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果园施肥用便携式电动挖穴机性能试验

Performance test of hand-held electric hole-digger for fertilization in orchard

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中文摘要:

为满足丘陵山区果园机械挖穴施肥的需要,降低劳动强度,提高作业效率,该文以自行研制的便携式电动挖穴机为对象,以电动挖穴机的工作性能和使用者的劳动强度为试验指标,与手持式汽油挖穴机进行了对比试验。结果表明:前者与后者相比,工作效率提高33.8%;满负荷工作时噪声等级和左右手柄处振动加速度方根值分别降低25.2 dB、95.1和170.3 m/s²;操作人员作业时的平均心率值降低8次/min。对2种挖穴机使用的经济效益进行分析,得出以蓄电池寿命为周期的时间内,电动挖穴机和汽油挖穴机的使用综合成本分别为4645.6和7888.9元。研究结果可为现有手持式汽油挖穴机的改进和电动挖穴机的优化设计提供参考。

英文摘要:

Abstract: In order to reduce labor intensity and improve efficiency of mechanical hole digger machinery, a portable hand-held electric hole digger was developed to meet the agronomic requirements of watering and fertilization. The operating performance of the developed hand-held electric hole digger was tested, and some main technical parameters of the machine (operational efficiency, noise, vibration acceleration, soil backfilling rate), labor intensity of users, and the economic benefit of usage were selected as the test index. Furthermore, the performance of the electric hole digger was compared with a commonly used hand-held gasoline hole digger. The experimental results showed that: 1) the operational efficiency of the electric hole digger was 76.6 holes/h and the work efficiency of the hand-held gasoline hole digger was 57.3 holes/h, which improved 33.8 percent. 2) The noise of the electric hole digger was 75.45 dB and the noise of the hand-held gasoline hole digger was 100.65 dB under full load working condition, which reduced 25.2dB. 3) The vibration acceleration of left and right hand shanks of the electric hole digger were 34.3 m/s² and 41.8 m/s² and the vibration acceleration of left and right hand shanks of the hand-held gasoline hole digger were 129.4 m/s² and 210.6 m/s² on full load operating condition, which reduced 95.1m/s² and 168.8 m/s². At the same time, the value of vibration acceleration coefficient variation is bigger for the three identified conditions of the gasoline hole digger, and its vibration is intense. 4) The soil backfilling rate was 7.7% for the electric hole digger and 11.5% for the gasoline hole digger. The performance improvement of the electric hole digger depends on its special features, including portable operation (the machine weighs 15 kg), lower noise (the noise level of full load operating condition was 75.45 dB), smooth operation (the handle vibration acceleration values were 34.3 m/s² in the left handle and 41.8 m/s² in the right handle), and appropriate operating speed (maximum speed 265 r/min); 5) The maximum heart rate of the group operators of the hand-held gasoline hole diggers were 160 bpm, 184 bpm, and 169 bpm, respectively, while the electric hole digger operators were 157 bpm, 165 bpm, and 143 bpm, respectively. The average heart rate of the group operators of the hand-held gasoline hole digger were 121 bpm, 138 bpm, and 121 bpm, respectively, and the electric hole diggers were 118 bpm, 122 bpm, and 115 bpm, respectively, which reduced 3 bpm, 16 bpm and 6 bpm respectively. 6) The average relative heart rate the operators of the hand-held gasoline hole diggers was 44%, and greater than 40%, the electric hole diggers were 36%. 7) HRw 50% level mean that the average heart rate value ratio at the 50% level. If the calculation resulting of HRw 50% level value is equal to or greater than 1, it means this work was severe labor intensity; the average value HRw 50% level of hand-held gasoline hole diggers was 0.94, the electric hole diggers was 0.88. At the same time, the economic benefit of the two kinds of hole digger was analyzed, and the comprehensive costs were 4645.6 RMB for the electric hole digger and 7888.9 RMB for the gasoline hole digger. These results provide fundamental parameters for the design and development of a new type of hole digger, which will suit the hilly, orchard regions in Southern China.

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