

# GUATEMALA GRASS ROOTS IN SOIL REHABILITATION

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When consideration is given to the growing of a cover crop for rehabilitating soil after tea has been uprooted, attention naturally tends to be focussed on the visible parts of the crop, the foliage. We have always emphasised that the root action of such a crop is just as important, if not more so, as the effect of the lopped foliage. Presentation of a few simple analyses may serve to bring home our contentions more clearly.

Hershall samplers were used to extract cores of soil from the top six inch layer in areas representing varying climatic conditions and soil types. The cores of soil were allowed to dry on the laboratory bench, after the larger clods were broken by hand to pass through a half inch mesh sieve. Stones retained by the sieve were discarded. After drying, as many as possible of the guatemala grass roots were removed by hand, dried at 98°C in an oven and weighed. On the assumptions that a cylindrical core of soil 6 inches deep and 4 inches in diameter weighs approximately 3 pounds and that an acre of field soil to a depth of 6 inches would weigh, if dried, approximately 2 million pounds, the following conversion was made:—

$$\begin{aligned} & \text{Weight of roots, in ounces, per core} \times \frac{2,000,000}{48} \\ & = \text{Weight of dry roots, in pounds, per acre of 6 inch top soil.} \end{aligned}$$

If desired, the same operation could be carried out for the soil layer between 6 and 12 inches depth, of course, and in some fields this would no doubt give surprisingly high weights of the grass roots. However, as the aim of these very simple experiments was to suggest methods of analyses which could be done on estates with no difficulty and with readily available standard equipment, it was decided to concentrate attention on the more important and more vulnerable top soil.

The centres from which samples were taken were:

Centre A. Dimbula: 4,500 feet; annual rainfall 90 inches. Site A at this Centre represents a steep, wind swept slope, more subject to drought than sites B, C or D, and had been planted with guatemala grass eight years earlier on virgin patana. Site B, which showed a decidedly more vigorous growth of grass, had been planted two years previously after old tea which had given a good cover. Site C represented a small area of over-cultivated garden soil which had been under the grass for three years. This period included a replanting of the grass, which had been exceptionally vigorous, one year before the present samples were taken.

Site D was quite exceptional in being a steep bank of sub-soil thrown out from a building site. When planted under the grass three and a half years previously the raw sub-soil, from an original depth of 10 to 15 feet, was hardly in a condition which could properly represent soil.

Centre B. Maskeliya: 4,500 feet; annual rainfall 120 inches, more uniformly distributed than Centre A. The effect of wind was also more moderate.

The area had been under guatemala grass for one year, following the uprooting of the old tea, which had given a very close cover.

Centre C. Lower Hewaheta: 3,000 feet; annual rainfall 95 inches; more exposed to drying wind than either of the previous centres. Sites A and B had both been planted in guatemala grass for one and a half years following tea which, for pathological reasons, had not provided a good soil cover.

All the sites examined had been regularly manured, and in more recent years, in certain sites, very generously. The accumulation of large grass roots is shown in table I.

TABLE I.—*Accumulation of large guatemala grass roots in the top 6 inch layer of rehabilitated soil*

Centre	Site	Dry weight of roots	Compost equivalent
		Approximated to tons per acre	As tons of fresh weight
A	A	3½	15—19
	B	5	20—25
	C	4½	18—22
	D	10	40—50
B		5	20—25
C	A	3	12—15
	B	15	60—80

Compost is such a variable commodity that only a rough approximation can be attached to the figures in the second column, but they are likely to be underestimates of the fresh weight equivalent as compost. They also provide an interesting basis for a practical evaluation of the grass root content. It should be remembered that, in this particular analysis, no account was taken of the very fine grass roots, which appeared to be most abundant in the top inch or two of the soil, nor of the humus resulting from death and decay of some of the roots produced early in the establishment of the grass.

An additional benefit to be derived from rehabilitation with a cover crop is to be seen in the tendency for a rehabilitated soil to have a definite crumblike structure, as opposed to a loose, powdery, structure all too common in soils which have been exposed to the full force of climatic extremes. Measurement of this effect is more difficult than the estimation of the addition of grass roots to a soil. Nevertheless, yet another attempt has been made to arrive at a very elementary approximation of a full scientific analysis. If a quantity of fresh soil is placed on a 2 millimetre mesh sieve, which is then submerged in a bucket of water and rotated gently about twenty times, it will usually be found that some of the soil remains on the sieve. Stones will also remain, and must be taken into account when estimating the weight of soil retained by the sieve. Crude though this analysis may be, it can give a practical illustration of the aggregating effect of the grass roots.

The following figures in table II will illustrate some comparative effects:—

TABLE II.—Simple estimation of the aggregation of soil by guatemala grass roots; top 6 inch layer

Centre	Site	Percentage of soil retained by a 2 mm. sieve. Stones excluded
A	B	32
	Tea adjoining B	24
	D	21
	Raw sub-soil	0
C	A	29
	Tea adjoining A and B	18
	B	34

Inspection of these results and also those in table I will show that quite wide variations in the measurable effects of the guatemala grass have been found, which do not correlate very closely with climatic conditions or the length of the rehabilitation period. No general conclusions must be sought for in such preliminary work, which was, in fact, directed deliberately at variations in the areas rehabilitated. Two points do merit special mention. The raw sub-soil, Centre A, Site D, after a short period under the grass has been brought into a condition where it is recognisable as soil and not merely weathered rock. Both sites in Centre C were on a loose, gravelly soil, of which Site A was doubtless the more susceptible to drought, and here the effect of the grass roots on the soil was more pronounced than the appearance of the leaf growth would have led one to expect.

A straightforward chemical analysis of the total organic matter of a soil, before and after rehabilitation, would be of little value as a practical tool for estimating the progress of the rehabilitation. The acquisition of many tons of "humus" in the six inch top soil would represent such a small increase in the analytical figure for total organic matter, which includes forms less active than "humus," that the detection of the increment would tend to be obscured by the errors introduced by sampling. It may even be found that the microbial decomposition of the original organic matter, stimulated by the upheaval of uprooting, may continue for a long period, giving a soil which has, excluding the large grass roots, less organic matter after rehabilitation than before. Analyses have been obtained which, allowing for sampling error, show this decrease.

In conclusion, it is suggested that the two physical analyses described may allow an estimation of some of the important effects of cover crop rehabilitation, and may well be found to be within the capacity of the staff of an estate. As usual, we must stress that a soil analysis can only properly be evaluated when it has been correlated with actual results in the field. Individual experimenting is again called for, and until the Institute is in a position to do detailed, on the spot, surveys and analyses we shall have to rely on the compilation of the efforts of individual estates in order to arrive at more general conclusions and eventually make general recommendations on the details of the rehabilitation process.

## Appendix

The scheme for the soil sieving analysis is as follows:—

- (a) Sieve the fresh soil through a  $\frac{1}{2}$ " mesh sieve as gently as possible to remove stones and large roots. Do not crush the soil crumbs more than is absolutely necessary, and do not let the soil dry out.
- (b) Take a small portion of this soil for determination of moisture at 100°C.
- (c) Spread 1 pound of the fresh soil evenly on a sieve of 2 mm. mesh and about 6 inches diameter, submerge gently in a bucket of water and rotate twenty times with a slight vertical movement in addition.
- (d) Dry the residue remaining on the sieve at 100°C and weigh.
- (e) Take the dried residue after weighing, crush the soil so that it falls through the 2 mm. sieve and weigh the remaining small gravel.
- (f) Percentage aggregation is then calculated from the dry weight of the original soil sample, as derived from (b):—

$$\% \text{ Aggregation} = \frac{d - e}{\text{Dry weight of sample} - e} \times 100$$