The effect of a ploughpan in marine loam soils on potato growth. 2. Potato plant responses

C. D. VAN LOON¹, L. A. H. DE SMET² and F. R. BOONE³

¹Research Station for Arable Farming and Field Production of Vegetables, Edelhertweg 1, Lelystad, Netherlands
²Soil Survey Institute, Marijkweg 11, Wageningen, Netherlands
³Soil Tillage Laboratory, State Agricultural University, Diedenweg 20, Wageningen, Netherlands

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Zusammenfassung, Résumé p. 328

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Summary

The effect of a ploughpan on root and foliage growth and on the yield and quality of tubers was studied in old and in recently reclaimed marine loam soils. In all experiments the ploughpan impeded root growth to a large extent. On the old land, removing the ploughpan did not affect tuber yield because roots could scarcely penetrate the subsoil. On the recently reclaimed land, where roots could penetrate the subsoil, however the ploughpan decreased yields considerably. The ploughpan had little influence on tuber quality.

Introduction

In the recently reclaimed polder Oostelijk Flevoland, potato yields are considerably higher than those in well-known potato-growing areas on older soils in the southwest of the Netherlands (Anon., 1971, 1972, 1973; van der Zaag, 1982). A survey by Hoekstra (1971) showed that potato crops in O. Flevoland had markedly deeper root systems. This could explain some of the differences in yields between the two regions. The survey also showed that the alluvial loamy soils that predominate in the southwest, often have a ploughpan ca 30 cm below the surface.

In a literature review, Leszczynski & Tanner (1976) concluded that penetration of potato roots in a ploughpan is very limited. In commercial fields with a ploughpan, Saini (1976) found a strong positive correlation between the oxygen diffusion rate (ODR) in this pan and the marketable yield of potatoes.

The research reported here was designed to investigate the effect of a ploughpan on physical properties of the soil, rooting depth and growth and yield of the potato crop in new and in old soils. Data on soil physical aspects and rooting patterns have been presented in a separate paper (Boone et al., 1985). The reactions studied included the growth of potato roots and foliage, tuber production and tuber quality. The results from 1976 have been reported in greater detail elsewhere (Boone et al., 1978; van Loon & Bouma, 1978).
Materials and methods

The research was done in the south-west of the Netherlands in an old loam soil (1973) and in an old sandy loam soil (1974), and in the new polder Oostelijk Flevoland in a new sandy loam soil (1976 and 1977).

The following treatments were applied (cf. Boone et al., 1985):

1973

P: ploughpan, untreated soil (control), with a severely compacted layer.
P+: as P, but with extra compacted ploughpan.
P+I: as P+, but with sprinkler irrigation.
L: loose soil, ploughpan completely eradicated.

1974

P: ploughpan, untreated soil (control), with a severely compacted layer.
L: loose soil; ploughpan loosened at ploughing by a subsoiler.

1976 and 1977

P: ploughpan; artificially established severe ploughpan.
L: loose soil, untreated (control), with a very weakly compacted layer.
LI: as L, but with furrow irrigation.

Potassium was supplied in the autumn preceding planting and, with the exception of 1973 and 1974, so was phosphorus; in all years nitrogen was applied some weeks before planting (Table 1). In all the experiments, seed tubers of cv. Bintje were planted with a four-row automatic planter in rows 75 cm apart at distances within the row of 33 cm. Planting was done in 1973 on 17 May, in 1974 on 9 April, in 1976 on 14 April and in 1977 on 20 April.

In 1974 there were two replicates, but there were no replicates in the other years because collection of soil physical and rooting data proved to be too laborious. In all experiments a growth analysis was carried out on all treatments. The growth and development of the crop were assessed on several dates by determining the stem length and the percentage of soil covered by green foliage. In 1977, leaf area index was determined; leaf water potential was obtained with a pressure chamber (Scholander et al., 1965) and stomatal opening was determined using an infiltration technique based on a description by Schorn (1929). On three occasions, mid-July,

Table 1. Fertilization with N, P₂O₅ and K₂O in kg/ha.

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<tr>
<td>N</td>
<td>234</td>
<td>234</td>
<td>205</td>
<td>200</td>
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<tr>
<td>P₂O₅</td>
<td>126</td>
<td>126</td>
<td>210</td>
<td>200</td>
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<td>K₂O</td>
<td>450</td>
<td>500</td>
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<td>200</td>
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Tabelle 1. Düngung mit N, P₂O₅ und K₂O in kg/ha.
Tableau 1. Fumures N, P₂O₅ et K₂O en kg/ha.