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PLANT SAMPLE ANALYSES AS AFFECTED BY SAMPLE DECOMPOSITION PRIOR TO LABORATORY PROCESSING[1]

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ABSTRACT

A study was made to estimate the error that could result from analyzing decayed plant samples. Uniform groups of corn leaves were permitted to reach variable degrees of decomposition. Dry weight losses were calculated. Samples were then dried and analyzed to establish apparent analyses.

Appreciable dry weight and nitrogen losses can occur with sample rotting. Analyses of decayed samples are distinctly different. The results can be completely and seriously misleading. To prevent sample rotting in shipment, fresh plant samples should be partially dried before packaged for shipment to the laboratory.

INTRODUCTION

During the first two years of plant analysis service operations, several plant samples were received in various states of decay. Numerous samples smelled of ammonia when unpacked. The worst samples were discarded, but the question concerning "how much decay is too much decay" needed answering. How much of an effect could rotting have on analysis and thus upon subsequent diagnosis and recommendations? This study was conducted to estimate these factors.

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METHODS

A uniform group of 60 corn leaves was divided at random into six groups of 10 leaves each. Fresh weight of each group was determined. Two samples, free of decay, were dried and processed immediately. Four samples were placed in a germination cabinet and permitted to decay. Two of these samples were weighed, dried and weighed again when "moderate" rotting had taken place. The last two samples were processed in a like manner after "severe" rotting had taken place. "Moderate" sample rotting is defined as a sample rotting to a point where there is a strong smell, but being free of apparent structural breakdown. "Severe" sample rotting is defined as a sample decaying to a point where apparent structural break-down has begun.

Laboratory processing of dried samples included grinding to pass a 40 mesh screen and subsequent analysis for total N, P, K, Ca, Mg, S, B, Cu, Fe, Mn, Zn and Al. Calculations were made to determine (1) wet-weight loss with rotting, (2) actual element loss with rotting, and (3) relative change in observed analyses as affected by degree of rotting.

RESULTS

Sample weights are shown in Table 1. Moderate rotting resulted in minor wet-weight losses. Severe rotting was accompanied by large wet-weight losses. Non-rotted samples contained about 22% apparent dry weight. Moderately rotted samples contained about 14% apparent dry weight. Severely rotted samples contained only about 11% apparent dry weight. Calculated dry weight loss equalled about 0, 36 and 52% for non-rotted, moderately rotted and severely rotted samples, respectively.

TABLE 1
Plant Sample Weights as Affected by Degree of Rotting

Line	Sample Measurements and Calculations	Degree of Sample Rotting: None, Rep. I	None, Rep. II	None, Avg.	Moderate, Rep. I	Moderate, Rep. II	Moderate, Avg.	Severe, Rep. I	Severe, Rep. II	Severe, Avg.
1	Fresh Weight (g./sample)	124.7	116.6	---	113.9	127.0	---	118.5	135.2	---
2	Wet Wt. After Rotting (g.)	---	---	---	105.4	118.3	---	70.6	51.6	---
3	Wet Wt. Loss with Rotting (g.)	---	---	---	8.5	10.7	---	47.9	83.6	---
4	Dry Wt. (grams)	29.0	25.4	---	16.5	18.1	---	12.0	15.3	---
5	Sample % Dry Wt.*[1]	23.2	21.8	22.5 ± 0.7	14.5	14.3	14.4 ± 0.1	10.1	11.3	10.7 ± 0.6
6	Calculated Dry Wt. (grams)*[2]	28.1	26.2	---	25.6	28.6	---	26.7	30.4	---
7	Estimated Dry Wt. Loss (grams)*[3]	0.9	-0.8	---	9.1	10.5	---	14.7	15.1	---
8	Estimated % Dry Wt. Loss*[4]	3.2	-3.1	0 ± 3.2	35.5	36.7	36.1 ± 0.6	55.1	49.7	52.4 ± 2.7
9	Concentration Factor for Dry Wt. Loss	$\frac{100}{100-0}$ X 100 = 100%			$\frac{100}{100-36.1}$ X 100 = 156%			$\frac{100}{100-52.4}$ X 100 = 210%		

*[1] Dry weight as % of fresh weight = (Dry Weight ÷ Fresh Weight) X 100

*[2] Estimated grams dry weight calculation: Grams fresh wt. X .225, the average % dry wt. of non-rotted samples

*[3] Calc.: Line No. 6 – Line No. 4 = Estimated dry weight loss in grams

*[4] Calc.: (Line No. 7 ÷ Line No. 6) X 100

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Average analyses of the variably rotted samples are shown in Table 2. The observed degree of element concentration relative to the "correct" element analysis (expressed as per cent of non-rotted samples) is shown in parentheses.

TABLE 2
Average Analyses (Dry Wt. Basis) of Variably Rotted Plant Samples and Analyses Change Expressed as Per Cent of Non-Rotted Analyses*1

Element	Sample Handling		
	(1) Non-Rotted	(2) Moderately Rotted	(3) Severely Rotted
N (%)	3.34 ± 0.02	2.49 ± 0.17 (75%)	3.22 ± 0.24 (96%)*1
P (%)	0.33 ± 0.06	0.45 ± 0.05 (136%)	0.68 ± 0.10 (206%)
K (%)	1.52 ± 0.15	2.30 ± 0.04 (151%)	3.10 ± 0.03 (204%)
Ca (%)	0.77 ± 0.08	0.95 ± 0.05 (139%)	1.75 ± 0.25 (250%)
Mg (%)	0.55 ± 0.03	0.82 ± 0.04 (149%)	1.19 ± 0.21 (216%)
S (%)	0.18 ± 0.00	0.34 ± 0.02 (189%)	0.38 ± 0.03 (211%)
B ppm	11 ± 2	13 ± 0 (118%)	12 ± 0 (109%)
Cu ppm	11 ± 1	11 ± 1 (100%)	17 ± 2 (155%)
Fe ppm	230 ± 100	240 ± 0 (104%)	345 ± 55 (150%)
Mn ppm	56 ± 18	78 ± 3 (139%)	87 ± 6 (155%)
Zn ppm	16 ± 4	19 ± 2 (119%)	32 ± 11 (200%)
Al ppm	42 ± 6	50 ± 5 (119%)	64 ± 10 (152%)
Expected Degree of Concentration (% of Non-Rotted)*2	(100%)	(156%)	(210%)

*1 Relative Concentration of Element = (Rotted Analysis ÷ Non-Rotted Analysis) X 100

*2 Expected relative concentration of element calculated on basis of 0, 36 or 52% dry weight loss

Rotting definitely changed the sample analyses. Moderate and severe rotting concentrated the P, K and secondary nutrients approximately as would be expected from calculated dry weight loss values. Nitrogen and sometimes the micronutrients were not concentrated as much as would be expected. Values for nitrogen concentrations would indicate that substantial nitrogen loss had occurred with rotting.

DISCUSSION

These data demonstrate that appreciable dry weight losses can occur with moderate to severe plant sample rotting. The dry weight loss usually has the effect of increasing apparent element analyses to a point where serious errors can result in the diagnosis (See Table 3). Using these data as examples, the actual problem would be a potassium stress accompanied by mild stresses of sulphur and zinc and by iron accumulation. If the sample had rotted moderately, the problem would have been diagnosed as a nitrogen stress accompanied by a minor zinc stress and an accumulation of several other elements. If the sample had rotted severely, the problem likely would have been diagnosed as being non-nutrient in nature, and that nutrient accumulation was a result of some other growth-limiting problem.

TABLE 3
Diagnoses of Plant Samples as Affected by Sample Rotting

Element	Non-Rotted		Moderately Rotted		Severely Rotted	
	Analyses	Status*1	Analyses	Status*1	Analyses	Status*1
N	3.3%	S	2.5%	L-D	3.2%	S
P	0.33%	S	0.45%	S-H	0.68%	H
K	1.5%	L-D	2.3%	S	3.1%	H
Ca	0.77%	S	0.95%	S	1.7%	H
Mg	0.55%	S	0.82%	H	1.2%	H
S	0.18%	L-S	0.34%	S	0.38%	S
B	11 ppm	S	13 ppm	S	12 ppm	S
Cu	11 ppm	S	11 ppm	S	17 ppm	S
Fe	230 ppm	H	240 ppm	H	350 ppm	H
Mn	56 ppm	S	78 ppm	S	87 ppm	S
Zn	16 ppm	L	19 ppm	L-S	32 ppm	S
Al	42 ppm	S	50 ppm	S	64 ppm	S

*1 Status for bloom stage, ear leaf samples:
S = Satisfactory, L = Low, D = Deficient, H = High

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These results show about 50% loss of the total nitrogen with rotting. Furthermore, the data indicate that nitrogen loss occurs most rapidly early during the rotting process. Final results would indicate that nitrogen losses eventually become about proportional to dry weight losses, thereby causing little apparent change in nitrogen analyses of severely rotted samples. Thus it could be concluded that the nitrogen losses with even a minor degree of sample rotting could possibly represent a major problem. About a 50% fraction of the total nitrogen in plant samples appears to be highly liable to loss by rotting.

The failure of micronutrients to always concentrate proportionately with dry weight loss cannot be explained by these data. It may be within the realm of combined experimental errors. The coefficient of variation with micronutrient analyses is much greater than with the primary and secondary elements.

Another interesting factor is indicated by the weight loss data of Table 1. The loss of wet-weight with moderately rotted samples is about equal to the dry weight loss (in terms of grams per sample). With severe rotting under the conditions of this experiment, water was lost more rapidly than organic constituents as the rotting proceeded. More closely controlled studies would be required to confirm these observations.

These data would strongly indicate that no sample rotting can be permitted if reliable results are to be expected with plant analyses. Further studies by this group have shown that field drying of plant samples can be accomplished in several practical ways. This author recommends that all rotted samples be discarded by laboratories doing custom plant sample work.

REFERENCES

1 Revision of technical report by R. B. Lockman, An Investigation Concerning the Effects of Plant Sample Rotting Prior to Drying and Analysis, Agronomic Service Division, AGRICO Chemical Company, October 1965.

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