

Study of root zone restriction by transplanting cultivation for suppression of cadmium content in Spinach

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ABSTRACT

In order to make the method for reduction of Cadmium (Cd) risk on spinach grown in the Cd polluted fields with non-contaminated soil dressing, we studied about the effect of the transplanting cultivation with plug seedlings on the root distribution and the Cd uptake on spinach. It was shown that the using of the transplanting on spinach cultivation suppressed the development of the spinach roots in contaminated soil and reduced the Cd uptake of spinach. It was verified that the application of transplanting with plug seedlings on spinach cultivation was effective to reduce the Cd risk on spinach grown in the Cd polluted fields with non-contaminated soil dressing.

KEYWORDS: spinach, cadmium, transplanting cultivation, plug seedling, root distribution

1. INTRODUCTION

It is known that the ability of Cd uptake of Spinach (*Spinacia oleracea* L.) is higher than in other vegetables. Therefore, we have to establish the method for reduction of Cd risk on spinach production. In Japan, non-contaminated soil dressing (about 30 cm thickness) has been used for improvement of cadmium (Cd) contaminated fields. But the 30 cm thickness of soil dressing is not enough to reduce Cd content in spinach because of penetration of spinach roots into the contaminated soil below the dressed soil (Kikuchi et. al., 2006). In this study, we researched about the effect of the transplanting cultivation with plug seedlings on the root distribution and the Cd content in spinach, in order to make the method for suppress of Cd content by the transplanting cultivation on spinach.

2. MATERIAL & METHODS

We compared with direct planting cultivation and transplanting cultivation on the spinach root growth in root boxes. Spinach seeds were sowed in plug trays filled with soil. 20days after germination, the seedlings were transplanted to the root boxes (transparent plastic boxes, W25cm, D3cm, H40cm) filled with soil. In addition, spinach seeds were sowed in the other root boxes directly. 60days after germination, we took photographs of the spinach roots with a digital camera. The digital images were used for measurement of the root length with WinRhizo (Regent Instruments Inc.) And to reveal the effect of transplanting cultivation

on Cd content of the spinaches grown in polluted fields with non-contaminated soil dressing, spinaches were grown in two boxes (W90cm, D90cm, H60cm). One of the box was filled with the Cd contaminated soil (Cd: 3.38mg kg^{-1} , 40cm thickness) which was covered with the non-contaminated soil (20cm thickness). Another box was filled with the contaminated soil (20cm) which was covered with the non-contaminated soil (40cm). 60 days after germination or transplanting, the spinach shoots were sampled. Cd content in the spinach shoots were analyzed by ICP-MS (PerkinElmer Co.).

3. RESULTS & DISCUSSION

The root distribution of the spinaches grown in the root box was affected by different ways of planting. It was shown that the spinach roots cultivated with direct planting were distributed over throughout the root box, but the root length in the soil below the depth of 20 cm on the transplanting cultivation was 50% lower than on the direct planting cultivation (Fig.1). It was suggested that the main root could not grow to lower area in the root box, because of the formation of root ball in plug tray, therefore, the spinach roots were limited on transplanting cultivation. The Cd content of the spinaches planted on the transplanting cultivation was 60% lower than on the direct planting cultivation in the both boxes (Fig.2). It was estimated that the suppression of spinach root growth in the contaminated soil cause to reduction of Cd uptake of the spinaches cultivated with transplanting. In conclusion, it was indicated that the application of transplanting with plug seedlings on spinach cultivation was effective to reduce Cd content in spinach grown in the Cd polluted fields with non-contaminated soil dressing.

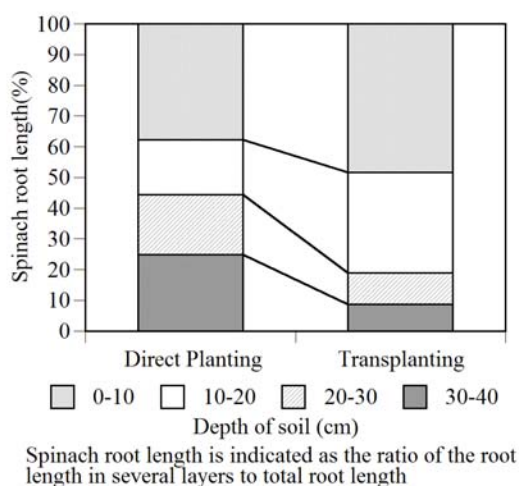


Figure 1. Spinach root distribution on different plantings.

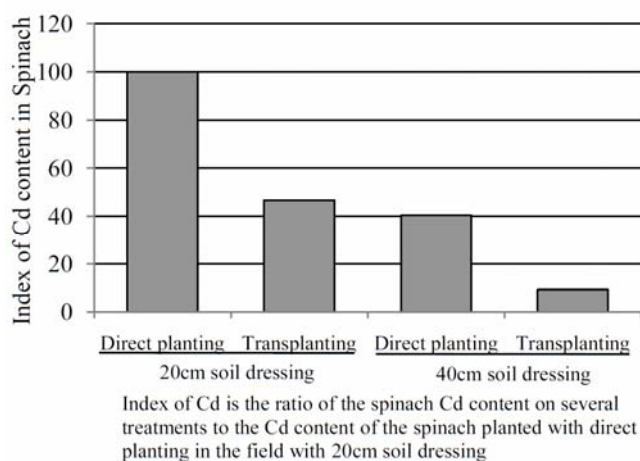


Figure 2. Effect of different plantings on Cd content in spinach.

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