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EFFECT OF WASTE TEA (TEA FLUFF) ON GROWTH OF YOUNG TEA PLANTS (*CAMELLIA SINENSIS L.*)

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Growth of young tea plants supplied with waste tea was followed in soil and in sand for a period of 4½ months. Treated plants in soil commenced vigorous growth within 2-3 weeks of application as compared to those receiving none. Their shoots were fleshy with large, darker green leaves and with longer internodes.

Plants supplied with waste tea in sand also showed improved growth without displaying deficiency symptoms of any particular element. This indicates the beneficial effects of waste tea as a fertilizer containing adequate quantities of essential nutrient elements which are readily absorbed and utilized by plants.

INTRODUCTION

Waste tea is the part of manufactured tea consisting of stalk and fluff which is not marketed but discarded from many tea factories in Sri Lanka. It constitutes about 3% of the manufactured products of a factory.

In a recent investigation, Krishnapillai (1979) has reported that waste tea, by its own microbial degradation readily liberates ammonium nitrogen which could be utilized by plants. Sivasubramaniam (1973) has also reported that there is a release of nutrients such as N and K from waste tea when incubated in soil. These investigations suggest that waste tea contains nutrients such as N, K and probably other nutrients which could be readily absorbed and utilized by plants.

However, no published work is yet available on the fertilizer effects of waste tea on growth of tea plants. The present investigation was therefore commenced to obtain some information on the above subject using young tea plants in the glasshouse.

MATERIALS AND METHODS

Two experiments were carried out, one in soil and the other in sand culture. The purpose of the latter experiment was to obtain information on the different source of nutrients readily available from waste tea for plant growth.

Experiment 1 — *Tea plants in soil*

The plants used in this study were young clonal plants grown under conventional nursery procedures. Two year old uniform plants of clones TRI 2023, DT 1, DN and nine month old plants of clone CY 9 were used. These plants which were originally in nursery bags were transferred to either cement or metal pots containing soil. At the time of transplanting, the roots of the plants were not disturbed or damaged. The entire root system along with the soil was transferred to the pots intact and the space left behind in the pot was filled with additional soil around the roots right up to the base of the stem. Waste tea (15 g) was then applied uniformly on the surface of the soil right round the plants and the fluff was dibbled in with a glass rod. While 5 plants (replicates) of each clone received fresh tea fluff, another set of 5 plants without fluff served as controls. The plants were arranged in the glasshouse in a randomized block design and watered regularly with tap water.

Experiment II — *Tea plants in sand*

Nine month old plants of clone CY 9 were transplanted into pots containing sand on 28th July 1980, and established in sand for a period of about one month as described by Pethiyagoda, Krishnapillai and Nagarajah (1969). At the end of this period, 15 g of fresh tea fluff was spread on the surface of the sand in the pots and the plants were watered regularly with demineralized water.

There were two plants treated with fluff while two other plants without added tea fluff served as controls. The growth of the plants (from both experiments) was followed for a period of about 4½ months at the end of which a single assessment was carried out.

RESULTS

General observations

Visual differences between the experimental plants were very evident within three to four weeks of commencement of the treatments, the treated plants showing vigorous growth than the untreated controls. The apical buds of most of the treated plants enlarged and commenced growth earlier than the controls producing succulent shoots. The shoots had large and darker green leaves with longer internodes (Figs. 1, 2 & 3). As a result of this behaviour the leaf areas of these two groups of plants differed markedly (Table 1).

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Fig. 1— Appearance of clone DT 1 in the soil treated with waste tea (Pt at left - with waste tea, Pt at right - without waste tea)

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Fig. 2. — Appearance of clone DN in the soil treated with waste tea (Pt at left - with waste tea, Pt at right - without waste tea)

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Fig. 3.—Appearance of clone CY 9 in the soil treated with waste tea (Pt at left—without waste tea, Pt at right—with waste tea)

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Fig. 4.—Appearance of clone CY 9 in the sand treated with waste tea (Pt at left — with waste tea, Pt at right — without waste tea).

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Plants grown in sand culture also showed similar differences between the two treatments (Fig. 4). While in the untreated controls the growth was stunted leading eventually to nitrogen deficiency and defoliation, the treated plants produced normal growth without displaying any deficiency symptoms in the leaves, indicating that the plants were extracting almost all the required nutrients from the waste tea.

Growth assessments

Growth assessments were carried out at the termination of experiment. The measurements carried out were:

1. Height, total stem length and leaf area
2. Fresh weights of the entire plants and
3. Dry weights of the entire plants and of stems, leaves and roots separately.

The above growth measurements are presented in Tables 1 and 2.

TABLE 1 — *Growth assessments of plants of clones DN, DT 1, CY 9 and TRI 2023 supplied with waste tea in soil (All figures are means per plant)*

Treatment	*Ht (cm)*	*Length of side shoots (cm)*	*Leaf area (cm^2)*	*Total F.W. (g)*	*D.W. stem (g)*	*D.W. leaves (g)*	*D.W. roots (g)*	*Total D.W. (g)*
Clone DN								
Without fluff	47.8	40.6	716	64.61	3.47	7.09	9.04	19.60
With fluff	68.4	125.4	1612	107.98	5.68	13.16	10.08	28.92
LSD (P=0.05)	15.1	68.93	274	26.71	1.43	2.20	NS	5.29
Clone DT 1								
Without fluff	74.6	87.2	906	79.88	7.43	6.81	7.69	21.93
With fluff	88.4	158.4	1477	106.45	9.36	11.06	8.97	29.39
LSD (P=0.05)	NS	46.5	370	25.90	NS	2.08	NS	6.63
Clone CY 9								
Without fluff	45.5	15.2	336	29.65	2.64	3.33	4.50	10.47
With fluff	57.0	51.2	849	62.27	5.12	7.40	6.95	19.47
LSD (P=0.05)	4.36	11.09	43.5	9.39	0.6	0.53	2.00	2.74
Clone TRI 2023								
Without fluff	66.8	7.4	1318	74.22	6.28	9.41	9.83	25.52
With fluff	85.6	72.2	1521	110.14	8.78	11.93	13.50	34.21
LSD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS

TABLE 2 — *Growth assessments of plants of clone CY 9 supplied with waste tea in sand (all figures are means per plant)*

Treatment	*Ht (cm)*	*Length of side shoots (cm)*	*Leaf area (cm2)*	*Total F.W. (g)*	*D.W. stem (g)*	*D.W. leaves (g)*	*D. W. roots (g)*	*Total D.W. (g)*
Without fluff	33	6	146	20.97	1.38	1.25	3.43	6.06
With fluff	42	37	514	48.56	2.17	3.76	4.94	10.87

It can be seen from the tables that there are marked differences in all the growth parameters recorded between the treated and control plants. The greatest difference between the treatments was in respect of leaves whose leaf area and dry weights were considerably greater in the treated plants for all the clones studied. Waste tea has not influenced the growth of the roots of any of the clones studied.

Anion and cation contents

The bulked and sub-sampled dried leaves, stems and roots of each experimental plant were used to determine total contents of N (by Technicon Auto Analyser II System), K and Ca (by flame photometry), P (by molybdo-vanado method) and Mg and Mn (by Atomic absorbtion spectrophotometry). The results are presented in Table 3.

TABLE 3 — *Effect of waste tea on total nutrient element content of plant components (mg per plant)*

Clone DN		*N*	*P*	*K*	*Ca*	*Mg*	*Mn*
Without fluff	Roots	155.0	13.56	80.5	71.2	88.30	5.33
	Stems	61.0	5.86	13.0	32.5	20.25	4.79
	Leaves	202.0	14.68	69.8	90.8	112.44	35.90
	Total/pt	418.0	34.10	163.3	194.5	220.99	46.02
With fluff	Roots	162.0	15.12	61.4	71.9	102.11	5.54
	Stems	68.0	8.52	29.3	34.1	55.43	4.90
	Leaves	359.0	27.64	101.2	155.3	223.98	56.70
	Total/pt	589.0	51.28	191.9	261.3	381.52	67.14

Clone DT 1		*N*	*P*	*K*	*Ca*	*Mg*	*Mn*
Without fluff	Roots	109.0	11.54	36.1	54.8	72.98	3.34
	Stems	83.0	11.15	38.3	69.7	60.18	5.80
	Leaves	171.0	11.51	79.7	74.2	106.23	33.40
	Total/pt	363.0	34.20	154.1	198.7	239.39	42.54
With fluff	Roots	148.0	15.97	33.6	84.1	68.44	4.89
	Stems	133.0	14.04	48.3	87.8	79.18	7.07
	Leaves	311.0	22.78	191.1	137.1	151.85	47.07
	Total/pt	592.0	52.79	273.0	309.0	299.47	59.03

Clone TRI 2023		*N*	*P*	*K*	*Ca*	*Mg*	*Mn*
Without fluff	Roots	138.0	11.54	72.1	72.1	65.98	3.50
	Stems	99.0	7.10	44.2	42.4	49.47	5.20
	Leaves	205.0	17.88	83.8	106.3	149.52	46.80
	Total/pt	442.0	36.52	200.1	220.8	264.67	55.50
With fluff	Roots	148.0	17.58	96.9	80.7	77.86	5.70
	Stems	122.0	14.75	45.3	103.6	82.27	7.99
	Leaves	381.0	25.05	139.6	179.0	178.00	53.90
	Total/pt	651.0	57.38	281.8	363.3	338.13	67.59

Table 3

Clone CY 9		N	P	K	Ca	Mg	Mn
Without fluff	Roots	48.0	7.60	42.3	38.8	41.10	3.98
	Stems	25.0	4.46	9.9	23.8	21.10	3.17
	Leaves	56.0	7.49	35.9	54.9	60.84	22.82
	Total/pt	129.0	19.55	88.1	117.5	123.04	29.97
With fluff	Roots	73.0	10.42	81.5	60.0	66.58	6.74
	Stems	54.0	5.79	24.0	60.4	49.41	7.53
	Leaves	161.0	13.17	86.7	87.3	146.74	53.54
	Total/pt	288.0	29.38	192.2	207.7	.262.73	67.81

Clone CY 9 in sand		N	P	K	Ca	Mg	Mn
Without fluff	Roots	39.0	7.07	16.1	34.1	25.30	0.77
	Stems	14.0	2.33	3.2	16.2	9.06	1.46
	Leaves	20.0	3.64	8.8	18.3	15.89	10.16
	Total/pt	73.0	13.04	28.1	68.6	50.25	12.39
With fluff	Roots	87.0	11.11	41.7	42.6	35.12	1.58
	Stems	25.0	4.08	8.1	20.4	20.00	2.03
	Leaves	96.0	7.90	33.5	56.4	76.03	15.60
	Total/pt	208.0	23.09	83.3	119.4	131.15	19.21

Total N, P, K, Ca, Mg and Mn contents varied between the different organs and also between the two treatments — the treated plants showing higher values. Generally, the more actively growing leaves and roots had higher values than the tissues of the stems. Treated plants of all the four clones had higher quantities of N, P, K, Ca, Mg and Mn in their roots, stems and leaves than the corresponding tissues of the controls. A large proportion of the total quantity of N, P, K, Ca and Mg assimilated by the plants was found in the leaves. This trend was also very evident in the plants growing in sand.

DISCUSSION

Waste tea exerts pronounced effects on the growth and on nutrient contents (N, P, K, Ca, Mg and Mn) of all the plant components of young tea plants grown in soil or in sand. The increased growth and high ionic contents obtained in the treated plants are to be attributed to the nutrient availability from the applied waste tea. Since the growth response was evident within 3—4 weeks of application of waste tea, it is legitimate to assume that there was a rapid release of nutrients from waste tea for absorption and utilization by the plants. The findings (Krishnapillai, 1979) that soil incubated with waste tea showed a rapid build up of ammonium nitrogen and the quantity so formed was directly related to the amount of waste tea incubated (ie a production of 300—600 ppm NH_4—N from 5—9% waste tea in soil during an incubation period of 0—8 days) also suggest that the treated plants were absorbing and utilizing ammonium ions liberated from the waste tea right from the beginning of the experiment. The rapid liberation of ammonium ions from waste tea may be due to its high content of N (above 4%) available for rapid metabolism and mineralization by the micro organisms in the soil. In addition, the fact that the total nutrient contents are all higher in the treated plants (Table 3) also emphasize that these elements were readily available in the treated soil for absorption by the plants.

Sand culture experiment supports the above findings. In this experiment, as there was possibly no nutrient element available from the sand medium, the plants were depending solely on the applied fluff for their nutrients. The observation that these plants grew well without displaying deficiency symptoms of any particular element, but accumulated reasonable quantities of them in their tissues, particularly in leaves, also suggests that they were extracting almost all the required essential nutrients from the fluff. However, it is to be noted that unlike in soil where the growth of the treated plants was vigorous, in sand the growth was comparatively slow and the total dry matter production was low. The slow growth in sand might have been due to the low microbial activity and slow release of nutrients from the added fluff in sand. On the other hand, the microbial activity would be faster in soil and therefore adequate quantities of nutrients would be available for absorption by the plants growing in soil.

The initial growth response to the applied tea fluff was observed to be greater for the vigorous clone (TRI 2023) than the less vigorous clones such as DN, DT 1 or CY 9. Vigorous clones such as TRI 2023, by virtue of its vigorousness, could have responded faster by extracting more nutrients from the applied fluff to produce the initial growth boost, which however, was not maintained throughout, probably due to insufficiency of the applied fluff. As a result of this, although there was a general increase in all the plant components of the treated plants of clone TRI 2023, such growth increase was not so marked as that obtained for the less vigorous clones (Table 1). It is, however, to be noted that applications of fluff in excess of plant's need could bring about toxic effects on plant growth. Since there is a ready liberation of ammonium ions from waste tea (Krishnapillai, 1979), heavy application of fluff in tea fields could lead to an accumulation of excess quantities of ammonium ions causing toxicities. Excess accumulation of ammonium ions have been shown to produce toxic symptoms in the leaves of tea plants (Krishnapillai, 1979).

Application of waste tea generally resulted in the production of more of the shoot system than the roots and this was evident in all the clones studied. The percentage increase in the dry matter production of the treated plants varied from 26—94 for stems, 62—200 for leaves and only 12—54 for roots. As the growth of shoots is generally promoted by nitrogenous nutrients, it could be inferred that more of nitrogen was available from fluff for absorption and utilization by the plants.

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KRISHNAPILLAI, S. (1979). Inhibition of nitrification by waste tea ('Tea fluff'). *Plant and Soil* **51**, 563-569.

KRISHNAPILLAI, S. and PETHIYAGODA, U. (1979). Effect of forms and levels of nitrogen on the growth and root starch reserves of young tea plants (*Camellia sinensis L.*) growth in sand culture. *Trop. Agric. Trinidad* **56**, 205-211.

PETHIYAGODA, U., KRISHNAPILLAI, S. and NAGARAJAH, S. (1969). Studies on the mineral nutrition of tea. 1. Techniques for growing tea plants in sand culture. *Tea Q.* **40**, 145-152.

SIVASUBRANANIAM, S. (1974). Report of the Agricultural Chemistry Division. Rep. Tea. Res. Inst. of Sri Lanka for the year 1973, 17-19.