

ROOT PRUNING AND YIELD OF MAIZE¹

Het verband tussen „wortelsnoei” en opbrengst bij maïs

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The effect on yield of artificial injury to the root system of maize was assessed in two trials both on sandy soil at Wageningen. In the first in 1960 only severe injury (removal of half of the root system in the five-leaf stage or a third or more at the beginning and end of flowering) reduced the yield of straw significantly. Length of plants and yield of cobs were not significantly decreased. In the second trial in 1961, none of the treatments, neither the most severe, gave significant decrease of length of plants and yields of cobs and straw. Where climate or soil conditions are less favourable than in these experiments, losses of yield would probably be greater.

INTRODUCTION

The assessment of losses caused by diseases or pests in the field is difficult because the time and rate of injury may vary. Some authors have tried to overcome this difficulty by defoliating, thinning or removing buds artificially (JONES, DUNNING & HUMPHRIES, 1955; HEUVER, DE LINT & STENVERS, 1960; HEUVER, 1960) but none, so far as I know, have attempted to injure roots artificially.

Provided they are not killed or severely checked by lack of water in the first few days, many crops recover quickly from transplanting despite losing most of their root systems in the process (TAMMES, 1961). To obtain more information about recovery from root injury, experiments were done with maize planted on sandy soil in Wageningen. Varying amounts of root system were cut away at different times during the season and the losses of yield determined.

EXPERIMENTS

Two field experiments with hybrid flint \times dent maize were made in 1960 and 1961 respectively. Each had six treatments with four replicates and plot size was 11,5 m² with 56 planting holes of three seeds each. In the two-till three-leaf stage the plots were thinned to one plant per hole. Each plot was surrounded by two rows of maize which were discarded.

A sharp spade was used to cut away to a depth of 20 cm one, two or three quadrants from the root system of each plant:

1. One quadrant. The side of the spade was placed against the stem and driven into the soil: a second cut was made at an angle of 90° (Fig. 1a).
2. Two quadrants. The middle of the spade was placed against the stem and driven into the soil (Fig. 1b).
3. Three quadrants. As for one quadrant but with the stem inside the quadrant remaining (Fig. 1c).

By lifting plants outside the experiment one quadrant was found to correspond to a loss of about 15% of the roots, two quadrants to about 30% and

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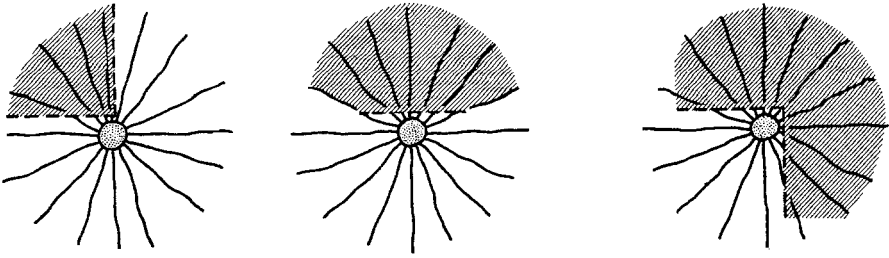


FIG. 1. Schematic representation of sectorial removal of roots; a. one quadrant, b. two quadrants, c. three quadrants (shaded), as seen from above.

Schematische weergave van het afsteken van sectoren van het wortelstelsel; a. één kwadrant, b. twee kwadranten, c. drie kwadranten (gearceerd), van boven gezien.

three quadrants to about 50%. Fig. 2 shows the removal of three quadrants of a root system. In treatments D, E and F in the 1960 experiment (see Table 1) and E and F in the 1961 experiment (see Table 2), root pruning was repeated twice. On the second occasion, the same part of the root was cut away as on the first.

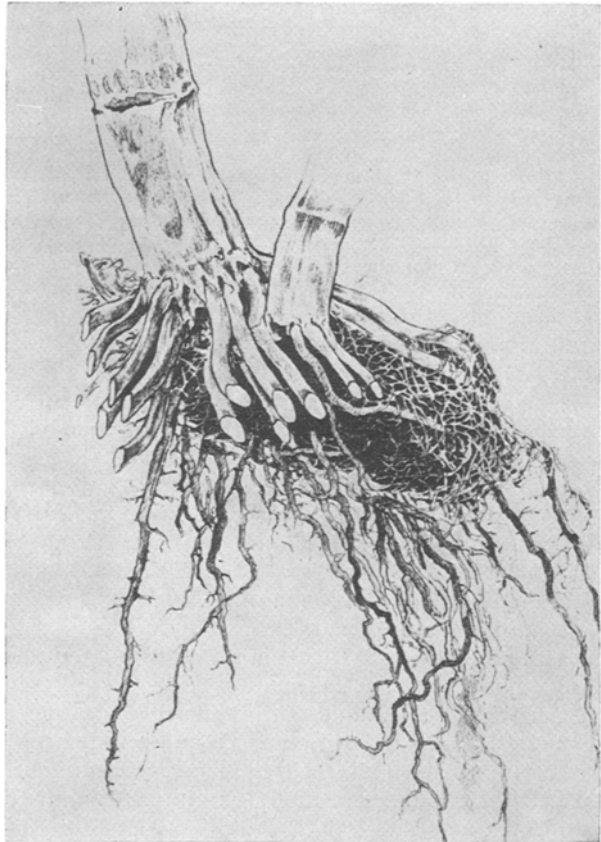


FIG. 2. Crown of a maize plant from which three quadrants of the root system were removed.

Voet van een maïsplant, waarvan drie kwadranten van het wortelstelsel waren afge-stoken.

TABLE 1. The effect of root injury on maize in 1960. Lengths and yields expressed as percentages of the untreated control.
Resultaten van de wortelbeschadigingsproef bij maïs in 1960. Lengte der planten en opbrengsten in relatieve cijfers ten opzichte van onbehandeld.

Treatments	Injury of the root system		Length of plants at harvest	Yield	
	Part removed	Time		Cobs	Straw
A	3 Quadrants	Five-leaf stage (13/6)	99	99	81
B	3 Quadrants	Beginning of flowering (20/7)	99	94	101
C	3 Quadrants	End of flowering (22/8)	97	92	93
D	1 Quadrant	Beginning and end of flowering	96	101	94
E	2 Quadrants	Beginning and end of flowering	100	100	89
F	3 Quadrants	Beginning and end of flowering	100	90	84
O	Untreated		100 (203)*	100 (12,8)**	100 (32,9)**
Least significant difference		95% 99%	n.s. n.s.	n.s. n.s.	6,4 8,8
Behandeling	Verwijderde gedeelte	Tijdstip	Lengte van de planten bij de oogst	Kolven	Stro
	Beschadiging van het wortelstelsel			Opbrengst	

* = length in cm; ** = yield in kg per plot; n.s. = not significant

* = lengte in cm; ** = opbrengst in kg per veldje; n.s. niet betrouwbaar

quadrant = kwadrant; untreated = onbehandeld; leaf stage = bladstadium; beginning of flowering = begin van de bloei; end of flowering = einde van de bloei; length of plants at harvest = lengte van de planten bij de oogst; yield = opbrengst; cobs = kolven; straw = stro; least significant difference = minimum-waarden voor betrouwbare verschillen

Yields of cobs and straw were ascertained and the length of the plants was measured at or before harvest. Results are in Tables 1 and 2.

Injury in the five-leaf stage (A) caused stunted growth but the plants recovered well. At the end of the growing season, there was a significant decrease in the weight of straw but plant height and yield of cobs, though depressed, were not significantly less than from untreated plants.

Injury at the beginning and the end of the flowering period had no influence on growth, as the plants were fully grown or nearly so at those times.

Injury at the beginning of the flowering period (B), at the end of flowering (C) and at both times (F) also gave lower yields, but the effect was less than root pruning in the five-leaf stage (A). Removal of one quadrant of the root system had hardly affected yield (D).

The results suggest that injury to the root system of the plants in five-leaf stage caused most damage; decreases in cobs and straw were 12 and 19% respectively, but none of the decreases in the yields of cobs were significant. Generally plants withstood severe injury to the roots very well.

Differences between the treatments were insignificant, confirming the results of 1960 which suggested that root injury after the five-leaf stage was of little consequence.

TABLE 2. The effect of root injury to maize in 1961. Lengths and yields expressed as percentages of the untreated control.
Resultaten van de wortelbeschadigingsproef bij maïs in 1961. Lengte der planten en opbrengsten in relatieve cijfers ten opzichte van onbehandeld.

Treat-ments	Three quadrants of the root system removed at	Length of plants		Yield	
		1/8	26/10 (at harvest)	Cobs	Straw
A	Five-leaf stage (15/6)	95	99	94	90
B	Ten-leaf stage (7/7)	99	100	97	82
C	Beginning of flowering (1/8)	99	99	95	98
D	End of flowering (23/8)	99	100	93	97
E	Five-leaf stage and beginning of flowering	96	99	94	88
F	Ten-leaf stage and end of flowering	95	99	94	84
O	Untreated	100 (161)*	100 (221)*	100 (12,7)*	100 (22,8)**
<i>Behan- deling</i>	<i>Drie kwadranten van het wortelstelsel verwijderd in</i>	<i>1/8 (b.d.oogst)</i>	<i>26/10</i>	<i>Kolven</i>	<i>Stro</i>
		<i>Lengte van de planten</i>		<i>Opbrengst</i>	

* = length in cm; ** = yields in kg per plot

* = *lengte in cm*; ** = *opbrengst in kg per veldje*

leaf stage = *bladstadium*; beginning of flowering = *begin van de bloei*; end of flowering = *einde van de bloei*; untreated = *onbehandeld*

SAMENVATTING

Zowel in 1960 als in 1961 werd met maïs op goede zandgrond te Wageningen een proef genomen om het effect van een kunstmatige beschadiging van het wortelstelsel op de ontwikkeling en de opbrengst van het gewas na te gaan.

Hierbij bleek dat zelfs een vrij ernstige beschadiging van het wortelstelsel een minder nadelige invloed op de groei en de opbrengst van de maïs uitoefende dan men zou verwachten. De verwijdering van ongeveer 50% van de wortels in het vijf-blad-stadium van het gewas of ongeveer 30% of meer van de wortels op twee tijdstippen (nl. in het begin respectievelijk tegen het einde van de bloei) gaf alleen in de in 1960 genomen proef een betrouwbare verlaging van de stro-opbrengst.

Ten aanzien van de lengte van het gewas en de zaadopbrengst werden echter zowel in 1960 als in 1961 geen betrouwbare verschillen tussen de objecten gevonden. Onder minder gunstige omstandigheden, bijv. op een slechte grond of bij ernstige droogte gedurende het groeiseizoen, geeft een dergelijke beschadiging van het gewas misschien een grotere opbrengstderving; hierover staan ons evenwel geen gegevens ter beschikking.

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