Tillage with straw incorporation declines the optimal nitrogen rate for maize production by affecting crop uptake, utility efficiency and soil balance of nitrogen

Zhengyu Wang[1], Xiyu Liu[1], Xiangwei Gong[1], Ying Jiang[1], Hua Qi[1]

([10]Shenyang Agricultural University, Shenyang 110866, China)

Abstract: 【**Objective**】In order to identify the effects of straw return with rotary or plow till and nitrogen (N) application rate on maize grain and straw yield, grain N uptake and N use efficiency (NUE), and soil N balance and to determine the optimal N fertilization rate for maize production under continuous straw incorporation with tillage which is vital for sustainable agriculture in northeastern China. 【**Method**】A four-year (2015–2018) field experiment was conducted to assess the impact of rotary tillage with straw incorporation (RTS) and plow tillage with straw incorporation (PTS) combined with different N fertilizer rates (0, 112, 187, 262, and 337 kg N ha^{-1}) on maize yield, N uptake, soil N balance, nitrogen use efficiency, and optimal N rate. 【**Result**】In general, higher straw N uptake and lower N partial factor productivity, NUE, and recovery of applied N in grains were obtained under PTS than under RTS. Moreover, grain yield and both straw and grain N uptake increased with the N application rate. However, no further increase in grain yield was observed when the applied N exceeded 187 kg N ha^{-1}. PTS resulted in a higher level of unaccounted N from applied N fertilizer (38–81 kg N ha^{-1}) than RTS. A high N fertilizer input (>262 kg N ha^{-1}) combined with straw incorporation resulted in a high soil mineral N profit and substantially increased unaccounted N (614–715 kg N ha^{-1}) over the four-year field trial period. The optimal N input required for the highest maize yield could be reduced by 35.0%–44.6% using tillage with straw return. Nevertheless, PTS was more effective than RTS at lowering the optimal N application rate. 【**Conclusion**】The results of this short-term maize field study conducted in northeastern China suggest that the amount of N fertilizer input required for maize production could be reduced by using tillage with continuous straw incorporation.

Acknowledgements：National Natural Science Foundation of China (No. 32071976)
Zhengyu Wang, E-mail：2021200073@stu.syau.edu.cn