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Model-based Approach to Quantify the Production Potential of Chinese Cabbage/Maize Strip Intercropping in the North China Plain

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Abstract

Intercropping is a traditional and sustainable production system in the North China Plain (NCP). In recent years however, with labour moving out of agriculture the area under intercropping cultivation has steadily declined. The traditional row-intercropping systems are very hand labour intensive and can hardly be mechanised. To maintain intercropping and the associated advantages new row-intercropping systems that can be mechanised have to be developed. In that respect the management of a tolerable degree of competition for growth factors is a key issue. Intercropping of maize with Chinese cabbage is a popular system in the NCP. Due to the strongly different canopy heights it offers a great potential to intensively study availability, competition and use-efficiency of solar radiation, a major growth factor. Field experiments in Germany and China showed that the level of incident radiation strongly influences the yield potential in Chinese cabbage/maize strip systems. In Germany significant yield reduction in Chinese cabbage occurred, whereas in China with incoming radiation being twice as high, radiation was not a limiting growth factor. To optimise the production potential of the system strip widths of Chinese cabbage have to be adjusted to the local solar radiation conditions. For this purpose the CROPGRO model was employed to simulate growth and development of Chinese cabbage under reduced incident radiation. The regional variability in available radiation was considered by using up to 30 years of weather data from 14 meteorological stations across the NCP. Simulations were carried out for five different soil texture. Performance of different strip widths, which were adjusted to common machinery working widths were tested. The results were linked to a Geographic Information System. In systems with a small strip widths yield decline was significantly stronger in the northern part of the NCP. A strip width wider than 2.4 meters did not cause any significant yield reductions over the entire NCP. In a next step cultivars with different shading tolerance will be tested in the model and in the field to further optimise the system.

Keywords: Chinese cabbage, crop growth model, GIS, intercropping, North China Plain

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