

RESPONSE OF CARROT (*DAUCUS CAROTA* L.)  
TO SOIL COMPACTION AND MULCHING

By

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## DECLARATION

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*I certify that substance of this thesis has not already been submitted for any degree and is not being currently submitted for any other degree.*

*I certify that to the best of my knowledge any help received in preparing this thesis, and all sources used, have been acknowledged in this thesis.*



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# Abstract

Carrot (*Daucus carota* L.) is a popular root vegetable known as a source of vitamin A. The market value of fresh carrot roots is determined by the shape and size of the storage roots and soil impedance is a major determinant of these properties.

Two experiments were conducted in the glasshouse in July 1985 and in April 1986, to study the response of carrots to soil bulk density, water regime, mulching, and manure application. Yield parameters including the storage root and tops fresh weight, the storage root : tops fresh weight ratio, the storage root length, and carrot shape as a quality parameter, were measured and analysed statistically in both experiments. The first experiment was carried out to study the effect of soil bulk density and water regime on carrot yield harvested at different growth stages. The effect of mulch, manure, and water regime on final yield and shape were studied in the second experiment. In the first experiment, pre-germinated hybrid-4 carrot seeds were grown in PVC pots at four bulk densities (1.25, 1.40, 1.55, 1.70 Mg m<sup>-3</sup>), with two watering regimes (high and low). The plants were harvested 68, 103 or 153 days after planting. The length of lateral roots and the soil strength as estimated by the cone penetrometer, was measured in this first experiment. In the second experiment, using polystyrene boxes as containers, the carrots were grown under rice straw, white and black plastic mulches, and in bare soils. In addition, the effects of two watering regimes and manure applications on carrot yield harvested 100 days after planting, were studied under these mulch conditions. Total water applied, water use efficiency, and soil temperatures at three different depths (the soil surface, 5 cm, and 15 cm) were recorded in the second experiment.

Soil bulk density had a significant effect on carrot yield and quality. The optimum bulk density for carrot yield, size and shape was  $1.40 \text{ Mg m}^{-3}$ , in both water regimes. This yield was not significantly different from that at  $1.25$  or  $1.55 \text{ Mg m}^{-3}$ , but the highest yield ( $92.30 \text{ g plant}^{-1}$ ), an acceptable shape and size of storage roots was obtained at  $1.40 \text{ Mg m}^{-3}$  in the high water regime. At  $1.25 \text{ Mg m}^{-3}$ , the yield and length of storage roots was not significantly different, but the size was smaller than at  $1.40 \text{ Mg m}^{-3}$ . However, at  $1.55 \text{ Mg m}^{-3}$ , the storage roots were significantly shorter, while the yield and the size was not different from that at  $1.40 \text{ Mg m}^{-3}$ . All parameters measured were significantly decreased at  $1.70 \text{ Mg m}^{-3}$ . At this bulk density, in the high and the low water regime respectively, the yield was reduced by 69% and 83%, and 0.91 and 1.56 cm of the storage root length was recorded above the soil surface. In both watering regimes the effect of bulk density was generally consistent at each growth stage. The yield was always higher in the high than in the low water regime.

Rice straw mulch, which was applied at a rate of  $5.5 \text{ t oven dry ha}^{-1}$ , significantly increased the fresh weight of carrot roots. The highest yield ( $69.90 \text{ g plant}^{-1}$ ) was found in this mulch treatment, in the high water regime. Plastic mulches resulted in lower yield compared to the straw mulch. However, the lowest yield was recorded in the bare treatment. This yield was 41% lower than that recorded in the straw mulch treatment. The highest yield recorded in the straw mulch treatment was associated with  $4.5^{\circ}\text{C}$  reduction in maximum soil temperature in 5 cm depth and 99% increase in water use efficiency.

The application of horse manure ( $15 \text{ t oven dry ha}^{-1}$ ) significantly increased the yield only under the straw mulch treatment, in the low water regime. This increase was 41% higher than that in the no manure treatment, and was associated with a 27% increase in water use efficiency.

Mulches had no significant effect on carrot shape, however, carrot shape was significantly affected by soil bulk density and water regime. The shape was more conical at high bulk density under low moisture conditions. Rice straw mulch, by modifying soil temperature and moisture, was found to increase carrot yield. These results need to be verified under tropical conditions.

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# Contents

<b>Abstract</b>	<b>iii</b>
<b>Acknowledgements</b>	<b>v</b>
<b>1 Introduction</b>	<b>1</b>
<b>2 Literature review</b>	<b>4</b>
2.1 Soil physical conditions and their effects on the growth of roots, underground organs and yield of crops . . . . .	4
2.1.1 The soil and plant root systems . . . . .	4
2.1.2 Soil compaction . . . . .	5
2.1.3 The interaction of mechanical impedance, moisture, and aeration, in compacted soils . . . . .	12
2.1.4 Manure and soil physical properties . . . . .	18
2.2 Soil temperature and moisture relationship and its effect on root growth and crop yields . . . . .	19
2.2.1 Soil temperature . . . . .	19
2.2.2 The effects of soil temperature and moisture on root growth .	24
2.2.3 Mulching . . . . .	25
2.2.4 Irrigation . . . . .	29
<b>3 Effects of soil bulk density and water regime on carrot yield harvested at different growth stages</b>	<b>31</b>
3.1 Introduction . . . . .	31

3.2	Materials and methods . . . . .	33
3.2.1	Treatments and experimental design . . . . .	33
3.2.2	Soil and carrot variety . . . . .	33
3.2.3	Pots . . . . .	34
3.2.4	The treatments . . . . .	34
3.2.5	Management . . . . .	36
3.2.6	Data collection . . . . .	36
3.2.7	Data handling . . . . .	38
3.3	Results . . . . .	38
3.3.1	Yield and quality . . . . .	38
3.3.2	Soil physical environment . . . . .	49
3.4	Discussion . . . . .	50
<b>4</b>	<b>Effects of mulch, manure, and water regime on carrot yield</b>	<b>57</b>
4.1	Introduction . . . . .	57
4.2	Materials and methods . . . . .	59
4.2.1	Treatments and experimental design . . . . .	59
4.2.2	Soil and carrot variety . . . . .	59
4.2.3	The treatments . . . . .	60
4.2.4	Management . . . . .	60
4.2.5	Soil moisture and temperature measurement . . . . .	61
4.2.6	Data collection . . . . .	62
4.2.7	Data handling . . . . .	62
4.3	Results . . . . .	63
4.3.1	Yield and quality . . . . .	63
4.3.2	Soil temperatures . . . . .	66
4.3.3	Total water applied and water use efficiency . . . . .	68
4.4	Discussion . . . . .	72
<b>5</b>	<b>General discussion and conclusions</b>	<b>80</b>
	<b>Bibliography</b>	<b>85</b>

<b>Appendices</b>	<b>106</b>
<b>A Experiment 1</b>	<b>107</b>
A.1 Particle size distribution of the soil . . . . .	107
A.2 Bulk density . . . . .	108
A.3 Rates of elements and chemicals applied . . . . .	109
<b>B Experiment 2</b>	<b>110</b>
B.1 Effect of mulch, manure, and water regime on carrot shape . . . . .	110
B.2 Rates of elements and chemicals applied . . . . .	111
B.3 Weights of monitor boxes . . . . .	112
<b>C Soil temperature</b>	<b>113</b>
C.1 Soil temperatures at the surface and 5cm depth in the manure - high water treatment . . . . .	113
C.2 Soil temperatures at the surface and 5cm depth in the manure - low water treatment . . . . .	113
C.3 Soil temperatures at 15 cm depth in the no manure - high and low water treatment . . . . .	113
C.4 Soil temperatures at 15 cm depth in the manure - high and low water treatment . . . . .	113

## List of Tables

3.1	The effect of soil bulk density and harvest time on tops fresh weight (g plant <sup>-1</sup> ) . . . . .	41
3.2	The effect of water regime and harvest time on tops fresh weight (g plant <sup>-1</sup> ) . . . . .	41
3.3	The effect of soil bulk density and water regime on tops fresh weight (g plant <sup>-1</sup> ) . . . . .	42
3.4	The effect of water regime and harvest time on storage root : tops fresh weight ratio . . . . .	43
3.5	The effect of soil bulk density and harvest time on storage root : tops fresh weight ratio . . . . .	43
3.6	The effect of soil bulk density and water regime on storage root : tops fresh weight ratio . . . . .	44
3.7	The effect of soil bulk density and harvest time on storage root length (cm) . . . . .	44
3.8	The effect of soil bulk density and harvest time on cylindricality (C) of carrots . . . . .	48
3.9	The effect of soil bulk density and water regime on cylindricality (C) of carrots . . . . .	48
4.1	The effect of mulch, manure and water regime on storage root fresh weight (g plant <sup>-1</sup> ) . . . . .	63
4.2	The effect of mulch and manure on carrot tops fresh weight (g plant <sup>-1</sup> )	64
4.3	The effect of mulch, manure and water regime on storage root:tops fresh weight ratio. . . . .	65

4.4	The effect of mulch, manure and water regime on storage root length (cm). . . . .	66
4.5	The effect of mulch, manure and water regime on total water applied (l). . . . .	68
4.6	The effect of mulch, manure and water regime on water use efficiency (g storage root FW l <sup>-1</sup> water applied). . . . .	72

# List of Figures

2.1	A functional relationship between soil compaction and crop growth (after Boone, 1986) . . . . .	7
2.2	Emergence of peas in relation to penetration resistance (after Hebblethwaite and McGowan, 1980) . . . . .	14
2.3	Schematic of radiation balance at Earth's surface (annual global average) (after Voorhees <i>et al.</i> , 1981) . . . . .	20
2.4	Soil temperature at four soil depths: 0.10.20.40 cm (after Hanks and Ashcroft, 1980). . . . .	21
2.5	Schematic of relationship between soil temperature modification and final yield (after Voorhees <i>et al.</i> , 1981) . . . . .	23
3.1	The effect of soil bulk density and water regime on storage root fresh weight . . . . .	40
3.2	The effect of soil bulk density and water regime on storage root length	46
3.3	The effect of soil bulk density and water regime on total root length	47
3.4	Soil strength at each bulk density . . . . .	49
3.5	Soil moisture content remaining in pots at the end of experiment . .	50
4.1	Soil temperatures at the surface and 5 cm depth in the no manure-high water treatment at early [a,b] and late growth stage [c,d]. . . .	70
4.2	Soil temperatures at the surface and 5 cm depth in the no manure-low water treatment at early [a,b] and late growth stage [c,d]. . . . .	71