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LOSS OF DRY WEIGHT DURING WASHING AND STORAGE OF ROOT SAMPLES

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Key words

Root mass determination Wheat

Summary

In the standard methods of washing and storage of root samples of wheat, losses of dry weight from 20 to 40% may occur.

Introduction

In developing methods for washing roots from soil samples, the possible loss of fine rootlets is usually recognised as a problem. But also the remaining roots may lose part of their dry weight, by respiration before they die, by leaking out of cell contents or by loss of part of the tissue. Such losses seem to have been disregarded so far. After preliminary observations which indicated that these losses may be considerable, we set up an experiment to simulate the treatment roots undergo with the pinboard or the auger method of root sampling[1]. By using roots from a water culture, the fresh weight of each sample could be measured before treatments started and the dry-matter content after different treatments could be compared with controls dried immediately.

Methods

Wheat (cv. Toro) was grown in water culture, and at three stages of growth (Feekes-scale 5, 10.1 and 11)[3] roots were harvested. At the first harvest, each sample consisted of a complete root system; at the second and third harvest root systems were divided into three samples. The fresh weight of the samples was determined after 30 s in a household centrifuge to remove excess water. The treatments (in triplicate) are shown in Table 1. The combinations used are listed in Table 2. They are a compromise between evaluating all procedures used in practice and treatments which show the most critical steps in these procedures.

Table 1. List of treatments

Treatment	Conditions affecting the roots	Symbol
sampling in the field	cutting roots, about $\frac{1}{3}$ of main axes (pinboard) or to 5 cm pieces (auger)	
and	then	
transport to laboratory	1 day in moist environment at 20°C (all samples)	S
storing soil samples before washing	– no	–
	– 1 week at 20°C (pinboard)	1
	– 2 weeks at 4°C (pinboard)	2
	– drying the soil at 20°C and soaking in pyrophosphate before washing (auger)	3
pretreatment with sodium pyrophosphate ($2.7\ g.l^{-1}$) in vacuum	– no (sandy coils)	–
	– yes (clay or compacted sandy soils)	p
washing	– 3 h in running water (pinboard)	W
	– $\frac{1}{2}$ h in running water (auger)	W
storing after washing	– 1 day in water at 20°C	a
	– 3 days in running water (about 10°C)	b
	– 2 weeks at 20°C with thymol added	c
	– 3 months at 4°C with thymol added	d

Results

Complete results are given in Table 2; an average of the three harvests is given in Fig. 1 to show the sequence of treatments. For the methods used in practice the losses vary from 20 to 40% of the dry matter. A considerable part of this loss occurs on the first day after sampling: 10% of the dry matter for the pinboards and 20% for the auger samples is lost before the samples have reached the laboratory. The use of sodium pyrophosphate under vacuum results in an additional 15% loss for the pinboard, but no additional loss for the auger samples. Drying the soil for storage and soaking it before washing results in an additional 10% loss for the auger samples. The relative losses are highest at the first harvest but they are remarkably similar for the three periods in view of the absolute dry-matter contents of the controls, which increase from 6.0 to 8.9 and 10.2%, respectively.

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Table 2. Loss of dry weight as percentage of untreated control

Treatments	Feekes stage			Average
	5	10.1	11	
Pinboard technique				
S – – – –	12	11	4	9
S – – W –	17	13	21	17
S 1 – W –	35	34	30	33
S 2 – W –	23	14	15	18
S – – W a	20	24	19	21
S – – W b	27	19	17	21
S – – W ac	33	24	27	28
S – p – –	28	31	19	26
S – p W –	37	31	34	34
S 1 p W –	47	39	44	43
S 2 p W –	33	28	29	30
S – p W ac	37	28	40	35
Auger technique				
S – – – –	24	20	14	19
S – – W –	25	14	21	20
S 3 – W –	35	34	23	31
S – – W d	33	26	18	26
S – p W –	23	19	24	22
S 3 p W d	43	36	36	38

Discussion

The lines indicating losses (Fig. 1) converge at certain levels: treatments with a large loss in the initial phase show smaller losses at later stages. This indicates that a certain fraction of the dry matter is easily lost, while another fraction (*e.g.* cell walls) is not affected. The same conclusion was reached by Knot and Mesker[2] for treatments with normal and high concentrations of sodium pyrophosphate combined with boiling of fresh or dried roots (total losses of up to 50% for wheat), and by Brouwer and Van Noordwijk[1] for treatments with HCl (for washing roots from rockwool) and storage methods (tomato and cucumber (unpublished results), total losses about 35%).

The difference in morphology between roots from a water culture and roots in soil makes it difficult to interpret these results. Only the effect of treatments after washing of

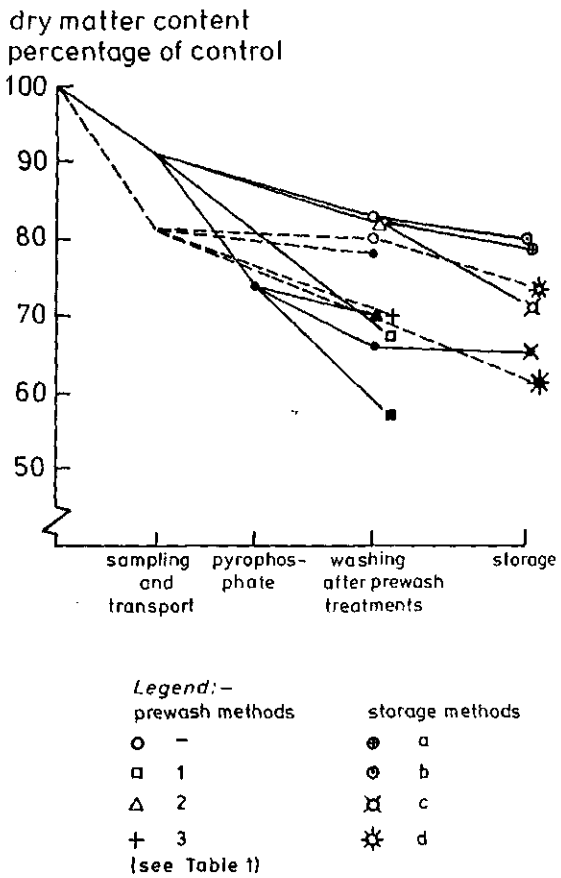

Fig. 1. Dry-matter content of roots after different treatments as a percentage of the untre control. The *broken lines* refer to the auger method, the *solid lines* to the pinboard method. Cl *symbols* are for treatments that include pyrophosphate.

the roots can be evaluated for roots grown in soil. Incidental measurements in the pas these extra losses do not contradict the present results. The presence of soil close to t root during storage and washing might influence the losses in other ways tha temperature and moisture of the environment simulated here. No data on thi available.

Often the absolute root weight is not of primary importance, but is used only comparing treatments or as a basis for estimating root length by subsampling. In the situations only the difference between 20 and 40 per cent loss by variations in washing a storage methods should be carefully considered. But for calculations of carbon balance

the plant (shoot/root ratio, partitioning of assimilates) or in the soil (humus build-up), absolute data on root weights are needed. Data on root weight in literature will often be about one-third too low, because these losses have been neglected. Of course, to correct data in the literature, exact values of these losses have to be determined for different crops and methods.

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