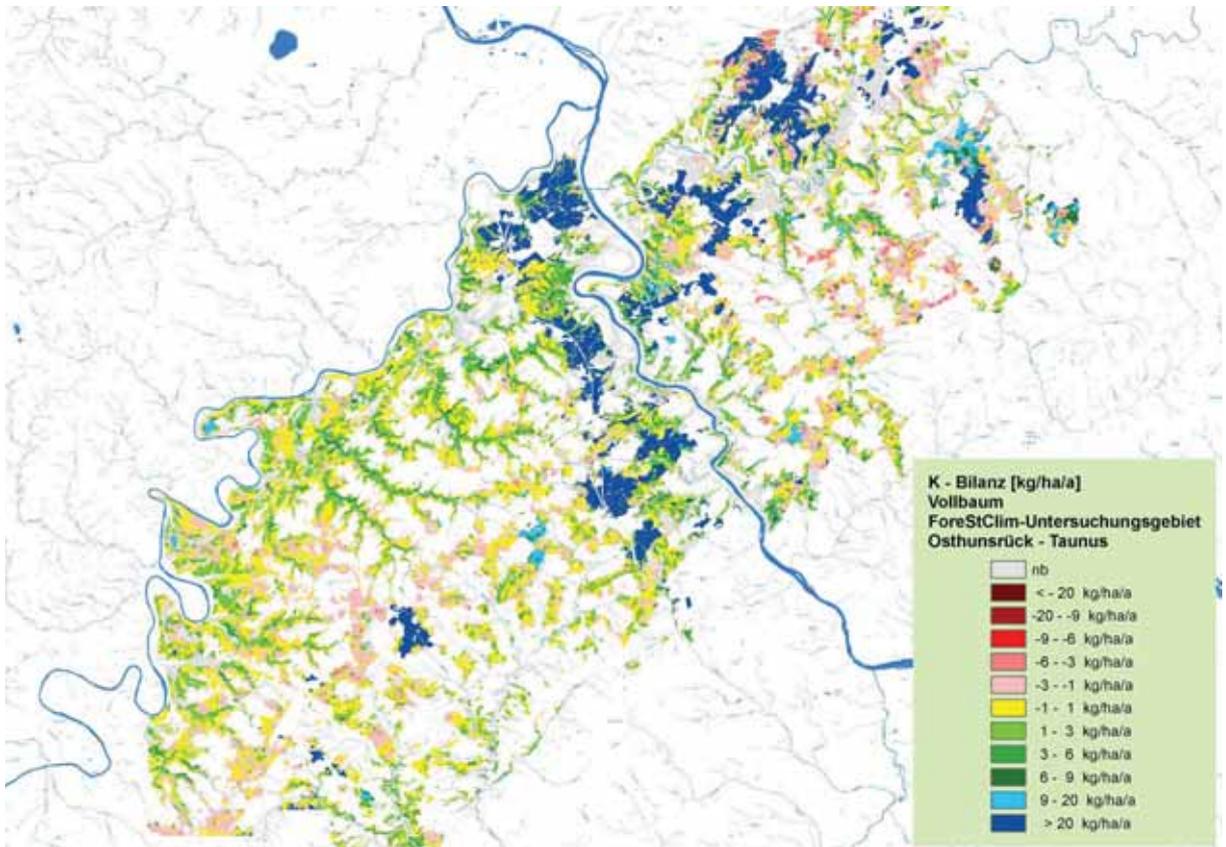
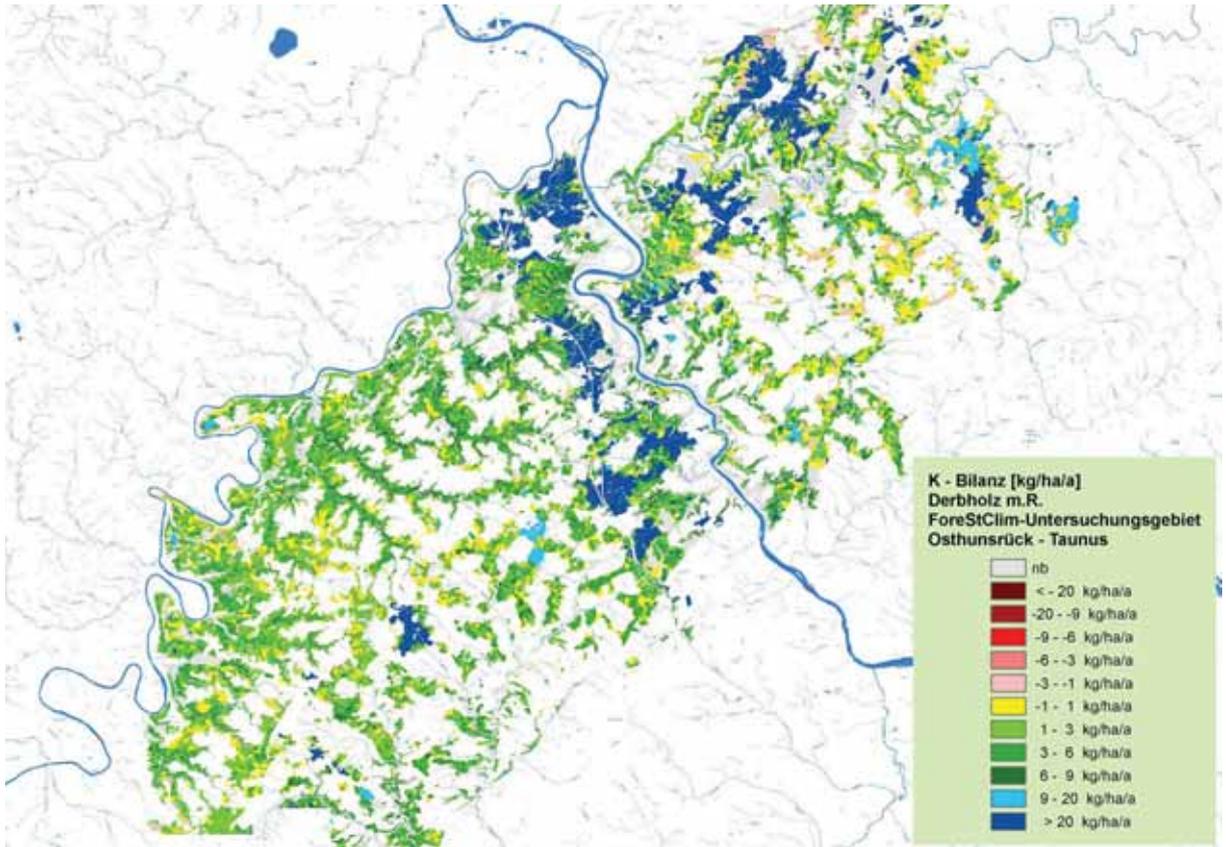


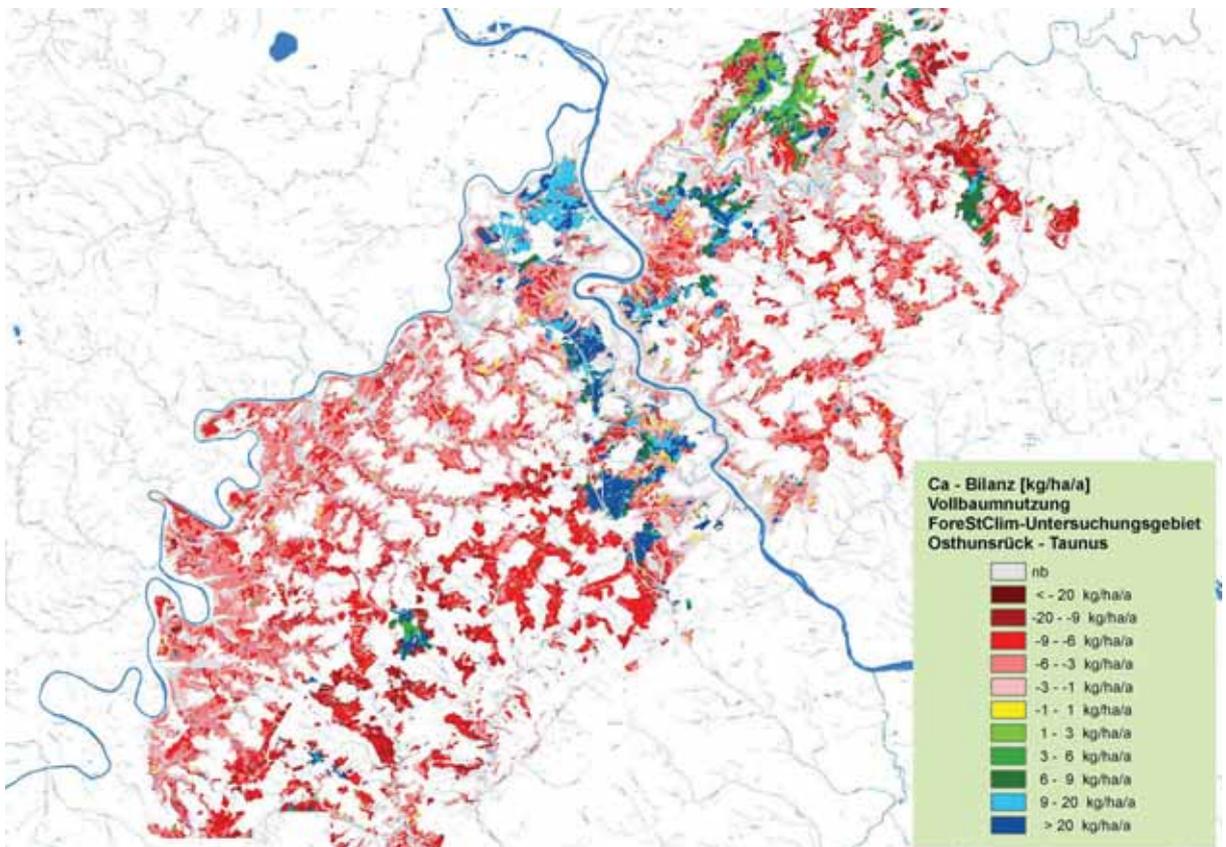
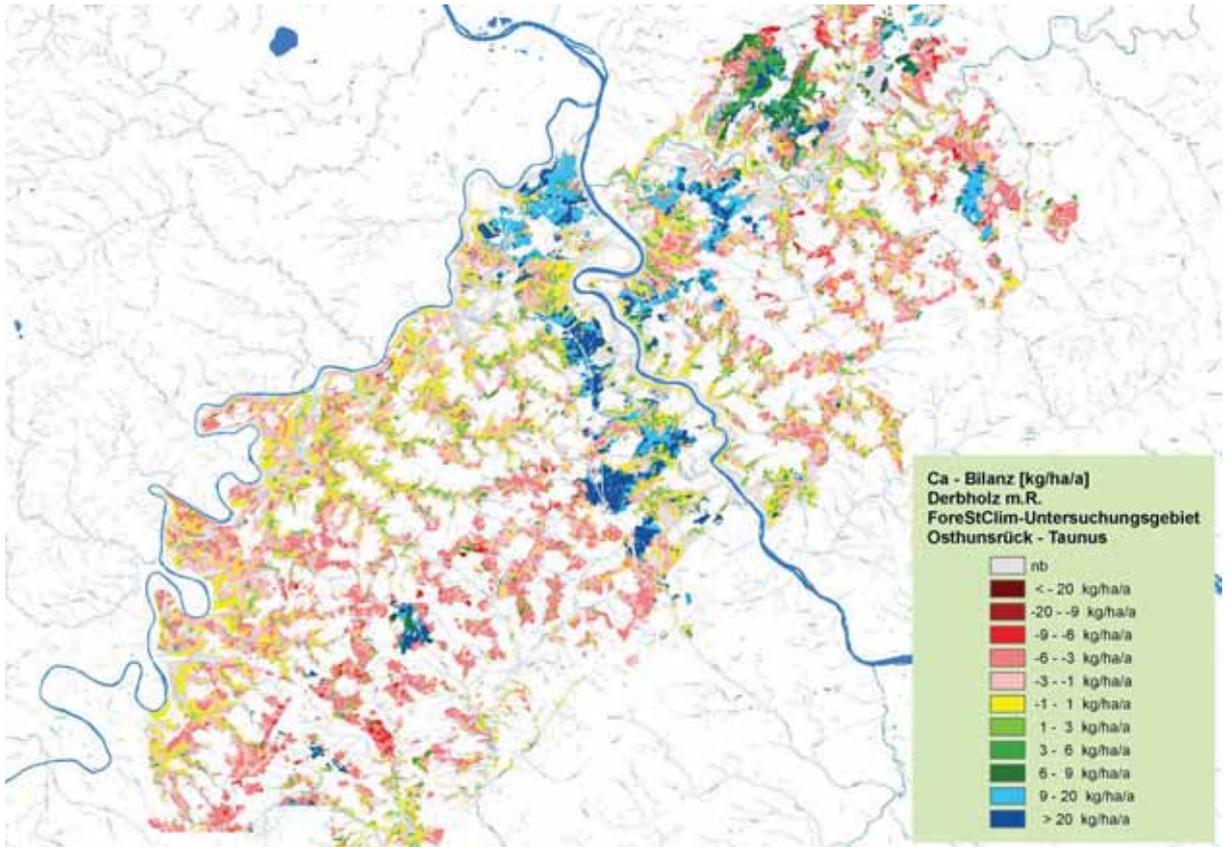


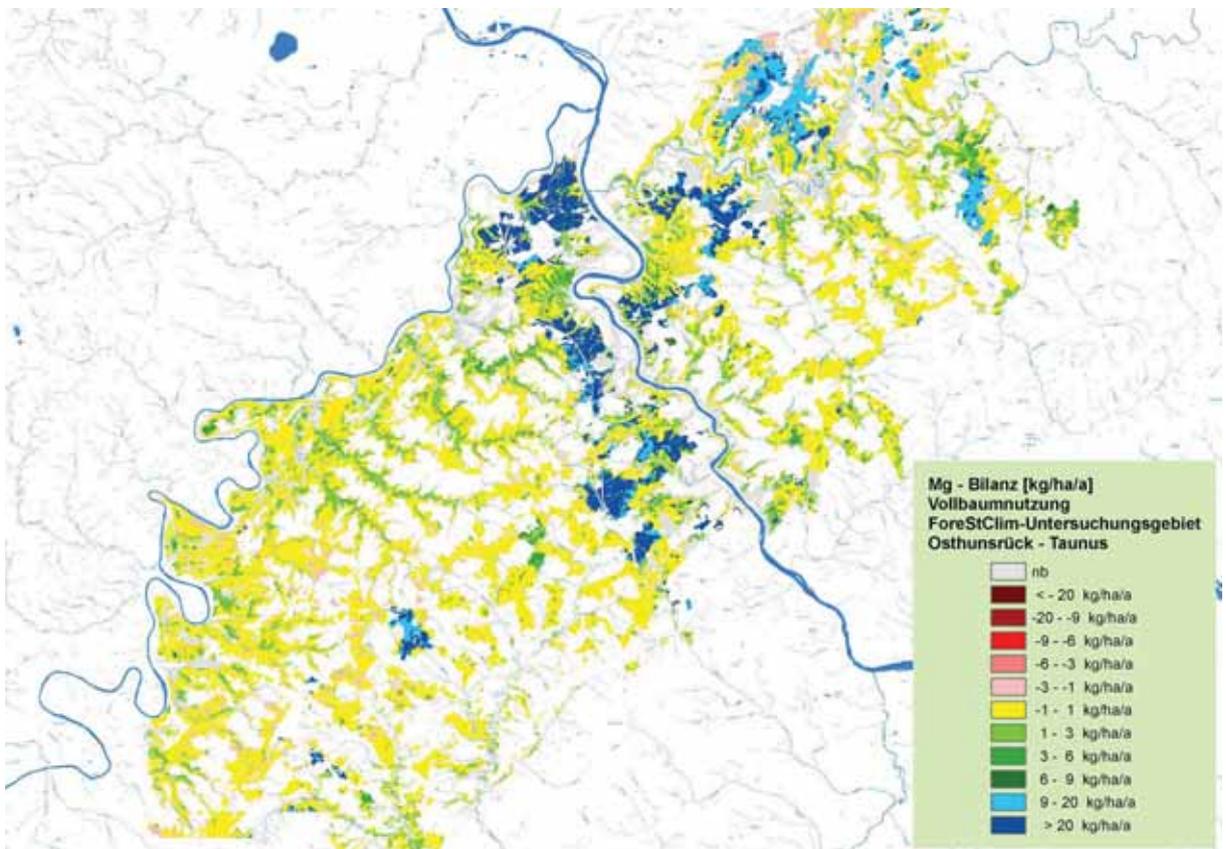
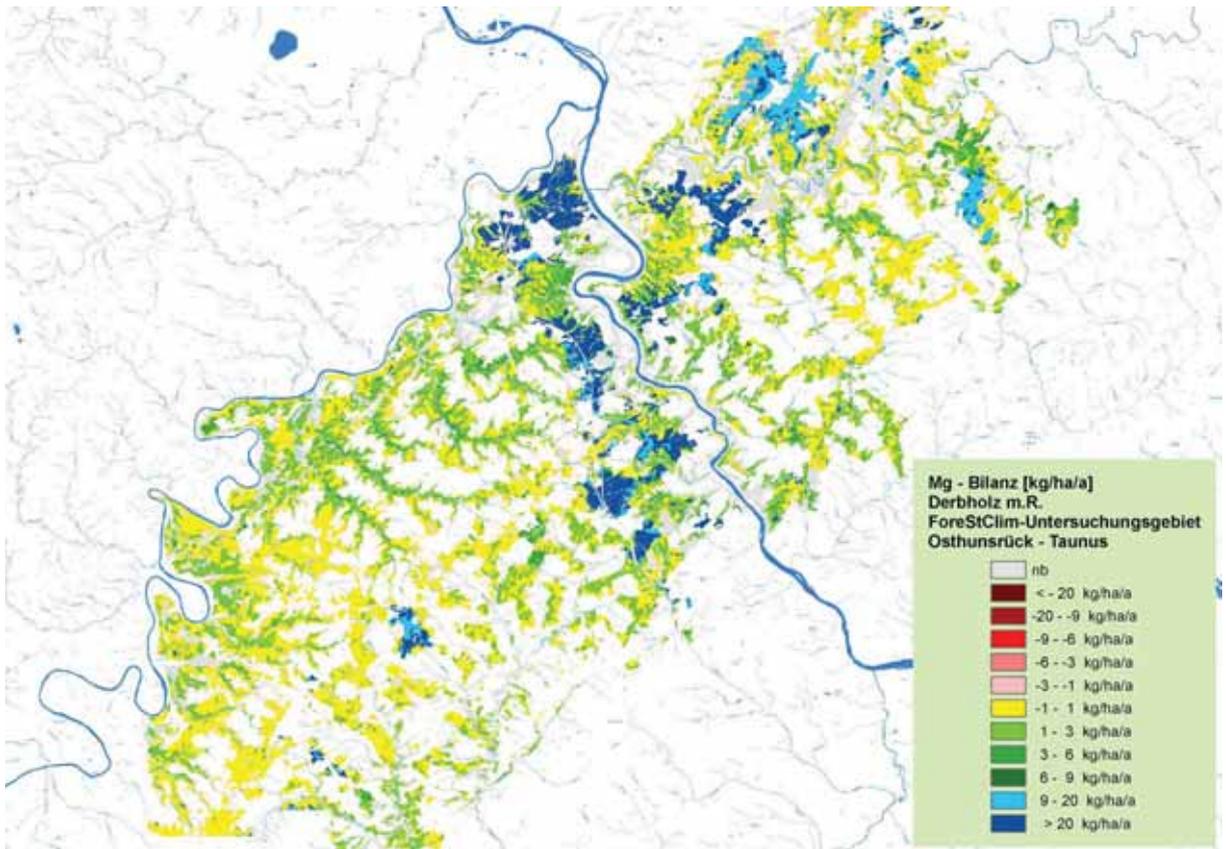












Anhang 4.2: Nährstoffflurkarten für das ForestClim-Untersuchungsgebiet Osthunsrück - Taunus

