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Export of nutrient by some rose cultivars in Tenerife

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INTRODUCTION. — To be able to apply fertilizer sensibly it is necessary to know the nutritional needs of the crop which depend on the species, and to some extent, the variety, and are affected by the physico-chemical characteristics of the soil, and also environmental and cultivation-factors. Therefore it is understandable that data on fertilizer needs estimated in given conditions have a limited utility when there is question of applying them in different conditions.

The work method to ascertain the nutritional needs, and therefore the fertilizer requirements, consists in determining the nutrient exports of the crop. In the case of the rose bush for cut flowers although the methodology used by the various researches is similar there are numerous procedural details which differ from one to the other, and complicate the interpretation of the results. Thus some researchers determine the nutrient export of the usable part of the crop, that is to say, what is taken away from the plantation (the flowering stem in the case of the rose for cut flowers), while others include wastage by pruning and fallen foliage.

The amount of nutrients extracted by the flowering stem is calculated by means of the analysis data of its various parts (flower young leaves, mature leaves, stems) carried out individually. The results are expressed in milligrammes of nutrients extracted by flowering stem, or plant. There is the difficulty that the percentages of flower os the different qualities are not usually specified, necessary data in view of the great variability which the lenght of the flowering stems can show, even within, the same variety.

Moreover the problem is still further complicated by the diversity of rootstocks, given the differences in the configuration and development of the root systems, and their capacity to absorb nutrients.

In view of all this [illegible] the various re[illegible] searches [illegible]

As an example we shall quote some results obtained in diffe rent rose-producing areas.

The cultivar Baccara (long stem) has been one of the most stu died, its nutritional needs having been determined in a variety o conditions. DROUINEAU (1962) determines the following annual ex ports in grs./m^2 in roses grafted on *R. Indica* rootstocks:

N: 12.00; P: 1.31; K: 8.33; Ca: 5.72

On the other hand MOULINIER and MONTARONE (1975) obtai for the same variety exports of:

N: 370; P: 39; K: 292; Ca: 200 and Mg: 55 expressed in mg/ flower.

LÓPEZ MELIDA in the Spanish Levant obtains:

N: 14.62; P_2O_5: 3.17; K_2O: 10.84 expressed in grs/plant.

This author estimates for the cultivar Carina (short stem) th extractions:

N: 14.01; P_2O_5: 1.97; K_2O: 11.49 expressed in grs/plant.

HAAG (1974) find that the cultivar Happiness extracts:

P: 23.6; K: 232.1; Ca: 158.6 and Mg: 32.8 mgs/plant.

Some researches note that in the determination of the export the material extracted in pruning and pinching out operations ha been taken into account. Thus DROINEAU (1962) obtains for th « Rouge Meilland » on *R. Canina*:

N: 14.50; P_2O_5: 1.49; K_2O: 3.88; CaO: 7.47 grs/plant.

We did not in the literature consulted data on the varieti grown in Tenerife, and therefore we carried out a study on thre cultivars of great commercial importance: « Visa » and « Ilona (long stem) and « Mercedes » (short stem) grafted on *R. Canir Inermis*.

MATERIAL AND METHODS. — The working [illegible] we followed [illegible] purpose [illegible] in the first place, in determining the [illegible] extracted by the flowering [illegible] was [illegible] dry weight, and analysing separately the different stem parts: bud, leaves and stem.

The sampling was carried out in two consecutive years in a commercial greenhouse on plants of 3 years old. On each occasion 15 subsamples (flowering stems) were taken of each of the commercial qualities which are given by stem lengths. The production data were collected in the principal commercial greenhouses of the island of Tenerife.

The buds, leaves and stems for the different qualities were analysed separately.

The mineralization of the samples was carried out by the dry ash method, the determination of the cations by atomic absorption spectrophotometry and the P by the vanadate-molybdate yellow method. The N was determined by the Kjeldahl procedure.

RESULTS AND DISCUSSION. — Tables n. 1, 2 and 3 set out the nutrient amount extracted by each flowering stem for the different qualities in the cultivars « Visa », « Ilona » and « Mercedes » respectively. Each of the data represents the average of the values obtained in the two years in which the study was carried out. In view of these figures the importance of taking stem length into account is regard to their nutrient contents are very clear. It can be seen that the total content of each of the macro and micronutrients in all parts of the stem increases with stem length. In most of the cases the leaves monopolize the greatest nutrient amount, followed by the stems, and finally the buds. Due to the large amount of nutrients contained in the leaves, the fallen foliage represents a considerable proportion of these nutrients, although as it is usually left on the ground, it need not be taken into account when estimating the net extractions of the crop.

The average nutrient extractions by the flowering stem for the three cultivars are as follows.

	mgs/flowering stem					µgs/flowering stem			
	N	P	K	Ca	Mg	Fe	Mn	Zn	Cu
Ilona	144.9	29.18	[illegible]	52.99	20.86	470.7	679.7	270.9	112.6
Visa	139.9	19.86	[illegible]	42.53	17.52	407.1	960.3	252.3	64.1
Mercedes	105.4	9.05	[illegible]	31.35	11.76	349.5	405.3	141.9	59.0

If the results in tables n. 1, 2 and 3 are examined it can be seen that the average extr[illegible] of the different qualities is very similar to th[illegible] of a 70 cm s[illegible] the case of [illegible] « Ilona »,

TABLE 1. *Nutrient content in the various parts of the flowering stem for the cultivar Visa*

Stem lenght	Organ	N	P	K	Ca	Mg	Fe	Mn	Zn	Cu
		mg/flowering stem					µg/flowering stem			
30	Bud	23.80	3.36	24.48	2.49	2.59	57.60	40.30	36.50	12.50
	Leaves	33.60	2.76	24.48	14.12	4.84	110.20	172.50	36.80	10.10
	Stem	7.60	1.26	13.94	1.91	0.93	27.90	19.20	22.80	6.60
		65.00	7.36	62.90	18.52	8.36	195.70	232.00	96.10	29.20
40	Bud	29.00	5.18	28.26	2.75	3.12	72.65	71.85	45.30	10.30
	Leaves	39.34	4.05	30.83	16.27	5.39	132.80	425.55	63.60	13.50
	Stem	9.36	3.21	19.94	2.75	1.67	40.75	52.50	40.70	10.50
		77.70	12.44	79.03	21.77	10.18	246.20	549.90	149.60	34.30
50	Bud	33.90	5.65	29.24	2.64	3.22	71.05	59.80	52.65	10.50
	Leaves	60.73	7.12	43.83	24.00	7.56	187.92	551.30	94.50	17.60
	Stem	14.37	4.46	27.34	3.82	2.58	59.03	58.90	54.10	16.50
		109.00	17.23	100.41	30.46	13.36	318.00	670.00	201.25	44.60
60	Bud	39.11	5.31	32.85	3.35	3.53	75.70	73.25	63.45	9.50
	Leaves	73.36	8.63	59.14	31.90	9.87	253.85	804.10	122.05	24.60
	Stem	19.88	6.43	39.82	5.38	3.80	77.45	92.90	71.35	18.70
		132.35	20.37	131.81	40.63	17.20	407.00	970.25	256.85	52.80
70	Bud	40.65	5.71	36.91	3.66	3.76	84.60	83.90	63.40	11.00
	Leaves	95.62	9.69	69.20	38.43	12.00	287.55	1028.00	146.25	24.00
	Stem	32.43	8.35	50.81	6.73	5.03	92.95	116.80	89.75	26.90
		168.70	23.75	156.92	48.82	20.79	465.10	1228.70	299.40	61.90
80	Bud	38.93	4.63	31.93	3.91	3.75	79.50	84.85	66.65	12.30
	Leaves	113.66	11.97	89.02	48.49	14.47	339.50	1292.75	181.35	33.60
	Stem	31.74	10.85	65.13	8.95	6.50	124.00	161.10	110.35	31.40
		184.33	27.45	186.08	61.35	24.72	543.00	1538.70	358.30	77.30
90	Bud	38.32	5.12	38.36	4.13	4.05	101.60	89.40	67.70	16.40
	Leaves	152.86	14.66	105.68	60.02	14.94	387.10	1231.70	179.85	48.20
	Stem	51.27	30.64	89.28	12.06	9.04	186.30	211.40	156.95	84.30

TABLE 2. — *Nutrient content in the various parts of the flowering stem for the cultivar Ilona.*

Stem lenght	Organ	mg/flowering stem					µg/flowering stem			
		N	P	K	Ca	Mg	Fe	Mn	Zn	Cu
30	Bud	14.67	2.33	14.01	0.60	1.73	45.36	18.68	28.01	8.67
	Leaves	46.89	3.93	30.58	18.71	6.31	124.25	189.46	46.20	17.53
	Stem	6.44	1.64	11.21	2.19	0.76	36.39	17.86	25.79	12.30
		68.00	7.90	55.80	21.50	8.80	206.00	226.00	100.00	38.50
40	Bud	16.95	2.43	15.84	0.66	1.92	43.48	21.37	30.95	7.37
	Leaves	50.07	4.69	36.26	19.39	6.63	117.69	228.48	49.01	19.11
	Stem	11.98	2.48	17.30	3.35	1.25	46.83	26.15	34.04	12.32
		79.00	9.60	69.40	23.40	9.80	208.00	276.00	114.00	38.80
50	Bud	18.05	2.51	17.27	0.79	1.96	54.95	25.12	39.25	11.78
	Leaves	70.87	5.95	48.69	26.61	9.50	179.19	338.73	74.99	29.00
	Stem	17.08	3.84	28.74	4.80	2.24	87.86	49.15	66.76	27.22
		106.00	12.30	94.70	32.20	13.70	322.00	413.00	187.00	68.00
60	Bud	15.78	2.63	19.54	1.84	2.37	55.21	35.06	33.44	10.52
	Leaves	76.08	8.51	71.91	34.42	11.50	236.38	422.98	92.95	39.99
	Stem	21.94	3.96	38.55	6.74	2.93	68.62	61.96	82.61	28.59
		113.80	15.10	130.00	43.00	16.80	381.00	520.00	209.00	79.10
70	Bud	15.70	3.05	20.60	2.40	2.49	68.35	51.72	42.48	14.78
	Leaves	97.01	9.32	84.26	42.86	13.15	255.62	766.54	123.94	45.35
	Stem	29.29	6.33	58.14	9.54	4.56	147.03	126.74	127.58	41.87
		142.00	18.70	163.00	54.80	20.20	471.00	945.00	294.00	102.00
80	Bud	16.92	3.28	21.39	2.09	2.49	61.69	48.76	44.78	14.93
	Leaves	119.37	12.58	99.48	53.40	17.96	301.35	834.55	134.08	52.89
	Stem	39.43	10.31	74.08	11.94	5.90	181.74	145.27	153.44	72.34
		175.72	26.17	194.95	67.43	26.35	544.78	1028.58	332.30	140.16
90	Bud	19.09	3.62	22.88	2.13	2.55	74.48	42.56	47.88	15.96
	Leaves	142.08	14.82	119.63	64.21	22.51	388.39	775.77	177.69	74.95
	Stem	55.97	12.88	107.94	17.14	8.56	268.90	170.03	221.14	179.42
		217.14	31.32	250.45	83.48	33.62	731.77	988.36	446.71	195.38
100	Bud	18.58	3.48	22.64	1.86	2.67	78.96	46.44	53.41	13.93
	Leaves	168.30	18.48	150.84	74.95	24.48	466.09	807.57	182.11	85.96
	Stem	70.97	18.44	144.29	21.30	10.50	355.42	186.93	254.77	138.88
		257.85	40.40	317.77	98.11	37.65	900.47	1040.94	490.29	238.77

TABLE 3. — *Nutrient content in the various parts of the flowerings stem for the cultivar Mercedes.*

Stem lenght	Organ	mg/flowering stem					µg/flowering stem			
		N	P	K	Ca	Mg	Fe	Mn	Zn	Cu
30	Bud	17.10	2.08	13.54	1.68	1.54	52.28	39.40	33.65	9.50
	Leaves	41.51	2.84	24.99	15.71	4.72	127.64	220.37	37.55	15.76
	Stem	10.59	1.17	7.18	2.98	1.37	40.53	23.23	24.05	13.24
		69.20	6.09	45.71	20.37	7.63	220.45	283.00	95.25	38.50
35	Bud	17.53	1.97	13.69	1.94	1.59	58.99	33.65	32.93	8.65
	Leaves	53.63	3.69	29.35	18.07	5.48	146.63	212.29	39.75	19.02
	Stem	11.99	1.54	8.76	3.59	1.63	50.63	22.56	27.32	16.33
		83.15	7.20	51.80	23.60	8.70	256.25	268.50	100.00	44.00
40	Bud	21.13	2.45	15.94	2.08	1.88	73.10	40.45	41.29	10.63
	Leaves	62.63	4.09	34.99	22.05	6.94	180.74	302.43	54.73	23.13
	Stem	17.09	2.04	11.29	4.73	2.27	64.21	35.02	43.03	22.69
		100.85	8.58	62.22	28.86	11.09	318.05	377.90	139.05	56.45
45	Bud	21.17	2.34	17.43	2.22	1.99	95.45	98.69	42.80	11.58
	Leaves	76.26	4.89	43.25	26.94	8.25	220.11	347.19	62.24	56.20
	Stem	22.07	2.89	15.89	6.30	3.39	109.64	47.32	58.61	29.42
		119.50	10.12	76.57	35.46	13.63	425.20	493.20	163.75	67.20
50	Bud	23.93	2.68	19.59	2.36	2.11	86.33	46.72	49.90	11.66
	Leaves	98.48	6.73	58.31	37.55	11.11	316.00	496.15	84.21	35.58
	Stem	31.74	3.86	20.83	8.55	4.56	125.12	60.93	77.74	41.86
		154.15	13.27	98.73	48.46	17.78	527.45	603.80	211.85	89.10

TABLE 4. — *Productions according to qualities in flower/m² obtained in commercial greenhouses*

Long-stemmed cultivars

Cultivar	Yield	Commercial quality (cm) ≥ 90	80	70	60	50	40	≤ 30	Total
Visa	Maximum	17	19	20	22	18	8	16	120
	Average	14	16	17	18	15	7	13	100
Ilona	Maximum	8	7	14	19	21	17	14	100
	Average	7	6	12	16	18	14	12	85

Short-stemmed in cultivars

Cultivar	Yield	Commercial quality (cm) ≥ 50	45	40	35	≤ 30	Total
Mercedes	Maximum	57	40	36	30	37	200
	Average	46	32	29	24	29	160

a 60 cm. stem in the cultivar « Visa », and a 40 cm. in the cultivar « Mercedes ». This suggest that a great deal of information could be obtained with a minimum of effort by sampling stems of medium length. Furthermore, as we have shown in another study these stems of medium size are the most suitable for taking samples for foliar diagnosis.

In the previous results it is noticed that the average extraction by flowering stem depends on the stem length of the plant, being maximum in the cultivar « Ilona » whose flowering stems at times exceed one metre in length, and minimum for « Mercedes » a typical representative of short-stemmed roses. These tendencies are maintained in « Ilona ». This could be because of the variation in the micronutrient contents of the leaves due to the occasional application of these elements by foliar aspersion. It is noteworthy that while for the two long-stemmed varieties the differences are relatively small, the cultivar « Mercedes » has contents that in some cases (phosphorus, potassium, copper, and zinc) reach 50% of the other cultivars.

In view of these results it might be thought that the nutritive needs of the first two cultivars are much greater than those of « Mercedes », but this is false, since the nutrient needs depend on the qualitative and quantitative production. Moreover the yields are, within certain limits, a ch[illegible] of the cultivar, that is to say, cer-

tain cultivars are by nature more productive than others in like conditions; all of which makes the calculation of the nutritional needs of a given cultivar a fairly complex problem. To carry out this calculation we examined the production and quality data of the most important commercial greenhouses in the island of Tenerife. As a result of this examination we obtained the figures in table n. 4 in which it can be seen that for the cultivar « Visa » a good production may range from 100 to 120 flowers/m² while for de « Ilona » it is from 85 to 100. The cultivar « Mercedes » (short stem) is much more productive, the productions obtained in this case varying from 160 to 200 flowers/m². As regards the quality it can be seen that in the long-stemmed varieties the greatest percentage of the flowers have flowering stems of intermediate length, whereas in the « Mercedes » the distribution of flowers by quality is more even. This is due to the arbitrariness of the classifications.

Based on these production data and the determinations of the nutrient content of the flowering stems of different lengths that appear in tables n. 1, 2 and 3 we calculated the total nutrient amounts extracted per square metre for the three cultivars under study (see table n. 5).

If the two long-stemmed cultivars are compared it is seen that the amounts of all the nutrients exported are always higher in the case of « Visa » in spite of the fact that the extractions per flowering stem are, on average, higher in « Ilona », which is due to the greater productivity of « Visa ». Hence it can be infered that it is desirable to express the exports by surface cultivated instead of by flowering stem as happens in most of the relevant publications.

In table n. 5 it can be seen that the cultivar « Mercedes » (short stem) extracts much more nitrogen than « Visa » and « Ilona », the extractions for an average production (17.8 grs. of N) exceeding the maximum of « Ilona » (11.8 grs.) and equalling the maximum of « Visa » (17.5 grs.). A similar situation is shown for calcium. As regards phosphorus and potassium the greatest extractions are shown in the cultivar « Visa », followed by « Mercedes » and « Ilona ». The greatest extractions of magnesium are always found in the cultivar « Mercedes » followed by « Visa » and « Ilona ».

With regard to the micronutrients it is seen that the cultivar « Mercedes » shows the greatest extractions of iron and copper, while « Visa » extracts the greatest amounts of manganese. The [illegible]

TABLE 5. — *Annual extraction of nutrient by the plant.*

Cultivar	Yield	grammes/m²					mgr/m²				Flowers/m²
		N	P	K	Ca	Mg	Fe	Mn	Zn	Cu	
Visa	Maximum	17.53	2.49	16.99	5.35	2.20	50.87	121.40	31.68	7.94	120
	Average	14.62	2.08	14.16	4.46	1.83	42.41	101.30	20.76	6.61	100
Ilona	Maximum	11.80	1.55	12.40	4.16	1.65	37.36	65.24	24.62	9.61	100
	Average	10.07	1.32	10.54	3.55	1.41	31.91	46.94	18.20	7.08	85
Mercedes	Maximum	22.26	1.91	14.18	6.68	2.50	74.37	86.28	30.16	12.54	200
	Average	17.81	1.53	11.34	5.34	2.00	59.50	69.02	24.13	10.03	160

traction do not seem to differ expecially among the three cultivars studied.

For the calculation of fertilizer needs it is necessary to take account of something not so far considered: the nutrient extraction of the material removed in pruning and pinching out which is usually removed from the nursery. According to the literature consulted and the data obtained that pruning could represent 15% of the total nutrients exported by a plant.

Based on the results previously set out we have calculated the following exports of nutrients expressed in grs/m².

Cultivar	Production	N	P_2O_5	K_2O	CaO	MgO
Visa	Maximum	20.16	6.55	23.45	8.61	4.17
	Average	16.81	5.47	19.54	7.18	3.47
Ilona	Maximum	13.57	4.08	17.11	6.69	3.14
	Average	11.58	3.48	14.54	5.71	2.67
Mercedes	Maximum	25.60	5.04	19.57	10.75	4.75
	Average	20.48	4.03	15.65	8.60	3.80

From these data it can be deduced that an adequate proportion in restitution fertilizer should be 1:0.30:1.25 for long-stemmed varieties, and 1:0.20:0.80 for short-stemmed expressed in the form of $N:P_2O_5:K_2O$.

In rose bushes already formed the application of the fertilizer amounts equivalent to these figures would cover only the extractions by the plant. N[illegible]ss, to carry out the recommend[illegible]

for fertilizer use it must be remembered that the degree of utilization for fertilizer is very variable depending on such diverse factors as fixation and insolubilization, and losses by washing which are conditioned, in turn, by the physico-chemical properties of the soil. Like-wise it is necessary to take account of the mobility of the nutrients which is maximal in the case of nitrogen somewhat less in potassium and minimal in phosphorus. On this point LINDEMAN (1957) estimates that the degree of utilization of nitrogen and potassium added to the soil is 70% and 30% for phosphorus.

These figures are of very doubtful application in our conditions in view of the great heterogeneity of the soils in which this plant is grown. Nevertheless these soils generally have high contents of available K and P, but on the other hand they also have, in many cases, a high phosphorus-fixing capacity because of the presence of alophanes and hydroxides of Fe and Al (DÍAZ, 1982).

In a fertilizer trial we have found no response to the qualitative and quantitative yields to potassium fertilizer when the soil-available potassium content is above 2.30 meq/100 gr. No response has been noted either to phosphate fertilizer when the available P_2O_5 is above 100 ppm.

As regards the nitrogen it is to be supposed that the losses by washing are considerable in view of the excessive amounts of irrigation applied because of the deficient quality of the water.

From the foregoing it is to be infered that by carrying out a frequent and periodic chek of the fertility by means of soil and foliar analysis, it would be possible, in many cases, to apply only, restitution fertilizer and even, on occasion, it is possible that cultivation could be carried on applying only nitrogenous fertilizers.

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SUMMARY. — The nutrient export by flowering stems in 3 year-old rose bushes was determined for three varieties of great commercial importance in Tenerife.

The cultivar VISA exports annually per m² 20,16 grs N, 6,55 grs P_2O_5 and 23,45 grs K_2O, white ILONA exports 13,57 grs N, 4,08 grs P_2O_5 and 17,11 grs K_2O, and MERCEDES 25,60 grs N, 5,04 grs P_2O_5 and 19,57 grs K_2O. The nutirent amounts extracted from the greenhouse in pruning and pinching out operations are included in these figures.

RÉSUMÉ. — On a étudié l'éxportation de nutrients par des tiges floraux de plantes de rose agées del 3 ans dans 3 cultivas avec de l'importance commerciale dans l'ile de Tenerife.

La cultivar VISA fait une exportation par m² de: 20,16 grs. N; 6,55 grs. P_2O_5; 23,45 grs. K_2O. Pour ILONA l'exportation est: 13,57 grs. N; 4,08 grs. P_2O_5; 17,11 grs. K_2O, et pour la c.v. MERCEDES: 25,60 grs. N; 5,04 grs. P_2O_5 et 19,57 grs. K_2O. On à inclué les quantités de nutrients qui sont exportés par la taille e l'évrillage.

ZUSAMMENFASSUNG. — Die Exportierung von Nahrungen in drei Jahre alte Rosen wird auf drei Cultivars von grosser geschäflichen Wichtigkeit bestimmt, auf Teneriffa liegend

Der Cultivar VISA exportiert Jährlich jedes M²: 20,16 gr. von N.; 6,55 gr. P_2O_5 und 23,45 gr. K_2O, auf der anderen Seite exportiert ILONA: 13,57 Gr. von N.; 4,08 Gr. von P_2O_5 und 17,11 Gr. von K_2O; und MERCEDES: 25,60 Gr. von N.; 5,04 Gr. von P_2O_5 und 19,57 Gr. von K_2O. Inbergriffen in diesen Summen wird die Menge von Nahrungen die aus den Operationen von Beschneidung und Pestigung entnommen sind.

RESUMEN. — Se determina la exportación de nutrientes realizada por los tallos florales en rosales de 3 años de edad de 3 cultivares de grán importancia comercial en Tenerife.

El cultivar VISA exporta anualmente por m²: 20,16 gr. N; 6,55 gr. P_2O_5 y 23,45 gr. K_2O. ILONA exporta: 13,57 gr. N; 4,08 gr. P_2O_5; 17,11 gr. K_2O y MERCEDES: 28,60 gr. N; 5,04 gr. P_2O_5 y 19,57 gr. K_2O. Se incluye en estas cifras las cantidades de nutrientes extraidas en las operaciones de poda y pinzado.

RIASSUNTO. — Si determina l'asportazione di elementi nutritivi con la raccolta dei fiori sulla pianta di rosa di 3 anni d'età in tre c.v. di grande importanza commerciale, nell'Isola di Tenerife.

La coltura « VISA » asporta annualmente per m²: 20.16 g. N; 6.55 g. P_2O_5 y 23.45 g. K_2O. Per « ILONA » l'asportazione è: 13.57 g. N; 4.08 g. P_2O_5; 17.11 g. K_2O, e per la c.v. « MERCEDES »: 25.60 g. N; 5.04 g. P_2O_5 e 19.57 g. K_2O. In queste cifre sono comprese le potature e la spuntatura

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Studies on water soluble boron in salt affected soils of semi-arid tract

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INTRODUCTION. — Boron is an essential micro-nutrient element for plants. The total boron content in the soils of world varies from 2 to 1000 ppm (SWAINE 1955). Indian soils have been found to vary from 7 to 630 ppm in total boron content (KANWAR 1976). Some of the Indian soils, particularly in the arid and semi-arid regions, and the saline-alkali soils are rather high in total boron. The form of boron that actually matters in growth and vigour of plants is water soluble boron which fortunately in Indian soils varies from traces to 12.2 ppm not with standing high total boron content. The salt affected soils are commonly met with the problem of high water soluble boron accumulation owing to poor surface and sub-surface drainage and exists probably as Na and Ca salts. In addition to the adverse effects of salinity and sodicity, accumulation of boron in to xic concentrations deserves due attention while undertaking a plan of reclamation of salt affected soils, to reduce it to the safe limit It becomes, therefore, imperative to study boron status and its pro file distribution and expose its relationship with different physico chemical characteristics of soils to aid the process of reclamation Keeping this in view, the present investigation was conducted o salt-affected soils fall in semi-arid region of India.

MATERIALS AND METHOD. — Soil samples from ninety profiles of natur saline-sodic occurring in semi-arid tract of India (Agra region) were coll cted and used in the present investigation. This region is a part of Ind gangetic plains and characterized by hot and dry summers and severe wi ters. The mean annual temperature and precipitation have been recorded t be 26°C and about 600 mm respectively. Most of the annual precipitatio (85%) is concentrated during the months of July, August and Septembe In summers, the temperature often goes upto 45°C with desiccating wind and in winters it goes down to about 2°C.

The soil samples collected from different profile depths were process and analysed for various physico-chemical properties following the metho described by RICHARDS (1954). Correlation coefficients and regression equa tions have been worked out for the concerning data