资源环境学院研究生论坛报告人简介

**一、论坛主题报告**

**1.李国学教授 报告题目：我国种养废弃物循环利用的技术与模式**

个人简介：中国农业大学资源和环境学院教授、博士生导师，环境科学与工程系主任，北京市农田环境污染控制与修复重点实验室主任，中国农业大学生物质工程中心主任。国务院政府特殊津贴专家。绒毛用羊产业技术体系粪污处理与资源化岗位专家。国家畜禽养殖废弃物资源化利用科技创新联盟国内专家委员会主任。主要从事废弃物处理与循环农业研究。近5年主持各类科研项目28项，在种养循环技术与模式、堆肥过程中碳氮硫转化、气体排放和控制技术取得了众多科研成果。创建了村镇生活垃圾分类收集分类处理技术体系。2009年获农业部神农奖三等奖（第2完成人）。2010年获得国务院第一次全国领导小组等颁发的全国污染源普查先进个人。2011年获国家技术进步奖二等奖（第2完成人），2013和2018年分别获得教育部技术发明奖二等奖（第2完成人），2017年获得大北农环境工程一等奖（第2完成人），2019年分别获得教育部科技进步二等奖（第1完成人）、农业农村部神农奖一等奖（第1完成人）和丰收奖（第3完成人）。发表论文220余篇，其中90余篇SCI/EI。出版专著6部，发明专利20余项。

**2.王朝辉教授 报告题目：旱地土壤培肥与高效施肥研究进展**

王朝辉，男，1968年9月生，博士，现任西北农林科技大学资源环境学院教授、博士研究生导师，中国植物营养与肥料学会理事，中国土壤学会《土壤学报》编委。1991年以来，一直从事作物营养调控和旱地水肥管理研究，内容涉及土壤有机碳氮、土壤与植物氨挥发损失、土壤硝态氮残留和淋溶、土壤供氮能力、植物硝态氮累积、小麦等作物的养分吸收转移利用与产量品质形成、旱地水肥管理与农作物矿质营养调控、新型肥料研制等。先后主持国家自然科学基金项目5项，教育部新世纪优秀人才支持计划1项，国家重点研发计划项目、公益性行业科技专项、科技支撑计划课题各1项，公益性行业科技专项课题2项，中澳合作项目1项。共发表论文200余篇，SCI收录60余篇；出版专著1部，参编2部。获国家科技进步二等奖1项（第2完成人），陕西省科技进步一等奖1项（第2完成人）、二等奖3项（分别为第2、3、6完成人），陕西省现代教育成果二等奖1 项（第1 完成人）。2005年被评为西北农林科技大学拔尖人才；2006年，获批教育部新世纪优秀人才支持计划；2008年，被聘为国家小麦产业技术体系岗位专家；2010年，被评为西北农林科技大学创新团队带头人；2012年，被评为农业部农业科研杰出人才。2018年，被评为农业部科学施肥专家指导组成员。

**二、论坛研究生报告**

**1.巩铁雄博士**

**个人简介：**男，汉族，中共党员，1991年11月19日生，甘肃正宁人。本科毕业于甘肃农业大学，水土保持与荒漠化防治专业；硕士毕业于中国科学院大学/中国科学院教育部水土保持与生态环境研究中心，土壤学专业；博士就读于西北农林科技大学，土壤学专业。截止目前，在该专业领域知名期刊以第一作者发表中文文章一篇。在国外知名SCI期刊以第一作者发表文章4篇。

**题目：超深黄土剖面土壤水分是否保持稳定?来自中国黄土高原南北向横断面土壤钻孔数据的证据**

**英文题目：Does soil water in the ultra-deep loess profile keep stable? Evidence from soil borehole data across a south-north transect of the Chinese Loess Plateau**

**中文摘要：**了解超深黄土剖面中土壤水分的时空变异性对于理解地球关键带的化学、物理和生物过程具有重要意义。在本研究中，我们定期监测黄土高原沿区域横断面深层土壤剖面的土壤含水量(SWC)。描述性统计分析发现，安塞和神木的SWC均值变异系数(CV)分别为16.036%和13.606%，变异程度适中。杨凌、长武、抚县的SWC均值变异系数分别为4.111%、7.951%、6.117%，变异程度较低。地质统计分析表明，平均SWC表现出较弱的空间依赖性。小波分析表明，5个采样点的平均SWC近似趋势沿深度序列呈增大趋势。此外，我们还确定了SW活动层的下限，根据CV(= 10%)的临界值，这些场地的活动层的土壤厚度(ST)分别为:5.2 m(杨凌)、7 m(长武)、23 m(富县)、33 m(安塞)和3.2 m(神木)。平均SWC随着采样位置的变化(由南向北)呈下降趋势。本研究填补了超深层土壤水分变化研究的空白。同时，我们的研究为保护深层土壤水分和保持深层土壤水分的措施提供了有价值的信息。

**英文摘要：**Knowledge of the spatiotemporal variability of soil water in the ultra-deep loess profile is important for understanding the chemical, physical, and biological processes in the CZ. In this study, we regularly monitor soil water content (SWC) in deep soil profile along regional transect on the Loess Plateau. Descriptive statistical analysis found that the coefficient of variation (CV) of mean SWC in Ansai and Shenmu were 16.036% and 13.606%, respectively, indicating moderate variability. The CV of mean SWC in Yangling, Changwu, and Fuxian were 4.111%, 7.951%, and 6.117%, respectively, showing low variability. Geo-statistical analysis indicated that mean SWC showed weak spatial dependence. Wavelet analysis showed that the approximative trend of mean SWC in five sampling sites showed an increased trend along depth series. In addition, we determine the lower limit of SW active layer, the soil thicknesses (ST) of active layers for these sites were determined as: 5.2 m (Yangling), 7 m (Changwu), 23 m (Fuxian), 33 m (Ansai), and 3.2 m (Shenmu) based on a critical value of CV (= 10%). Mean SWC had a decreasing trend with the change in sampling position (from south to north). This study fills the gap in research’ ultra-deep soil water changes, evidence from soil borehole data. At the same time, our research provides valuable information for the protection of deep soil water and measures to maintain deep soil water.

**2.卢冠男博士**

**个人简介：**2015级资源环境生物学专业博士，师从和文祥教授。自2012年起开始对土壤重金属污染及其酶效应进行研究，主要研究对象为变价类金属元素砷（As）。近年来先后对As在土壤中的环境行为、形态分布及其生物有效性进行了研究。探讨了As在土壤团聚体尺度上的分布情况，利用动力学手段分析了其对碱性磷酸酶的抑制机理。先后在Ecotoxicology and Environmental Safety及Chemosphere期刊中发表论文两篇。

**论文题目：利用Qmax\*来科学的评价不同pH土壤对As(V)的吸附能力**

**摘要：**砷（As）作为一种类金属元素，大量的人类活动使得其释放到环境中，对土壤和水体造成危害。砷在土壤中的环境行为，尤其是吸附-解吸行为会显著影响其生物有效性。吸附剂对吸附质的吸附能力常用Langmuir模型拟合所得的参数------最大吸附量（Qmax）来进行评价。然而，土壤相较单一吸附剂来说是一种极为复杂的体系。因此，在本研究中，我们试图获得一个更科学的用来评价土壤对As的吸附能力的参数（Qmax\*）。选取采自我国的18个不同pH的土壤进行吸附-解吸试验。通过Langmuir模型拟合得到土壤对As(V)的最大吸附量在50.25-312.50 mg kg-1间波动。此外，分析表明Qmax与土壤pH有极大的相关性。将土壤对As(V)的吸附量与解吸量间的差值视为非静电吸附态砷，从而拟合获得土壤对As(V)的最大专性吸附量（Qmax\*）。酸中性土壤的Qmax\*均值为162.18 mg kg-1，而碱性土壤则仅为79.52 mg kg-1。通过多元线性逐步回归分析可以看出Feox和黏粒含量对Qmax\*有着强烈的影响。不仅如此，土壤对As(V)解吸的迟滞系数（HI）在0.83-1.82间波动。上述结果表明由解吸过程引起的二次污染不容忽视。

关键词：砷，土壤，专性吸附，解吸

**Title：Using Qmax\* to evaluate the reasonable As(V) adsorption on soils with different pH**

**Abstract:** As a toxic metalloid element, arsenic (As) derived from human activities can pose hazardous risks to soil and water. The bioavailability of arsenic is influenced by its behavior, in particular its adsorption-desorption in the soil environment. The maximum adsorption amount (Qmax) calculated from Langmuir equation is an important parameter to estimate the adsorption capacity of adsorbents. However, the soil is a more complicated system compared with specific adsorbents. Thus, in this study, we tried to find a more reasonable parameter (Qmax\*) to evaluate the adsorption capacity of soils. Eighteen Chinese soil samples with different pH were used for adsorption-desorption experiments. The maximum As(V) adsorption capacity calculated through Langmuir fitting for 18 samples were ranged from 50.25 to 312.50 mg kg−1. Besides, Qmax was highly related with soil pH. Using the difference value of adsorption amount and desorption amount to indicate the amount of nonelectrostatic adsorption of As(V) onto soils, calculated the maximum adsorption amount of non-electrostatic adsorption (Qmax\*). The average Qmax\* of acidic and neutral soils was 162.18 mg kg−1 whereas that for alkaline soils it was only 79.52 mg kg−1. The result from multiple linear regression analysis showed Qmax\* was strongly influenced by Feox and clay contents. Furthermore, hysteresis index (HI) in the As(V) desorption varied from 0.83 to 1.82. The results further indicated the risk of secondary pollution originating from the desorption process cannot be ignored.

**Keywords:** Arseinc, Soil, Non-electrostatic adsorption, Desorption

**3.贺丽燕博士**

**个人简介**：贺丽燕，2016级博士研究生，专业为土壤学，指导教师为王旭东教授，研究方向是土壤化学，邮箱：heliyanhly@yeah.net。博士期间主要研究不同耕作措施对旱作农田土壤有机碳转化的影响及微生物机制，目前发表1篇SCI和1篇中文核心论文。

He Liyan, Zhang Afeng, Wang Xudong, Li Jun, Hussain Qaiser. Effects of different tillage practices on the carbon footprint of wheat and maize production in the Loess Plateau of China. Journal of Cleaner Production, 2019, 234: 297-305.

贺丽燕, 杜昊辉, 王旭东. 渭北高原典型黑垆土区土壤物理性 状及其对小麦产量的影响[J]. 应用生态学报, 2018, 29(6): 1911-1918.

**论文题目：**不同耕作措施对黄土高原地区冬小麦和春玉米生产碳足迹的影响

**摘要：**适宜的耕作措施可以降低作物生产碳足迹，减缓气候变化。然而，中国黄土高原地区不同耕作措施下冬小麦和春玉米生产碳足迹还缺乏综合性地评估。为了明确该地区耕作措施间和主要粮食作物间的碳足迹差异，我们进行了长期（2007-2016）定位试验，设置了冬小麦和春玉米试验田，并实施6种耕作措施：翻耕（PT）、免耕（NT）、深松（ST）、翻耕/免耕隔年轮耕（PT/NT）、免耕/深松隔年轮耕（NT/ST）和深松/翻耕隔年轮耕（ST/PT）。研究结果表明，PT的碳足迹为正值（488 kg CO2-eq ha-1），表现为碳源；而其他耕作措施（NT, ST, ST/PT, PT/NT和NT/ST）的碳足迹为负值（-628 , -1382, -2328, -3038, -3545 kg CO2-eq ha-1），表现为碳汇。单位功能碳足迹（单位产量碳足迹、单位产值碳足迹、单位成本碳足迹和单位利润碳足迹）的趋势与碳足迹一致，耕作措施间由高到低依次为：NT/ST> PT/NT>ST/PT> ST>NT>PT。冬小麦的碳足迹和单位功能碳足迹均显著高于春玉米。碳足迹和单位功能碳足迹随种植年限的增加呈降低趋势。此外，增加土壤有机碳储量和作物产量有助于降低碳足迹。NT/ST措施下的土壤有机碳储量和作物产量最高，碳足迹和单位功能碳足迹最低，因此，NT/ST耕作措施是黄土高原地区平衡农业可持续生产和良好环境效益的最适宜的耕作措施。

**关键词：**碳足迹；耕作措施；土壤有机碳储量；产量；冬小麦；春玉米

**Title: Effects of different tillage practices on the carbon footprint of wheat and maize production in the Loess Plateau of China**

**Abstract:** Appropriate tillage practices reduce a crop’s carbon footprint (CF) and mitigate climate change. However, little is known about the CF of winter wheat and spring maize production under different tillage practices in the Loess Plateau of China. To quantify the tillage differences and crop type differences in CF, a field experiment was established in 2007 in which the following six tillage practices were evaluated: plow tillage (PT), no-tillage (NT), subsoil tillage (ST), PT/NT rotation, NT/ST rotation and ST/PT rotation. The results showed PT had the positive CF value (488 kg CO2-eq ha-1), indicating a carbon source. However, NT, ST, ST/PT, PT/NT and NT/ST significantly decreased the CF (-628, -1382, -2328, -3038 and -3545 kg CO2-eq ha-1), demonstrating these tillage practices served as carbon sinks. The functional unit-scaled CFs (yield-scaled CF, cost-scaled CF, production value-scaled CF and net income-scaled CF) were similar to the trend of CF, which exhibited the following order: NT/ST>PT/NT>ST/PT>ST>NT>PT. The CF and functional unit-scaled CFs of winter wheat production were significantly higher than those of spring maize production. The CF and functional unit-scaled CFs decreased as planting year increased. In addition, increasing SOC storage and grain yield were benefit for decreasing CF. The results of this study showed NT/ST rotation produced the highest grain yield and SOC storage with the lowest CF and functional unit-scaled CFs and was thus determined to be the best tillage practice for balancing sustainable production with the environment in the Loess Plateau.

**Keywords:** Carbon footprint; Tillage practices; Soil organic carbon storage; Yield; Winter wheat; Spring maize

**4.刘涛博士**

**个人简介**：刘涛，2019级博士生（提前攻博），环境工程专业，导师张增强。研究方向：黑水虻对畜禽粪便的资源化利用。具有较强的责任心，善于与老师、同学们交流，稳重细心，在实验学习过程中认真严谨，并且取得了相应的成果。目前已经有2篇SCI见刊，其中一篇中科院一区，一篇二区，还有一篇文章在大修阶段（中科院二区）。接下来的学习过程中，我会继续努力。日常生活中保持积极向上的生活态度。邮箱：[liutao199549@163.com](mailto:liutao199549@163.com)

**摘要：**畜禽养殖场的增加导致了畜禽粪便的大量产生，不恰当的处理会对环境造成威胁。黑水虻幼虫具有将畜禽粪便转化为优质肥料的潜力。本研究的目的是观察不同畜禽粪便中挥发性有机酸，有机质等的转化，并对最终产物进行评价。按照1.2:7 的比例，将黑水虻幼虫添加到鸡粪、猪粪和牛粪中，作为实验组；以不添加黑水虻幼虫作为对照组，实验进行9天。结果表明，相比于对照组，黑水虻堆肥降低了有机质的20.31–22.18% ，降低了挥发性有机酸积累排放的25.58-80.08%。黑水虻堆肥显著降低了氮的含量，降幅可达6.08-14.37%。黑水虻堆肥显著增加了总磷，总钾和总养分的含量，增幅分别为42.30–64.16%， 45.41–88.17% 和 26.51–33.34%。研究表明，采用BSFL可以提高堆肥产品的质量和堆肥的成熟度。因此，黑水虻可以作为一种高效的生物添加剂，将畜禽粪便转化为稳定的堆肥，特别是在发展中国家，因为使用设备堆肥是昂贵的和难操作的。

**关键词：**黑水虻幼虫；总养分；粪便；堆肥；肥料。

**Title：Performance of black soldier fly larvae (Diptera: Stratiomyidae) for manure composting and production of cleaner compost**

**Abstract：**The increasing number of livestock farms has led to a great deal of manure generation, and its improper treatment results in threats to the environment. Black soldier fly larvae (BSFL) have the potential to effectively convert manure into high-quality fertilizer. The aims of this investigation were to observe the organic matter transformation of different livestock manures and volatile fatty acids (VFAs), and to evaluate the end product quality. Three types of manure [chicken (T1), pig (T2), and cow (T3)] were inoculated with BSFL (1.2:7 ratio on fresh weight basis), three types without BSFL were used as control (T4, T5, and T6), and both were composted for 9 days. The results showed that the BSFL composting reduced the organic matter by 20.31–22.18% and the accumulation of VFAs by 25.58–80.08% as compared to the control. BSFL composting greatly decreased the nitrogen, by 6.08–14.37%. The employment of BSFL significantly increased the total phosphorous (TP), total potassium (TK), and total nutrients by 42.30–64.16%, 45.41–88.17%, and 26.51–33.34%, respectively. This study showed that employing BSFL could improve the quality of the product and the maturity degree of the composting. Therefore, the BSFL could be added as a high-efficiency transformation agent for converting organic manure into stable compost, especially in developing countries, where adopting technical devices for composting is expensive and difficult to manipulate.

**Keywords:** Black Soldier Fly Larvae; Total nutrient; Manure; Compost; Fertilizer.

**5.赵国庆博士**

**个人简介**：赵国庆，中共党员，山东邹平人。2015年9月至今先后于西农攻读硕士与博士学位，目前师从王力研究员，主要从事关中灌区冬小麦土壤水分及其利用效率对活化水灌溉的响应机理研究。曾担任硕士班及博士班班长、院研究生会文体部部长及副主席，硕士研究生期间带领班级获“先进班集体”，个人先后获“优秀研究生”、“优秀研究生干部”、“优秀团干部”，硕士研究生“优秀毕业生”、博士研究生一等学业奖学金、博士研究生国家奖学金等荣誉称号。邮箱：zhaogq007@126.com。

**摘要：**活化水灌溉可以促进作物生长，提高作物产量，进而提高水分利用效率，但其在农业灌溉生产中的影响机制还有待进一步探索。在田间试验的基础上，本研究结合不同灌水量与活化水灌溉类型，研究了不同活化水灌溉制度对我国粮食主产区冬小麦生长参数的影响，探讨了不同活化水灌溉制度对冬小麦产量和水分利用效率的影响。结果表明：与普通地下水灌溉相比，冬小麦对灌溉活化水的吸收增加约12.2%。活化水灌溉处理下冬小麦地上生物量较普通地下水灌溉增加约8.0%。灌溉量为120 mm时冬小麦产量构成要素表现较好，且产量分别较60 mm和180 mm灌溉下的产量高出28.3%和3.2%。在同一灌水量水平下，磁化水和去电子水灌溉的冬小麦籽粒产量分别较普通地下水灌溉提高10.1%和13.9%。磁化水和去电子水灌溉120 mm时，二者**冬小麦**水分利用效率最高，分别为28.0 kg ha-1 mm-1和30.3 kg ha-1 mm-1。相同灌水量下，磁化水和去电子水灌溉的冬小麦水分利用效率分别为22.3 kg ha-1 mm-1和22.1 kg ha-1 mm-1，分别较普通地下水灌溉高出8.8%和7.9%。

**关键词：**磁化水；去电子水；灌溉制度；水分利用效率

**Abstract:** Irrigation activated water can promote crop growth, increase crop yield, and then improve water use efficiency (WUE), but its impact mechanism in agricultural irrigation and production needs to be further explored. Based on field experiments, we analyzed the response of the growth parameters of winter wheat in main grain producing area of China to different irrigation regimes by combining different irrigation amount and types of activated water irrigation, and then discussed the influences of irrigation regimes on winter wheat yield and water use efficiency (WUE). We found that: the absorption of activated water by winter wheat increased by about 12.2%, compared with the pure groundwater irrigation. The aboveground biomass under activated water irrigation was increased by about 8.0% compared with the pure groundwater irrigation. The yield components with the irrigation amount of 120 mm performed better, the grain yield of the treated 120 mm irrigation was 28.3% and 3.2% higher than that of 60 mm and 180 mm, respectively. At the same level of irrigation volume, the grain yield of winter wheat with magnetized and de-electronic water irrigation increased by 10.1% and 13.9% compared with the pure groundwater irrigation. Under different irrigation volumes of magnetized and de-electronic water, the WUE of winter wheat were highest when the amount of irrigation was 120 mm, which were 28.0 kg ha-1 mm-1 and 30.3 kg ha-1 mm-1, respectively. The WUE of magnetized and de-electronic water irrigation under the same irrigation amount were 22.3 kg ha-1 mm-1 and 22.1 kg ha-1 mm-1, respectively, which were 8.8% and 7.9% higher than that of pure groundwater irrigation.

**Keywords:** magnetized water; de-electronic water; irrigation regime; water use efficiency

**6.姬王佳硕士**

**个人简介：**姬王佳，女，陕西渭南人，预备党员，2018级环境科学专业硕士，导师为李志教授。主要从事土壤水文方面的研究。已获得学业一等奖学金，并已在应用生态学报(A类核心)发表一篇文章《陕北黄土区深剖面不同土地利用方式下土壤水氢氧稳定同位素特征》。另外，于2019年7月至10月赴新西兰梅西大学访学并获得结业证书。

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**论文题目：**深厚黄土区硝酸盐滞后效应及其对土地利用变化的响应

**摘要：**过度施用化肥可导致硝态氮(NO3-−N)在土壤中大量累积，对地下水构成严重威胁。在过去几十年中，我国有大量农地已转化为非肥料用地(草地和林地)，目前NO3-−N在厚达100 m的黄土矿床中的遗留效应尚不清楚。我们采集不同土地利用方式(农地、草地、杏树、油松、柠条、沙柳和杨树)下>13 m的深剖面土壤样品，其中，非肥料用地均由农地转化而来。我们测定硝酸盐含量和氮氧稳定同位素组成，以量化前者的累积和来源以及对地下水的潜在威胁。七个NO3-−N剖面均呈抛物线形，峰值深度为2.6-9.2 m。峰值深度与NO3-−N峰值对应，且均介于0-10 m。NO3-−N总累积量为3181-9018 kg N ha-1，其中，非肥料用地的总累积量占农地的35%-73%。硝酸盐来源随深度而变化。根据同位素质量平衡，峰值深度以上，附近和以下的硝酸盐主要来自大气NO3-(25%−34%)、合成氮肥(49%−68%)以及土壤有机氮和有机肥(50%−73%)。土壤中硝酸盐的估计停留时间长达270-620年。因此，硝酸盐滞后效应需得到较大关注，以保护土壤和地下水环境。

**关键词：**黄土矿床；遗留硝酸盐；稳定同位素；硝酸盐源识别；土地利用变化

**Abstract:** The accumulation of nitrate-nitrogen (NO3-−N) in soils from excessive synthetic fertilizer application is a long-term threat to groundwater in regions with thick unsaturated zones. Given the substantial conversions of arable farmlands to non-fertilizer land uses for the restoration of degraded land in the past decades, the legacy effects of NO3-−N in up to 100-m thick loess unsaturated zones in China remain uncertain. We collected soil samples from loess profiles > 13 m deep under arable farmland and grassland, apricot, pine, peashrub, willow, and poplar converted from arable farmland over 15−35 years. We determined their nitrate content and isotopic compositions to quantify the accumulation and sources of the former and its potential threat to groundwater. The seven NO3-−N profiles exhibited a parabolic shape with peak depths at 2.6−9.2 m. Greater peak depths corresponded to greater NO3-−N values, and the peak nitrate level varied from 0−10 m. The total NO3-−N accumulation ranged 3181−9018 kg N ha-1, and the non-fertilizer profiles accounted for 35%−73% of the arable farmland. The nitrate sources varied with depths. According to the isotope mass balance, the nitrate above, near and below the peak depths mainly originated from atmospheric NO3- (25%−34%), synthetic N fertilizer (49%−68%), and soil organic N and manure (50%−73%). The estimated residence time of nitrate in the soils ranged from 270−620 yr. As such, the nitrate legacy effects should be given considerable attention for the protection of the soil and groundwater environment.

**Keywords:** loess deposits–legacy nitrate–stable isotopes–nitrate source identification–land use change

**7.马任甜博士**

**个人简介：**马任甜，女，陕西延安人，西北农林科技大学资源环境学院土壤学专业2017级博士研究生。硕士导师是安韶山研究员，博士导师是赵世伟研究员。研究方向为土壤养分，土壤胶体与界面化学，土壤侵蚀机理等。曾获“国家奖学金”、“优秀研究生”、“优秀毕业生”、“优秀研究生干部”等荣誉称号，并参与中国科学院知识创新项目、国家自然科学基金以及教育部新世纪优秀人才支持计划项目。目前已发表第一作者文章5篇，其中SCI一篇，中文核心4篇。邮箱：[1371105625@qq.com](mailto:1371105625@qq.com)

**论文题目：**植被恢复改变土壤颗粒间相互作用提高团聚体稳定性

**摘要：**植被恢复可以增加土壤有机质含量，提高土壤团聚体稳定性。然而关于土壤有机质(SOM)提高团聚体稳定性方面的内力作用机制及其控制因素尚未得到充分认识。本研究分析了植被恢复过程中SOM含量、土壤表面电化学性质和土壤内力(包括静电斥力、水合斥力和范德华引力)的变化，来评估SOM在增加土壤团聚体稳定性方面起到的作用。结果表明，自然植被恢复后SOM的积累增加了土壤表面电荷数量、比表面积和土壤表面电荷密度，从而增强了土壤颗粒间的静电斥力。另外，SOM的增加使分子水平上Hamaker常数增加，从而增强了土壤颗粒间的范德华引力。因此，土壤颗粒间的净内力，即静电斥力、水合斥力、范德华引力之和，是排斥力，并随着SOM的增加而减小。同时，土壤颗粒间的净压力随着本体溶液中电解质浓度的降低先增加后趋于稳定。土壤团聚体的破碎强度与土壤颗粒间的净压力变化趋势相似。不同演替阶段土壤团聚体稳定性的变化顺序依次为农田<草地<灌木<林地。总体而言，土壤团聚体稳定性的实验结果与土壤内力的理论预测基本一致。因此，我们认为植被恢复过程中有机质的输入增加团聚体稳定性主要是由于土壤颗粒间净排斥压力降低造成的。本研究结果为理解团聚体稳定性与SOM之间的关系提供了新思路，揭示了土壤颗粒表面性质和土壤内力在评价团聚体稳定性中的作用。

**关键词：**表面电位; 静电斥力; 范德华引力; Hamaker常数; 植被恢复

**Abstract:** Vegetation restoration can input amounts of organic matter into soils to improve soil aggregate stability. However, the underlying mechanism of soil organic matter (SOM) in accelerating aggregate stability and its controlling factors are not fully understood. Here, we analyzed changes in SOM content, soil surface electrochemical properties and soil internal forces (including electrostatic, hydration, and van der Waals forces) across a vegetation restoration chronosequence to evaluate how SOM increase the stability of soil aggregate. Our results revealed that the enrichment of SOM after natural revegetation increased the cation exchange capacity, specific surface area, and soil surface charge density, thereby strengthening the electrostatic repulsive pressure between soil particles. On the other hand, the increasing SOM led to the increase in Hamaker constant at the molecular level and thus enhanced the van der Waals attractive force between soil particles. As a result, the net pressure of soil internal forces, i.e., the sum of electrostatic, hydration, and van der Waals forces, was repulsive and decreased with increasing SOM during vegetation restoration. Meanwhile, the net pressure between soil particles increased first and then leveled off with decreasing electrolyte concentration in the bulk solution. The determined soil aggregate breaking strength showed similar trends to that of net pressure between soil particles in electrolyte solution. Soil aggregate stability among different succession stages followed the order of farmland < grassland < shrub < forest. Overall, the experimental results of soil aggregate stability were in excellent agreement with the theoretical predictions of soil internal forces. Consequently, we conclude that organic input during vegetation restoration increased aggregate stability mainly due to the decrease of the repulsive net pressure of soil internal forces. These findings provide a new way to understand the relationship between aggregate stability and SOM and reveal the utility of soil particle surface properties and internal forces in evaluating aggregate stability.  
**Keywords:** Surface potential; electrostatic force; van der Waals forces; Hamaker constant; natural revegetation

**8.李莎莎博士**

**个人简介：**李莎莎，西北农林科技大学资源与环境学院植物营养学2019级博士生。2019年7月毕业于陕西师范大学生物化学与分子生物学专业，获理学硕士学位。目前分别在SCI一区期刊《Journal of Agricultural and Food Chemistry》和国内核心期刊《农业生物技术学报》发表一篇文章。研究生阶段曾获得国家奖学金、积学二等奖学金两次、陕西师范大学优秀研究生和陕西师范大学优秀毕业生等荣誉称号。目前主要从事农作物抗逆生理及分子机制方面的研究。邮箱：[409484476@qq.com](mailto:409484476@qq.com)

**论文题目：**丹参转录因子SmMYB111对酚酸类物质合成调控的研究

**摘要：**酚酸是丹参的主要生物活性成分但含量较低的次生代谢产物。成髓细胞瘤(MYB)、碱性螺旋-环-螺旋(bHLH)和色氨酸-天冬氨酸重复序列蛋白(WD40) 转录因子通常单独或形成三元复合体来调节酚酸类物质的合成。然而，目前只有少数文献对MYB、bHLH转录因子参与丹酚酸B（Sal B）的生物合成进行了报道，但关于丹参中与WD40蛋白(SmTTG1)互作的MYB转录因子还未见报道。在丹参cDNA文库中，通过酵母双杂交(Y2H)筛选与SmTTG1互作的蛋白，发现一个新的R2R3-MYB转录因子SmMYB111。过表达和减少SmMYB111表达的丹参转基因植物中Sal B的含量同样增加和减少。通过Y2H和双分子荧光互补实验表明SmMYB111、SmTTG1和酚酸途径的正调节因子SmbHLH51互作。我们的结果验证了SmMYB111在丹参中调控酚酸生物合成中的作用。此外，还首次确定可能参与调控Sal B生物合成的潜在的三元复合体SmTTG1−SmMYB111−SmbHLH51。

**关键词：**丹参，转录因子，酚酸类成分，SmMYB111，转录复合体

**Abstract:** Phenolic acids are the main bioactive components but low-content secondary metabolites in Salvia miltiorrhiza Bunge. Transcription factors that include myeloblastosis (MYB), basic helix−loop−helix (bHLH), and tryptophan−aspartic acid repeat protein (WD40 protein) often used alone or form a ternary complex to regulate the phenolic acid synthesis. However, only a few MYB and bHLH members involved in the biosynthesis of salvianolic acid B (Sal B) have been reported, and little is known about Sal B pathway regulation by the MYB transcription factor interacting with WD40 protein (SmTTG1) in Salvia miltiorrhiza. Interaction partners of the SmTTG1 protein were screened by yeast two-hybrid (Y2H) assays with the cDNA library of S. miltiorrhiza. A new R2R3-MYB transcription factor, SmMYB111, was found through this screening. Transgenic plants overexpressing or showing reduced expression of SmMYB111 upregulated or deregulated, respectively, the yields of Sal B. Both Y2H and bimolecular fluorescent complementation experiments demonstrated that SmMYB111 interacts with SmTTG1 and SmbHLH51, a positive regulator of the phenolic acid pathway. Our data verified the function of SmMYB111 in regulating phenolic acid biosynthesis in S. miltiorrhiza. Furthermore, ours is the first report of the potential ternary transcription complex SmTTG1−SmMYB111−SmbHLH51, which is involved in the production of Sal B in that species.

**Keywords:** Salvia miltiorrhiza, transcription factor, Phenolic acid component, SmMYB111, transcription complex

**9.祝可成博士**

**个人简介：**祝可成，2018级环境科学博士研究生，指导老师为祝凌燕和贾汉忠教授，研究方向主要为微塑料光老化过程中环境持久性自由的形成及其潜在毒性。研究生期间以第一作者已发表SCI论文3篇（包括中科院一区论文（IF>6）2篇、环境权威期刊Environ. Sci. Technol.（自然指数收录期刊）论文1篇），授权发明专利1项。先后获得东华大学优秀毕业论文奖、第十届全国环境化学大会优秀展报奖以及2018-2019学年优秀研究生干部。

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**论文题目：**微塑料光老化过程中环境持久性自由基的形成

**摘要：**在环境条件下，微塑料（MPs）在老化过程中被认为是惰性的。在本研究中，四种原始聚苯乙烯（PS）、酚醛树脂（PF）、聚乙烯（PE）、聚氯乙烯（PVC）微塑料被暴露在模拟太阳光下进行老化实验。令人惊讶的是，通过电子顺磁共振光谱法（EPR）在光老化后的PS和PF上检测到一种新兴的污染物—环境持久性自由基（EPFRs），而在老化的PE和PVC上未被检测到。PS和PF在光老化过程中产生的EPFRs的特征g-因子分别为2.0044-2.0049和2.0043-2.0044。停止光照后，PS和PF上产生的EPFRs在初始阶段快速减少，随后缓慢降低。通过衰减全反射-傅里叶变换红外光谱（ATR-FTIR）、X射线光电子光谱（XPS）、核磁共振（NMR）和凝胶渗透色谱（GPC）分析表明，MPs在光老化过程中可能经历了化学链断裂、O2/H2O参与的氧化反应以及EPFRs的形成。伴随着EPFRs的形成，如O2•−和•OH等活性氧（ROS）也被检测到。我们的研究结果为评价MPs对生物体和生态系统的潜在危害提供了一个新的视角。

**关键词：**微塑料；光老化；环境持久性自由；活性氧

**ABSTRACT:** Microplastics (MPs) are presumed to be inert during aging under ambient conditions. In this study, four types of virgin MPs, including polystyrene (PS), phenol-formaldehyde resin (PF), polyethylene (PE), and polyvinyl chloride (PVC), were aged under simulated solar light irradiation. Surprisingly, several environmentally persistent free radicals (EPFRs), which are considered to be a type of emerging contaminants, were detected on the irradiated PS and PF, rather than PE and PVC, by electron paramagnetic resonance (EPR) spectroscopy. Depending on the photo-aging duration time, the characteristic g-factors of the EPFRs produced on PS and PF were 2.0044-2.0049 and 2.0043-2.0044, respectively. The generated EPFRs on PS and PF decayed rapidly at the initial stage, and then slowly disappeared with the elapsed aging time. Analyses by attenuated total reflectance-fourier transform infrared spectroscopy (ATR-FTIR), X-ray photoelectron spectroscopy (XPS), nuclear magnetic resonance (NMR) and gel permeation chromatography (GPC) suggested that the MPs might experience chemical chain scission, O2/H2O addition, and EPFR formation under the light irradiation. Accompanying with the formation of EPFRs, reactive oxygen species, such as O2•− and •OH, were also observed. The findings provide a novel insight to evaluate the potential hazards of MPs to organisms and ecosystem.

**10.赵松博士**

**个人简介：**赵松，女，新疆和硕县人，中国共产党党员，18级博士。本科毕业于新疆师范大学化学专业；硕士毕业于新疆大学有机化学专业；2015年7月-2018年3月就职于中国科学院新疆理化技术研究所。2018年9月考入西北农林科技大学资源环境学院攻读土壤学博士学位。2012-2019年期间以第一作者发表SCI文章5篇（化学类论文1篇，环境类论文4篇，影响因子大于7.5论文2篇）。博士研究生期间荣获国家奖学金及学业一等奖学金。

**论文题目：**苯并[a]芘与Cu(II)-蒙脱土的相互作用:环境持久性自由基和活性氧的产生及毒性

**摘要：**环境持久性自由基作为一种新型污染物逐渐成为研究热点。我们主要研究苯并[a]芘 (B[a]P)与铜(II)-蒙脱石的相互作用，以研究环境持久自由基（EPFRs）在黑暗和可见光照射条件下的形成，演变和潜在毒性。通过气相色谱-质谱（GC-MS）技术监测B[a]P和粘土矿物上产生的转化产物的降解。在黑暗条件下B[a]P的转化过程中观察到羟基-B[a]P和B[a]P-二酮。B[a]P-3,6-二酮和B[a]P-6,12-二酮是可见光照射下的主要产物。B[a]P转化伴随着EPFR的形成，其通过电子顺磁共振（EPR）光谱法定量。随着反应时间的增加，产生的EPFR的浓度最初增加，然后逐渐降低至不可检测的水平。EPR光谱的反卷积结果揭示了三种类型的有机基团（以碳为中心的自由基，以氧为中心的自由基和具有共轭氧的碳中心自由基）的形成，它们也共存。相应地，可见光照射促进了这些EPFR的形成和衰变。产生的B[a]P型EPFRs诱导产生活性氧（ROS），如超氧化物（O2-●）和氢氧根（●OH），这对生物体的细胞和组织造成氧化应激效应。通过人胃上皮GES-1细胞的存活性评估降解产物的毒性。毒性最初增加然后随着反应时间的流逝而减少，这与EPFRs浓度的变化相关。目前的工作提供了直接的证据，即PAHs与受金属污染的粘土相互作用中EPFR的形成可能对人类健康产生负面影响。

**关键词：**环境持久性自由基；苯并[a]芘；蒙脱土；毒性

**Abstract:** Environmental persistent free radical (EPFRs), as a new pollutant, has become a research hotspot. We mainly investigated the interaction of benzo[a]pyrene (B[a]P) with Cu(II)-montmorillonite to investigate the formation, evolution and potential toxicity of environmentally persistent free radicals (EPFRs) under dark and visible light irradiation conditions. Degradation of B[a]P and the generated transformative products on clay mineral are monitored by gas chromatography–mass spectrometry (GC–MS) technique. Hydroxyl-B[a]P and B[a] P-diones are observed during the transformation of B[a]P under dark condition. B[a]P-3,6-dione and B[a]P-6,12-dione are the main products under visible light irradiation. B[a]P transformation is accompanied by the formation of EPFRs, which are quantified by electron paramagnetic resonance (EPR) spectroscopy. With increasing reaction time, the concentrations of the produced EPFRs are initially increased and then gradually decrease to an undetectable level. The deconvolution results of EPR spectra reveal formation of three types of organic radicals (carbon-centered radicals, oxygen-centered radicals, and carbon-centered radicals with a conjugated oxygen), which also co-exist. Correspondingly, visible-light irradiation promotes the formation and the decay of these EPFRs. The produced B[a]P-type EPFRs induce the generation of reactive oxygen species (ROS), such as superoxide (O2-●) and hydroxide radicals (●OH), which may cause oxidative stress to cells and tissues of organisms. The toxicity of degradation products is evaluated by the livability of human gastric epithelial GES-1cells. The toxicity is initially increased and then decreases with the elapsed reaction time, which correlates with the evolution of EPFRs concentrations. The present work provides direct evidence that the formation of EPFRs in interaction of PAHs with metal-contaminated clays may result in negative effects to human health.

**Keywords:** Environmentally persistent free radicals, Benzo[a]pyrene, Montmorillonite, Soil, Toxicity

**11.李冰冰博士**

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1. 李冰冰，王云强，李志. 2019. HYDRUS-1D模型模拟渭北旱塬深剖面土壤水分的适用性. 应用生态学报，30(2)：398-404.

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**论文题目：**基于HYDRUS-1D评估黄土塬区土壤水量平衡对土地利用变化的响应

**摘要：**土地利用变化对土壤水量平衡的影响对于有效的水资源管理和土地利用规划具有重要意义。我国黄土高原黄土沉积厚达350米，形成了大型的土壤储水库，近几十年来，这些水库中的水已经被消耗殆尽。尽管土地利用变化对土壤蓄水的影响在该地区已有研究，然而，由于直接测量土壤水量平衡的组成成分（如蒸散发和深层排水）的困难，土地利用变化对这些成分的影响仅做了有限的研究。2011−2013年在农地和从农地转换为的10、20和30年苹果园下，用连续监测的10米剖面土壤水分资料，对HYDRUS-1D模型进行校准和验证，然后基于1960−2013气候数据评估长期土地利用变化对土壤水量平衡的不同组组分的影响。研究结果表明：与农地和幼龄苹果园（林龄<10年）相比，成熟苹果园（林龄>20年）的实测土壤蓄水量显著降低。农地下模拟深层排水为12.1毫米每年，占年均降水量的2%，但在成熟苹果园下，这一数值降低到接近于零。模拟年均实际蒸散发为565.8毫米，占农地年均降水量的98%，但成熟苹果园蒸散发增大。土壤蓄水量和地下水补给量的减少，威胁着黄土高原水资源和农业的可持续发展。因此，经济发展与农业生态系统和环境可持续性之间的平衡是未来土地利用规划的重要考虑因素。

**关键词：**土壤水量平衡；土地利用变化；地下水补给；深厚黄土堆积；HYDRUS-1D模型

**Abstract:** Land use change (LUC) impacts on the soil water balance is important for effective water resources management and land use planning. The Loess Plateau of China has loess deposits up to 350-m depth and constitutes large reservoirs of soil water storage. In recent decades, areas within these reservoirs have been depleted of their water storage. LUC impacts on soil water storage have been previously investigated in this region; however, LUC impacts on other components of soil water balance such as evapotranspiration and deep drainage have received limited study because of difficulties in direct measurement of these components. Using continuously monitored 10-m soil water profiles under farmland and apple orchards converted from farmlands for 10, 20, and 30 years for the period 2011−2013, the HYDRUS-1D model was calibrated and then employed to evaluate long-term LUC impacts on different components of the soil water balance in a typical loess tableland based on climate data for the period 1960−2013. Compared with farmlands and young apple orchards (stand age<10 years), the measured soil water storage under mature apple orchards (stand age>20 years) was significantly decreased over time. The simulated deep drainage was 12.1 mm year−1 under farmland and accounted for 2% of the annual average precipitation, but this value was reduced to near zero under mature apple orchards. The simulated average annual actual evapotranspiration was 565.8 mm and represented 98% of the average annual precipitation under farmlands, but the evapotranspiration was increased under mature apple orchards. The LUC-induced decrease in soil water storage and groundwater recharge threatens the sustainability of water resources and agriculture on the Loess Plateau. The balance between economic development and agriculture ecosystems and environmental sustainability are, therefore, important considerations in future land use planning.

**Keywords:** Soil water balance; land use change; groundwater recharge; deep loess deposits; HYDRUS-1D model

**12.王春丽硕士**

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**论文题目：**有机质去除对黄土纳米颗粒悬浮液稳定性的影响

摘要：土壤纳米颗粒是有机无机复合体，研究有机质对土壤纳米颗粒体系稳定性的影响具有重要意义。以塿土和褐土纳米颗粒以及去除有机质塿土和去除有机质褐土纳米颗粒为研究对象，分别测定颗粒的粒径分布、zeta电位、临界聚沉浓度（Critical coagulation concentration, CCC）等指标，利用德查金-朗道-维韦-奥弗比克（Derjauin-Landau-Verwey-Overbeek, DLVO）理论计算颗粒的哈默克（Hamaker）常数和相互作用能。结果表明：塿土和褐土纳米颗粒的平均直径分别为94.00 nm和88.20 nm，去有机质黄土纳米颗粒的平均直径则略高于100 nm；相较于黄土纳米颗粒，去有机质黄土纳米颗粒的zeta电位绝对值降低，颗粒间静电排斥势能降低；DLVO模型拟合得到塿土和褐土纳米颗粒在真空中的哈默克常数分别为6.86 × 10−20 J和9.73 × 10−20 J，去有机质处理后相应数值为3.14 × 10−20 J和3.40 × 10−20 J，后者范德华引力势能降低；去有机质黄土纳米颗粒间总势能高于黄土纳米颗粒，其CCC更大，稳定分散能力更强。土壤有机质含量越高，有机无机复合程度越高，颗粒越趋向于凝聚，这可能是有机质增强团聚体稳定性的原因之一。

**关键词**  临界聚沉浓度；zeta电位；哈默克常数；有机无机复合作用

**Abstract**  【Objective】 Soil nanoparticles are organic-mineral complexes. Aggregation and/or dispersion of soil nanoparticles affect transport of adsorbed nutrients and pollutants, which may lead to soil fertility degradation, agricultural non-point source pollution, water body eutrophication and contamination. Therefore, it is of great practical significance to study stability of the suspension of natural soil nanoparticles. Organic matter is one of the main cementing materials of loess-derived soils and also an important factor affecting soil nanoparticle aggregation. However, so far little attention has been paid to effect of organic-mineral complexes on stability of soil nanoparticles, and let alone its mechanism. 【Method】 In this study soil nanoparticles were extracted, separately, from soil samples of Lou soil and cinnamon soil before and after soil organic matter was removed with the aid of the ultrasonic dispersion method and the Stokes’ law based high-speed centrifugation method for analysis of particle size distribution, zeta potential, critical coagulation concentration (CCC) in NaCl and CaCl2 solutions and characterized with the dynamic light scattering technique. Furthermore, Hamaker constants of and interaction energies between the soil nanoparticles were calcuated in line with the DLVO (Derjauin-Landau-Verwey-Overbeek) theory, mechanism of organic matter removal affecting stability of soil nanoparticle suspensions explored and role of organic-mineral complexation in stabilizing soil aggregates explained. 【Result】 Results show that the Lou and cinnamon soil nanoparticles were 94.00 nm and 88.20 nm, respectively, in average diameter and the OMR (organic matter removed) loess nanoparticles slightly higher than 100 nm; the obtained loess nanoparticles were all of the polydisperse system and quite approximate to each other in ploydispersity. The nanoparticles in the all the four types of loess soil samples carried negative charge on the surface and their zeta potential increased with rising pH of the solution in absolute value due to deprotonation of the functional groups on the surface of the organic matter. As the soils varied in clay mineral property, the nanoparticles in the cinnamon soil varied more sharply in surface zeta potential than those of the Lou soil; the cinnamon soil contained more variably-charged kaolinite, while the Lou soil contained more permanently-charged illite. The functional groups on the surface of organic matter, like alcoholic hydroxyl, phenolic hydroxyl and carboxyl, are the main sources of soil negative charges. Compared with the nanoparticles in the Lou and cinnamon soils, those in the OMR Lou and cinnamon were lower in absolute value of the zeta potential as they were lower in organic organic matter. The nanoparticles in the Lou and cinamon soils were 1.70 mmol•L−1 and 1.51 mmol•L−1, respectively, in CCC while those in the OMR Lou and cinnamon soils were 10.58 mmol•L−1 and 11.69 mmol•L−1; Obviously, removal of organic matter enhanced stability of the nanoparticle suspension. Based on DLVO-based simulation, the nanoparticles in the Lou and cinnamon soils in vacuum were 6.86 × 10−20 J and 9.73 × 10−20 J, in Hamaker constant and those in the OMR Lou and cinnamon soils were only 3.14 × 10−20 J and 3.40 × 10−20 J. Apparently, the Hamaker constants of the latters were lower than the formers and so were their van der Waals attractive potential energies. Lower absolute values of the zeta potentials of the nanoparticles in the OMR loess soils resulted in reduced electrostatic repulsive potential energies. Therefore, the removal of organic matter reduced both the van der Waals attractive potential energies and electrostatic repulsive potential energies of the nanoparticles in the loess soils. But the decrements in van der Waals attractive potential energy were higher in magnitue than those in electrostatic repulsive potential energy. Further calculations demonstrate that the nanoparticles in the OMR loess soils were higher in total potential energy than those in the Lou and cinnamon soils, which resulted in higher CCCs and higher dispersion stability of the suspensions. 【Conclusion】 The presence of organic matter affects stability of the nanoparticles in loess soils through adjusting both attractive and repulsive potential energies. The complexation of organic-mineral alters soil nanoparticle composition, which in turn determined their Hamaker constant. Removal of organic matter reduces Hamaker constants of the nanoparticles in loess, leading to low attractive potential energy between nanoparticles in OMR Lou and cinnamon soil. Therefore, it is concluded that organic-mineral complexation may enhance stability of soil aggregates through increasing Hamaker constant.

**Key words**  Critical coagulation concentration; Zeta potential; Hamaker constant; Organic-mineral complexation

**13.惠晓丽博士**

**个人简介：**惠晓丽，植物营养学博士研究生。研究领域：目前主要从事养分管理与作物品质研究，内容涉及小麦的养分吸收转移利用与产量品质形成、水肥管理与农作物矿质营养调控等方面的研究工作。近几年利用同步辐射技术分析了粮食作物微量元素的空间分布和生物有效性，基于“土壤—植物—人体”体系合理有效地提出集约化农田养分管理与作物营养强化的综合管理措施，实现农业绿色可持续发展。相关研究成果已在农学领域TOP期刊Plant and Soil和 Field Crops Research等上发表。

**论文题目：**石灰性缺锌土壤小麦产量和锌营养的土壤关键有效磷水平

**摘要：**【目的】磷肥施用降低谷类作物籽粒锌含量已引起人们的广泛关注。生产中由于对磷肥施用量与土壤有效磷关系，及有效磷与有效锌、相关土壤因子、作物锌吸收利用认识的不足，致使实现高产和籽粒锌含量仍存在问题。【方法】本研究利用2004年开始的冬小麦磷用量（0，50，100，150和200 kg P2O5 ha−1）长期定位试验，分析了2013-2016年三个生长季的土壤和小麦样品。【结果】随着土壤有效磷含量的增加，小麦产量和籽粒锌含量分别以线性加平台的方式增加和降低。土壤有效磷为10.2±2.5和14.2±1.8 mg kg−1时，产量和籽粒锌含量分别达到平均的平台6009±155 kg ha−1和22.4±0.9 mg kg−1。磷肥的施用对小麦花后地上部锌吸收无影响，但土壤有效磷低于11.6 mg kg−1时，营养器官向籽粒锌的再转移和锌收获指数增加。在有效磷低的土壤，磷肥施用对有效锌和根系菌根侵染也无影响。因此，低有效磷的土壤，施用磷肥降低的小麦籽粒锌含量主要是由于产量引起的稀释效，不是土壤有效锌和根系菌根侵染的变化。在当前的试验条件下，土壤有效磷必须低于0.7±0.4 mg kg−1才可以实现目标籽粒锌水平40 mg kg−1，此时产量将只有4127±252 kg ha−1。

**关键字：**土壤有效磷；土壤有效锌；菌根侵染率；籽粒锌含量；锌吸收转移

**Title:** Critical concentration of available soil phosphorus for grain yield and zinc nutrition of winter wheat in a zinc-deficient calcareous soil

**Abstract**

Background and aims The decrease in cereal grain zinc (Zn) caused by phosphorus (P) application has attracted wide attention. However, optimizing P fertilization for both satisfactory grain yield and grain Zn concentration is still a problem due to a poor understanding of the relationship between P application rates and available soil P, and that of available soil P and soil Zn availability, relevant soil factors, and plant Zn uptake and utilization.

Methods A location-fixed field experiment was initiated in 2004 with winter wheat (Triticum aestivum L.) grown at five P rates of 0, 50, 100, 150, and 200 kg P2O5 ha−1, and soil and plant samples were collected during the three growing seasons of 2013–2016.

Results Winter wheat grain yield increased, and the grain Zn concentration decreased with increasing available soil P in a linear-plus-plateau manner. The grain yield plateau, averaging 6009±155 kg ha−1, was reached at an available soil P concentration of 10.2±2.5 mg kg−1, and the grain Zn plateau, averaging 22.4±0.9 mg kg−1, was reached at an available soil P of 14.2±1.8 mg kg−1. Shoot Zn uptake after flowering was not affected, while Zn remobilization from vegetative parts to grains and the Zn harvest index increased with P application at available soil P levels below 11.6 mg kg−1. The available soil Zn increased, and root mycorrhizal colonization was unaffected at lower available soil P levels.

Conclusions The decrease in wheat grain Zn concentration with increasing P application at lower available soil P levels was primarily explained by yield dilution effects, not the changes in available soil Zn and root mycorrhizal colonization. Under

the experimental conditions, the available soil P would have to be as low as 0.7±0.4 mg kg−1 to achieve the target grain Zn concentration of 40 mg kg−1, and at this level, the grain yield would only be 4127±252 kg ha−1.

**Keywords** Available soil P; Available soil Zn; Mycorrhizal colonization; Grain Zn concentration; Zn uptake and remobilization

**14.赵杰博士**

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**论文题目：**昼夜增温对全球植被绿度影响程度的变化特征

**摘要：**过去50年的气温数据表明，全球夜间增温速率约为白天的1.4倍。由于大部分地表植物的光合作用在白天进行，然而植物呼吸作用贯穿全天。因此，这种不均衡的变暖速率会影响植被的碳吸收和碳消耗，对植被绿度变化造成重要影响。尽管众多的研究讨论了植被活动对不对称昼夜增温的响应，但是其中大多数研究属于静态评估，对植物绿度与昼夜增温的关系随时间变化的动态特征关注不够。鉴于此，本研究基于 1982-2015 年归一化植被指数( NDVI) 数据集、植被类型和气象数据，采用滑动偏相关分析、线性趋势分析和GIS空间分析方法，揭示了全球植被绿度对昼夜气温响应的变化特征。结果表明：(1) 从全球尺度来看，植被绿度与夜间增温的相关性呈现为减弱态势；(2) 不同纬度区间植被绿度与昼夜温度相关性的变化趋势差异明显；全球中纬度和北半球高纬度地区植被绿度和白天气温的相关性呈现为减弱趋势，而植被绿度与夜间气温的相关性呈现为减弱趋势的地区主要位于低纬度地区；(3) 不同植被类型植被绿度与昼夜增温相关性的变化趋势差异明显。本研究旨在探讨昼夜增温对全球植被生态系统的影响，对于揭示全球气候变化背景下昼夜不对称增温对全球陆地植被生态系统的影响以及厘清植被生态系统对全球变暖的适应性具有重要意义。同时可以为了解全球碳循环长期动态及其研究提供理论基础，而且对于增强适应和减缓气候变化的能力也具有重要的指导作用。

**关键词：**响应变化，白天增温，夜间增温，植被活动，NDVI

**Title:**Varying responses of vegetation greenness to day- and night-time warming across the globe

**Abstract:** The distribution of global warming has been varying both diurnally and seasonally. Little is known about the spatiotemporal variations in the relationships between vegetation greenness and day- and night-time warming during the last decades. We investigated the global inter- and intra-annual responses of vegetation greenness to the diurnal asymmetric warming during the period of 1982–2015, using the normalized different vegetation index (NDVI, a robust proxy for vegetation greenness) obtained from the NOAA/AVHRR NDVI GIMMS3g dataset，the MODIS Terra+Aqua Combined Land Cover product and the monthly average daily maximum (Tmax) and minimum temperatures (Tmin) obtained from the gridded Climate Research Unit, University of East Anglia. Several findings were obtained: (1) The strength of the relationship between vegetation greenness and the diurnal temperature varied on inter-annual, indicating generally weakening warming effects on the vegetation activity across the globe. (2) The decline in the vegetation response to Tmax occurred mainly in the mid-latitudes of the world and in the high latitudes of the northern hemisphere, whereas the decline in the vegetation response to Tmin primarily concentrated in the low-latitudes. The percentage of areas with a signiﬁcantly negative trend in the partial correlation coefficient between vegetation greenness and diurnal temperature was greater than that of areas showing a signiﬁcantly positive trend. (3) The trends in the correlation between different types of vegetation and diurnal warming showed a complex pattern. These findings are expected to have important implications for studying diurnal asymmetry warming and its effect on terrestrial ecosystems. The purpose of this study is to explore the effects of day and night temperature increasing on the global vegetation ecosystem. It is of great significance to reveal the influence of the asymmetric temperature increasing on the global terrestrial vegetation ecosystem and clarify the adaptability of vegetation ecosystem to global warming in the context of global climate change. Moreover, it can provide a theoretical basis in order to understand the long-term dynamics of global carbon cycle. It also plays an important role in enhancing the ability to adapt and mitigate climate change.

**Keywords:** varying response, daytime warming, nighttime warming, vegetation activity, NDVI

**15.王彤彤博士**

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**论文题目：**Al改性柠条生物炭对P的吸附特性及其机制

**摘要：**柠条作为“三北防护林”广泛种植的先锋树种，因其管理不善和需每年平茬，其利用率还不到40%；为了防治环境污染，我国立法禁止焚烧各类秸秆，将农林废弃物炭化是资源变废为宝、高效综合利用的研究热点。在650℃、3h条件下，采用限氧升温法制备生物炭，通过超声修饰法用Al改性柠条生物炭，进行批量吸附P实验。利用4种等温吸附模型(Langmuir、Freundlich模型、Temkim、D-R模型)和4种吸附动力学模型(准一级动力学、准二级动力学、Elovich模型、颗粒内扩散模型)以及pH值、添加量影响试验，探讨Al改性生物炭对P的吸附特性。同时，使用FTIR红外、元素分析、SEM、XRD和比表面积及孔径分析等技术表征了生物炭的理化性质，揭示了Al改性生物炭对P的吸附机理，并对比了多种改性生物炭对P的吸附效果。结果表明：柠条生物炭(NB)对P的吸附量很低，Al改性柠条生物炭(Al-NB)最佳改性比例为0.2:1，对P的吸附量是NB的8.35倍。Langmuir模型能够很好的描述Al-NB对P的等温吸附过程；Al-NB对P的吸附动力学符合准一级动力学模型，说明其吸附通过边界扩散完成的单层吸附。Al-NB对P的理论最大吸附量为19.97mg/g，平衡时间为24h。随着添加量的增大，Al-NB对P的吸附量不断减小去除率逐渐增加，2.5g/L为最佳添加量；最适pH为4～10，当pH=7时，达到最大；吸附P后，溶液的pH值向中性范围倾靠，有一定缓冲作用。吸附机理包括：静电吸附作用，配体交换(羟基)，P与阴离子(NO3-)交换，颗粒内表面络合作用等。以期为水体富营养化治理提供科学依据。

**关键词：**生物炭；柠条；Al改性；吸附特性；磷；机制

**Abstract**：In order to utilize the waste biomass resources efficiently, *Caragana Korshinskii* was selected as raw material to produce biochar at 650℃ for 3h by oxygen-limited pyrolysis, using Al modified Caragana biochar by direct modification method, and the adsorptions of phosphate in aqueous solutions were evaluated. The effects of initial phosphate concentration and contact time in batch sorption experiments were investigated by the four kinds of isothermal adsorption model (Langmuir, Freundlich, Temkim, D-R model) and the four kinds of adsorption kinetics model (Pseudo first-order, Pseudo second-order, Elovich model, Intraparticle diffusion model), respectively. In addition, the adsorption properties of Al modified biochar on phosphate were investigated by the effects of isothermal adsorption, adsorption kinetics, pH and addition concentration, respectively. The influencing factors of adsorption characteristics about Caraganabiochar (NB) and Al modification Caragana biochar (Al-NB) were discussed by characterized for their elemental composition, functional groups, surface area, surface morphology and scanning electron microscope. The results showed that the adsorption capacity of NB to phosphate was very low; however, when the optimum modification ratio of Al-NB was 0.2:1, the adsorption capacity reached the largest, which is 8.35 times higher than that of the unmodified NB. The adsorption kinetics was best fitted by the pseudo-first order model, while the isothermal adsorption was best described by Langmuir isotherms, indicating that the beneficial adsorption process was monolayer via the boundary diffusion. The adsorption equilibrium was reached in 24h, and the maximum adsorption capacity of reached 19.97mg/g. With the increase of Al-NB addition amount, the adsorption capacity of phosphate decreased and the removal rate gradually increasing. The best addition amount was 2.5g/L. The optimum pH was 4~10, and the adsorption capacity reached the largest when pH=7. After adsorption phosphate, the pH of the solution was leaned to the neutral range and had a certain buffer effect. The mechanism of phosphate adsorbed by Al-NB mainly includes: electrostatic attraction, ligand exchange (hydroxyl), anion exchange (NO3-), as well as the inner-sphere surface complex formation process. It was demonstrated that Al-NB could be considered as a promising material to immobilize phosphate in contaminated Eutrophication water.

**Key words**：biochar；*Caragana Korshinskii*；Al modification；adsorption characteristics；phosphate；mechanism

**16.韩佳乐博士**

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[1]韩佳乐,郝珊,刘振杰,张曼,张阿凤.黄土高原地区两种土地利用方式CO2和N2O排放特征[J].环境科学,2019,40(11):5164-5172.

[2]李秀,韩佳乐,吴文雪,张建国,赵英,冯浩.秸秆还田方式对关中盆地土壤微生物量碳氮和冬小麦产量的影响[J].水土保持学报,2018,32(04):170-176.

**论文题目：**黄土高原地区两种土地利用方式CO2和N2O排放特征

**摘要：**为探究黄土高原地区两种不同土地利用方式下二氧化碳（CO2）和氧化亚氮（N2O）的排放特征，在长武黄土高原农业生态试验站，分别以15a树龄的果园和麦田为研究对象，采用静态暗箱-气相色谱法对土壤CO2和N2O的排放进行了周年（2017年7月～2018年7月）田间原位观测。试验共设置果园施肥（AF）、果园对照（ACK）、小麦施肥（WF）和小麦对照（WCK）这4个处理。结果表明，土壤CO2和N2O 排放随季节变化明显，降雨和施肥后均出现明显排放峰。AF处理的CO2和N2O累积排放量比WF处理高7.14 %和 461.4%。但ACK的CO2累积排放量比WCK低10.41 %，而N2O的累计排放量比WCK高109.5 %。ACK的CO2累积排放量较WCK低，ACK的N2O累积排放量比WCK高。果园N2O的排放通量与表层土壤温度、水分显著正相关（P< 0.01），果园和麦田的CO2排放通量均与表层土壤温度显著正相关（P< 0.05），而与表层土壤水分相关性不显著。因此，田间管理和环境因素综合影响土壤CO2和N2O排放，施肥量和土壤水热是造成两种土地利用方式CO2和N2O的排放特征和温室效应差异的主要因素。

**关键词：**土地利用方式；二氧化碳；氧化亚氮；土壤养分；综合温室效应

**Abstract：**To evaluated the emission characteristics of carbon dioxide (CO2) and nitrous oxide (N2O) in the Loess Plateau, a field in situ study was conducted from July 2017 to July 2018 under two land-use types (15years old apple orchard and wheat field) using static chamber-gas chromatographic techniques. Four treatments were carried out in this experiment as follow: apple orchard with fertilization (AF), orchard without fertilization (ACK), wheat field with fertilization (WF) and wheat field without fertilization (WCK). The results showed that CO2 and N2O emissions varied significantly with the season, and the emission peaks appeared after rainfall and fertilization. The cumulative amount of CO2 and N2O emissions from AF treatment were 7.14% and 461.4% higher than that of WF treatment, respectively. However, the cumulative amount of CO2 emissions under ACK treatmentwaslower10.41% than that of WCK treatment, whereas the cumulative amount of N2O emissions washigher109.5% than that of WCK treatment. The N2O emission flux from orchard was significantly positively correlated with soil temperature and moisture (P< 0.01). The CO2 emission fluxes from orchard and wheat field were significantly positive correlated with topsoil temperature (P< 0.05), but were not correlated with topsoil moisture. Thus, the combination of field management and environmental factors affected soil CO2 and N2O emissions. The fertilizer regime and soil hydrothermal conditions were the main factors to influence the characteristics of CO2 and N2O emission under different land-use types.

**Keywords：**land use patterns; carbon dioxide; nitrous oxide; soil nutrient; global warming potential

**17.李惠通博士**

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**汇报题目：**不同栽培方式与施氮量下雨养冬小麦氨挥发及其与土壤不稳定氮库的关系

**摘要：**氨挥发是人类活动深入影响自然环境的一个缩影，是氮循环的重要组成部分。土壤不稳定氮素组分与土壤质量和肥力密切相关，加上当前农业对高产稳产的需求，在植物-土壤生态系统中受到广泛关注。目前少有报道它们之间的关系，特别是不同的耕作管理方式和尿素施用量对小麦全生育过程的影响。本研究旨在：（1）阐明黄土高原常见的耕作方式和施氮量对氨挥发和土壤不稳定态氮的影响；（2）阐明田间条件下土壤不稳定态氮和NH3挥发的相互关系。于2017年和2018年实施田间试验，有9个处理：三个耕作系统（常规耕作（CT）、薄膜覆盖（FM）、秸秆还田（SM））和3氮肥梯度（对照（N0），144 kgN/ha（N144），180 kgN/ha（N180））的完全随机裂区设计。结果表明，施氮显著增加了施肥后40天的NH3通量（p<0.1）。SM和FM分别显著增加和减少了NH3挥发累积量（p<0.05）。2年大田试验肥料氮损失率的变化幅度分别为2.08%~3.18%和1.55%~4.84%，两年平均表现为CT>SM>FM。FM对小麦耕层土壤含水量（SWC）和土壤温度（ST）有促进作用，尤其在冬前分蘖期，对铵态氮和硝态氮（NH4+-N和NO3--N）也有促进作用。SM较CT和FM表现出更高的微生物生物量氮（MBN）和可溶性有机碳（DOC）含量。当小麦由营养生长阶段向生殖生长阶段转变时，SM处理可以提高水溶性有机氮（WEON）和NO3--N的含量。各处理的氨挥发受SWC和TC的影响分别表现出显著的正和负相关性（p<0.05）。土壤不稳定态氮组分对土壤NH3挥发有积极影响。田间因素可直接或间接影响NH3的挥发。WEON和MBN分别发挥N源和催化剂的作用，增加氨挥发。总的来说，FM可以用来防止氨的挥发，而SM虽增加了旱地土壤的有机物但也应该避免氨损失的风险。

**关键词：**氨挥发、土壤不稳定氮、耕作管理、田间因素

**Abstract:** Ammonia (NH3) volatilization is an epitome of human activities affecting the total environment and a key part of the nitrogen cycle. Soil labile nitrogen components are closely related to soil quality and fertility, coupled with the current agricultural demand for high and stable yields, and has received widespread attention in the plant-soil ecosystem. Currently, few reports the relationship of them, especially the different tillage managements and urea application rates influence them during the wheat cultivation. This study aimed to (1) illuminate the common tillage methods and nitrogen rates effect on ammonia volatilization and soil labile nitrogen in Loess Plateau and (2) expound the interrelation among field conditions, soil labile nitrogen and NH3 volatilization. Field experiment was implemented at 2017 and 2018, and composed of nine treatments: the completely randomized split-plot design of three tillage systems (conventional tillage with residue removed (CT), film mulching with residue removed (FM), straw residue mixed with soil (SM)) and 3 nitrogen rates (the control rate (N0), 144 kg N ha-1 (N144), 180 kg N ha-1 (N180)). The results showed the nitrogen (N) application increased NH3 fluxes in 40 days after fertilization significantly (p<0.1). SM and FM could significant increased or reduced cumulative NH3 volatilization separated during two wheat season (p<0.05). Compared 2-year field experiment, the motion ranges of fertilizer ammonia loss rate (FR) were 2.08% ~ 3.18% and 1.55% ~ 4.84% separately, and revealed CT>SM>FM in average. Soil water content (SWC) and soil temperature (ST) were promoted by FM at topsoil during the wheat cultivation especially in pre-winter tillering stage, ammonium and nitrate nitrogen (NH4+-N and NO3--N) also increased with them. SM exhibited higher microbial biomass nitrogen (MBN) and dissolved organic carbon (DOC) contents than CT and FM. Water extraction organic nitrogen (WEON) and NO3--N could be improved by SM when wheat changes from vegetative to reproductive growth. Ammonia volatilization under each treatment had significantly positive or negative influenced by SWC and TC separately (p<0.05). Soil labile nitrogen components had positive influenced to NH3 volatilization beside WEON in CT and FM. The field factors could directly or in directly influence the NH3 volatilization. The WEON and MBN played the N resource pool and promoter respectively to improve the ammonia volatilization. Overall, FM could be used to prevent ammonia volatilization, while the crop residue should be used property to avoid risk of ammonia loss which improved natural organic material in dryland.

**Keyword:** Ammonia volatilization, soil labile nitrogen, tillage management, field factors