

《中文核心期刊要目总览》收录  
Ei Compendex(核心版)收录  
百种中国杰出学术期刊  
RCCSE 中国权威学术期刊

2019. **21**  
第35卷 VOL. 35



ISSN 1002-6819  
CN 11-2047/S  
CODEN NGOXEO

# 农业工程学报

TRANSACTIONS OF THE CHINESE SOCIETY  
OF AGRICULTURAL ENGINEERING

NONGYE  
GONGCHENG  
XUEBAO



ISSN 1002-6819



中国农业工程学会 主办

# 农业工程学报

2019 年 11 月第 21 期 总第 373 期 (第 35 卷)

## 目次

### •农业装备工程与机械化•

- 开沟深度定压电液仿形控制系统设计与试验 ..... 梁方, 雷淇奥, 郑思远, 王鹏, 郭洲, 刘伟 (1)
- 悬挂振动式油茶果采摘执行机构设计与试验 ..... 高自成, 赵凯杰, 李立君, 庞国友, 王晓晨 (9)
- 耦合 CFD-DEM 的气力式种肥穴施装置投肥路径分析与试验  
..... 刘正道, 王庆杰, 李洪文, 何进, 卢彩云, 于畅畅 (18)
- 大中型拖拉机压实对土壤坚实度和大豆产量的影响  
..... 乔金友, 张丹, 张宏彬, 张斌, 陈海涛, 谌礼鹏, 郑大明, 孙健 (26)
- 拖拉机后悬挂横向位姿调整的模糊 PID 控制 ..... 邵明奎, 辛喆, 江秋博, 张延安, 杜岳峰, 杨后富 (34)
- 柴油机多次喷射干扰的喷油脉宽评估方法及抑制策略 ..... 王正江, 申立中, 姚国仲, 黄粉莲, 万明定 (43)

### •农业航空工程•

- 无人机倾斜航空摄影监测崩岗侵蚀量变化的方法 ..... 周小荃, 余宏亮, 魏玉杰, 胡节, 蔡崇法 (51)

### •农业水利工程•

- 一体化压力补偿式热塑性弹性材质滴头设计与试验 ..... 杨小坤, 牛文全, 张亮 (60)
- 灌溉方式对西辽河平原玉米产量及水分利用效率的影响  
..... 杨恒山, 薛新伟, 张瑞富, 李金琴, 王宇飞, 邵继承, 刘晶 (69)
- 根域水分亏缺对涌泉灌苹果幼树产量品质和节水的影响 ..... 钟韵, 费良军, 曾健, 傅渝亮, 代智光 (78)
- 耕层土壤虚实结构优化春玉米根系形态提高水分利用效率  
..... 白伟, 孙占祥, 张立祯, 郑家明, 冯良山, 蔡倩, 向午燕, 冯晨, 张哲 (88)
- 灌溉水中悬浮固体对土壤水分入渗性能的影响 ..... 盛丰, 方娴静, 吴丹, 胡国华, 危润初, 谌宏伟 (98)
- 秸秆带状覆盖下培土对马铃薯产量与水分利用效率的影响  
..... 李辉, 柴守玺, 常磊, 程宏波, 韩凡香, 柴雨葳 (107)
- 免耕覆膜增加中度盐碱土团聚体有机碳和微生物多样性  
..... 卢闯, 张宏媛, 刘娜, 张晓丽, 逢焕成, 李玉义 (116)
- 水平沟整地措施对黄土丘陵区草原土壤水分动态平衡的影响  
..... 宿婷婷, 韩丙芳, 马红彬, 马非, 赵菲, 周瑶, 贾希洋 (125)
- 微生物固化砂质黏性紫色土的三轴抗剪强度与浸水抗压强度 ..... 沈泰宇, 李贤, 汪时机, 许冲, 薛乐 (135)
- 改性纤维素类聚合物固沙剂的吸附力学及崩解特性试验 ..... 袁进科, 裴向军, 叶长文, 杨晴雯, 陈杰 (144)

集水区耕作对干热河谷冲沟沟头溯源侵蚀过程的影响

..... 杨鸿琨, 苏正安, 朱大鹏, 何周窈, 周 涛, 熊东红, 方海东, 史亮涛 (151)

## •农业信息与电气技术•

基于模糊判别成分分析法的高光谱作物信息提取与分类 ..... 杨 晨, 董丽芳, 赵海士, 常志勇 (158)

GNSS 双天线结合 AHRS 测量农田地形 ..... 景云鹏, 刘 刚, 金志坤 (166)

改进作物水分亏缺指数用于东北地区春玉米干旱灾变监测 ..... 李崇瑞, 游松财, 武永峰, 王一昊 (175)

典型干旱指数在黄河源区的适宜性评估 ..... 王作亮, 文 军, 李振朝, 韩 博, 刘 蓉, 王 欣 (186)

风光储微电网系统复合储能的网格式优化 ..... 田 德, 陈忠雷 (196)

## •农业生物环境与能源工程•

地源热泵水蓄能型植物工厂降温系统夏季运行特性

..... 石惠娴, 田沁雨, 孟祥真, 任亦可, 欧阳三川, 张中华, 安文婷 (202)

人字形板式换热器流道传热特性及参数优化 ..... 杨艳霞, 马晴婵, 左玉清 (210)

东北地区奶牛舍围护结构的低限热阻计算与验证

..... 鲁煜建, 张 璐, 王朝元, 计博禹, 饶光辉, 施正香, 李保明 (216)

简化低温放热法用于葡萄叶片耐霜冻能力评价 ..... 孙鲁龙, 丁家宁, 翟 衡, 杜远鹏 (223)

## •农业资源循环利用工程•

生物质成型燃料热解半焦产率及理化特性 ..... 涂德浴, 潘庆民, 张传佳, 陈 文 (229)

沙柳生物质燃料颗粒致密成型粘结机理研究 ..... 李 震, 王宏强, 高雨航, 闫 莉, 王 鹏, 德雪红 (235)

## •土地整理工程•

县域高标准基本农田建设适宜性评价与优先区划定 .....

汤 峰, 徐 磊, 张蓬涛, 张贵军, 付梅臣, 张俊峰 (242)

黄土丘陵沟壑区治沟造地土壤快速培肥效应

..... 付 威, 雍晨旭, 马东豪, 樊 军, 张佳宝, 魏宏安, 冯小龙, 魏润哲, 刘霄飞, 王光东, 谭 钧 (252)

省域土地人口经济多维协调格局及分区发展策略 ..... 张 慧, 苏 航, 薛 睿, 章桂芳 (262)

山区土地利用多功能时空分异特征及影响因素分析

..... 刘愿理, 廖和平, 李 涛, 蔡 进, 李 靖, 何 田, 罗 刚 (271)

## •农产品加工工程•

农产品质量安全生产技术对要素替代弹性的影响 ..... 康 婷, 穆月英, 侯玲玲 (280)

基于酶抑制法的自助式农药残留检测平台建立 ..... 陈子鹏, 马建博, 杜建华 (289)

太空厨房及饮食保障研究 ..... 董海胜, 赵 伟, 臧 鹏, 罗明磊, 袁 淼, 袁雯竹, 娄 贞, 陈 斌 (295)

亚麻籽饲喂对苏尼特羊肉风味品质的影响

..... 刘 畅, 罗玉龙, 窦 露, 杨致昊, 李文博, 赵丽华, 苏 琳, 孙雪峰, 靳 烨 (304)

饲料原料粉体流动特性预测模型 ..... 陈计远, 王红英, 金 楠, 方 鹏, 段恩泽, 常楚晨 (312)

**Transactions**  
**of the Chinese Society of Agricultural Engineering**  
**Vol.35 No.21 Nov. 2019**  
**CONTENTS**

**•Agricultural Equipment Engineering and Mechanization•**

Design and experiment of electro-hydraulic profiling system with consistent pressure for drilling depth of furrow opener

..... *Liang Fang, Lei Qi'ao, Zheng Siyuan, Wang Peng, Guo Zhou, Liu Wei* (1)

Design and experiment of suspended vibratory actuator for picking *Camellia Oleifera* fruits

..... *Gao Zicheng, Zhao Kaijie, Li Lijun, Pang Guoyou, Wang Xiaochen* (9)

Fertilizer injecting route analysis and test for air-blowing seed-fertilizer hole-applicator via CFD-DEM coupling

..... *Liu Zhengdao, Wang Qingjie, Li Hongwen, He Jin, Lu Caiyun, Yu Changchang* (18)

Effects of soil compaction by various tractors on soil penetration resistance and soybean yields

..... *Qiao Jinyou, Zhang Dan, Zhang Hongbin, Zhang Bin, Chen Haitao, Chen Lipeng, Zheng Daming, Sun Jian* (26)

Fuzzy PID control for lateral pose adjustment of tractor rear suspension

..... *Shao Mingxi, Xin Zhe, Jiang Qiubo, Zhang Yan'an, Du Yuefeng, Yang Houfu* (34)

Estimation method of injection pulse width and suppression strategy for multiple injection interference of diesel engine

..... *Wang Zhengjiang, Shen Lizhong, Yao Guozhong, Huang Fenlian, Wan Mingding* (43)

**•Agricultural Aviation Engineering•**

Method for monitoring change in Benggang erosion based on oblique aerial images of UAV

..... *Zhou Xiaoquan, Yu Hongliang, Wei Yujie, Hu Jie, Cai Chongfa* (51)

**•Soil and Water Engineering•**

Design and experiment of integrated pressure-compensating emitter made of thermoplastic elastomer

..... *Yang Xiaokun, Niu Wenquan, Zhang Liang* (60)



Effects of irrigation methods on yield and water use efficiency of maize in the West Liaohe Plain	.....	<i>Yang Hengshan, Xue Xinwei, Zhang Ruifu, Li Jinqin, Wang Yufei, Tai Jicheng, Liu Jing</i>	(69)
Effects of root-zone water deficit on yield, quality and water use efficiency of young apple trees under surge-root irrigation	.....	<i>Zhong Yun, Fei Liangjun, Zeng Jian, Fu Yuliang, Dai Zhiguang</i>	(78)
Furrow loose and ridge compaction plough layer structure optimizing root morphology of spring maize and improving its water use efficiency	.....	<i>Bai Wei, Sun Zhanxiang, Zhang Lizhen, Zheng Jiaming, Feng Liangshan, Cai Qian, Xiang Wuyan, Feng Chen, Zhang Zhe</i>	(88)
Effects of suspended solids in irrigation water on soil water infiltration	.....	<i>Sheng Feng, Fang Xianjing, Wu Dan, Hu Guohua, Wei Runchu, Shen Hongwei</i>	(98)
Effects of earthing up on yield and water use efficiency of potato under straw strip mulching planting pattern	.....	<i>Li Hui, Chai Shouxi, Chang Lei, Cheng Hongbo, Han Fanxiang, Chai Yuwei</i>	(107)
Increasing soil organic carbon in aggregates and microflora diversity in moderate salt-affected soils through no till combined with plastic film mulching	.....	<i>Lu Chuang, Zhang Hongyuan, Liu Na, Zhang Xiaoli, Pang Huancheng, Li Yuyi</i>	(116)
Effects of contour trenches engineering measures on soil moisture dynamics and balance of typical steppe in Loess Hilly Region	.....	<i>Su Tingting, Han Bingfang, Ma Hongbin, Ma Fei, Zhao Fei, Zhou Yao, Jia Xiyang</i>	(125)
Triaxial shear strength and immersion compressive strength of sandy clayey purple soil treated by microbial induced calcite precipitation	.....	<i>Shen Taiyu, Li Xian, Wang Shiji, Xu Chong, Xue Le</i>	(135)
Adsorption mechanics and disintegration characteristics of modified cellulose polymer sand fixing agent	.....	<i>Yuan Jinke, Pei Xiangjun, Ye Changwen, Yang Qingwen, Chen Jie</i>	(144)
Effect of cultivation in upstream catchment on gully headcut erosion process in dry-hot valley	....	<i>Yang Hongkun, Su Zheng'an, Zhu Dapeng, He Zhouyao, Zhou Tao, Xiong Donghong, Fang Haidong, Shi Liangtao</i>	(151)

## •Agricultural Information and Electrical Technologies•

Hyperspectral feature extraction using fuzzy-statistics-based discriminative component analysis method for crop classification	.....	<i>Yang Chen, Dong Lifang, Zhao Haishi, Chang Zhiyong</i>	(158)
Topographic survey of farmland based on GNSS dual antenna combined with ARHS	.....	<i>Jing Yunpeng, Liu Gang, Jin Zhikun</i>	(166)
Improved crop water deficit index for monitoring drought disaster change process of spring maize in the Northeast China	.....	<i>Li Chongrui, You Songcai, Wu Yongfeng, Wang Yihao</i>	(175)

Evaluation of suitability using typical drought index in source region of the Yellow River

..... Wang Zuoliang, Wen Jun, Li Zhenchao, Han Bo, Liu Rong, Wang Xin (186)

Subregional optimization of wind-solar microgrid composite energy storage system

..... Tian De, Chen Zhonglei (196)

### •Agricultural Bioenvironmental and Energy Engineering•

Operating characteristics of energy storage ground source heat pump cooling system in plant factory in summer

..... Shi Huixian, Tian Qinyu, Meng Xiangzhen, Ren Yike, Ouyang Sanchuan, Zhang Zhonghua, An Wenting (202)

Heat transfer characteristics and parameter optimization of flow passage of herringbone heat transfer

..... Yang Yanxia, Ma Qingchan, Zuo Yuqing (210)

Calculation and validation of minimum thermal resistance of dairy barns in the Northeastern China

..... Lu Yujian, Zhang Lu, Wang Chaoyuan, Ji Boyu, Rao Guanghui, Shi Zhengxiang, Li Baoming (216)

Simplified low temperature exothermic method for evaluating frost resistance of grapevine leaves

..... Sun Lulong, Ding Jia'ning, Zhai Heng, Du Yuanpeng (223)

### •Agricultural Resource Recycling Engineering•

Yield and physicochemical properties of pyrolysis char of biomass briquetting pellets

..... Tu Deyu, Pan Qingmin, Zhang Chuanjia, Chen Wen (229)

Bonding mechanism of dense forming of salix biomass fuel particles

..... Li Zhen, Wang Hongqiang, Gao Yuhang, Yan Li, Wang Peng, De Xuehong (235)

### •Land Consolidation and Rehabilitation Engineering•

Suitability evaluation and priority area delineation of high standard basic farmland construction at county level

..... Tang Feng, Xu Lei, Zhang Pengtao, Zhang Guijun, Fu Meichen, Zhang Junfeng (242)

Rapid fertilization effect in soils after gully control and land reclamation in loess hilly and gully region of China

..... Fu Wei, Yong Chenxu, Ma Donghao, Fan Jun, Zhang Jiabao, Wei Hong'an, Feng Xiaolong,

Wei Runzhe, Liu Xiaofei, Wang Guangdong, Tan Jun (252)

Multidimensional coordination pattern of provincial land population economy and its zoning development strategy

..... Zhang Hui, Su Hang, Xue Rui, Zhang Guifang (262)

Spatio-temporal diversity and influencing factors of multi-functionality of land use in mountainous regions

..... *Liu Yuanli, Liao Heping, Li Tao, Cai Jin, Li Jing, He Tian, Luo Gang* (271)

### •Agricultural Produce Processing Engineering•

Effects of agricultural products safety production technologies on elasticity of substitution

..... *Kang Ting, Mu Yueying, Hou Lingling* (280)

Self-service detection platform of pesticide residue based on enzyme inhibitory method

..... *Chen Zipeng, Ma Jianbo, Du Jianhua* (289)

Research on space kitchen and dietary provision

..... *Dong Haisheng, Zhao Wei, Zang Peng, Luo Minglei, Yuan Miao, Yuan Wenzhu, Lou Zhen, Chen Bin* (295)

Effect of feeding flaxseed on meat flavor quality of Sunit lambs

..... *Liu Chang, Luo Yulong, Dou Lu, Yang Zhihao, Li Wenbo, Zhao Lihua, Su Lin, Sun Xuefeng, Jin Ye* (304)

Prediction model of flow properties of feed material powder

..... *Chen Jiyuan, Wang Hongying, Jin Nan, Fang Peng, Duan Enze, Chang Chuchen* (312)