Siman et le pourcentage de erreur le quel affecte la moyenne proportionelle.

ZUSAMMENFASSUNG. — Da wir eine Verbesserung der Prozent von K, Na und Na in die kathodenextracte die wir durch E.U.F. in einen kalkhaltigen Boden, bei Druckkraft von —0.6 bar (kathode) und —0.14 bar (Anode), erlangt haben, war es möglich 6 verschiedene kalkhaltige Böden zu untersuchen um die Reproduzierbarkeit von erhaltenen Angaben zu prüfen.

Man hat auch eine Gleichung festgestellt, die L- und L.C.- Wert mit dem mittleren Wert korreliert.

RIASSUNTO. — Conseguito un miglioramento delle percentuali di K, Na e Ca negli estratti catodici ottenuti per E.U.F. in un suolo calcareo utilizzando pressioni di —0,6 bars catodica e —0.15 bars anodica, si è cercato, lavorando con le stesse pressioni e utilizzando 6 suoli calcarei, di determinare la riproducibilità dei dati ottenuti per questi elementi, facendo uno studio statistico degli stessi; si ottengono dei risultati molto accettabili per il K e Na ma meno validi per il Ca.

Si è ottenuta una equazione che correla i valori di L, L.C. con il valore medio, e che permette di stabilire una equivalenza fra i limiti fissati per i valori di L con il criterio seguito da Siman e con l'errore percentuale medio.

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Effect of stem length in the foliar analysis of rose bush for cut flowers

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INTRODUCTION. — In our previous work on carrying out the foliar analysis with the aim of studying the nutritional status of the rose bush for cut flowers in the island of Tenerife, we took samples of flowering stems of different lengths, chosen at randow, but always avoided doing so in very short or excessively developed stems, taking account of the normal dimensions for each variety. In view of the great variability which these dimensions can show in a given variety with the purpose of as certaining whether stem length can have any effect on the mineral composition of the leaf taken as sample.

Leaves of 5 leaflets have been used by a great number of the researchers into mineral nutrition. Nevertheless, there are discrepances as regards the position of the chosen leaves on the stem, and also the degree of opening of the bud on the flowering stem (BOODLEY, 1970; JOHANSSON, 1978 and LÓPEZ MELIDA, 1981). In our work on the mineral nutrition of the rose bush we used as a sample, the first two leaves of 5 leaflets from flowering stems whose buds show from one to three sepals open. In the present work we study the variations of the foliar nutrient concentrations in these leaves in relation to the length of the stem on which they appear.

MATERIAL AND METHODS. — The work was carried out on the varieties Visa and Ilona, long stemmed and Mercedes, short stemmed. The samples were collected during January from 4 year old rose bushes in three commercial greenhouses. The stem length is used as an index of commercial quality, ranging those stems from $\leqslant$ 30 to $\geqslant$ 50 cm for Mercedes, and from 30 to $\geqslant$ 90 cm for Visa and Ilona.

A sample was taken from each of the varieties for each quality comprising 15 subsamples (composed of the first two leaves of 5 leaflets) taken in flowering stems whose bud showed from one to three sepal open (a little before gathering).

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The mineralization of the foliar samples was carried out by dry ashing. The ashes were extracted with HCl 6N, the extract cations were determined by atomic absorption spectrophotometry, and the phosphorus by colorimetry according to the vanadate-molybdate method. The N was determined in a Technicon autoanalyzer.

RESULT AND DISCUSSION. — The results of the foliar analysis according to the stem length for the three cultivars we are concerned are exposed in tables 1, 2 and 3. We shall consider separately the results of each nutrient:

TABLE 1. — *Mineral nutrient levels of the leaves according to the stem length (cult. VISA)*

Stem length (cm)	%					ppm		
	N	P	K	Ca	Mg	Fe	Mn	Zn
90	3.50	0.32	1.92	1.19	0.33	90	397	43
80	3.00	0.35	2.00	1.59	0.35	90	456	47
70	3.50	0.35	2.28	1.34	0.39	110	487	59
60	3.50	0.36	2.16	1.30	0.35	107	442	58
50	3.50	0.41	1.96	1.32	0.37	117	430	69
40	3.50	0.40	2.16	1.30	0.38	117	590	75

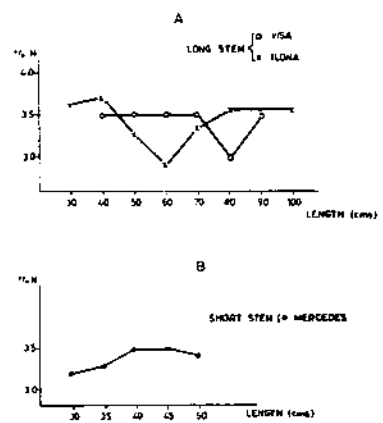
TABLE 2. — *Mineral nutrient levels of the leaves according to the stem length (cult. ILONA)*

Stem length (cm)	%					ppm		
	N	P	K	Ca	Mg	Fe	Mn	Zn
100	3.55	0.31	2.20	1.18	0.40	73	143	29
90	3.55	0.31	2.05	1.22	0.43	68	139	29
80	3.55	0.28	2.22	1.28	0.44	65	198	32
70	3.33	0.28	2.32	1.33	0.41	72	234	35
60	2.90	0.29	2.29	1.29	0.43	75	169	33
50	3.26	0.27	2.05	1.25	0.43	79	175	32
40	3.70	0.31	2.20	1.20	0.43	62	124	30
30	3.62	0.28	2.15	1.30	0.43	97	136	30

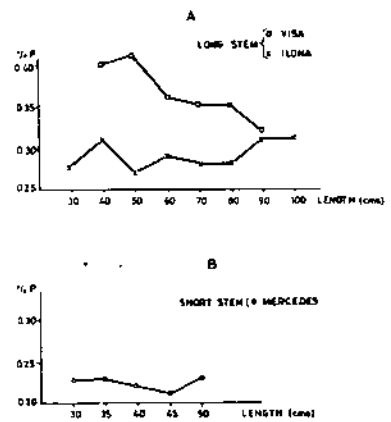
TABLE 3. — *Mineral nutrient levels of the leaves according to the stem length (cult. MERCEDES)*

Stem length (cm)	%						ppm		
	N	P	K	Ca	Mg	Fe	Mn	Zn	Cu
50	3.40	0.23	2.05	1.28	0.38	94	207	29	13
45	3.50	0.21	2.20	1.26	0.41	114	186	24	16
40	3.50	0.22	2.12	1.08	0.39	82	158	27	17
35	3.30	0.23	2.05	1.12	0.37	92	134	23	16
30	3.20	0.23	1.95	1.19	0.36	101	142	29	17

Nitrogen. — It is seen in graph 1A that in the variety Visa stem length does not seem to affect the foliar N concentration in stems of less than 70 cm. In the variety Ilona no clear tendency in the variation of the N percentage in the leaf with stem length is noted. Between 40 and 60 cm. a decrease is observed in the concentrations which reach a minimum in stems of 60 cm. and increase therafter until they stabilize in stem lengths of between 80 and 100 cm. In the variety Mercedes (graph 1B) due, not doubt, to the reduced stem-length intervals (aproximately half that of the long-stemmed varieties)



GRAPH N. 1. — Variation of the foliar N concentrations with stem length.



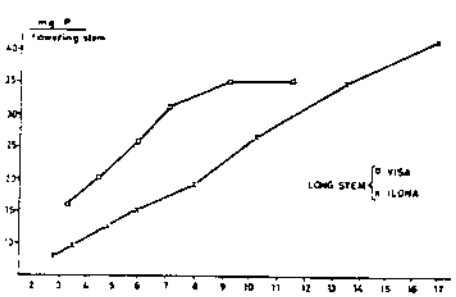
GRAPH N. 2. — Variation of the foliar P concentrations with stem length.

the variations of the foliar levels are smaller, the greatest stability being noted in stem length of between 40 and 50 cm.

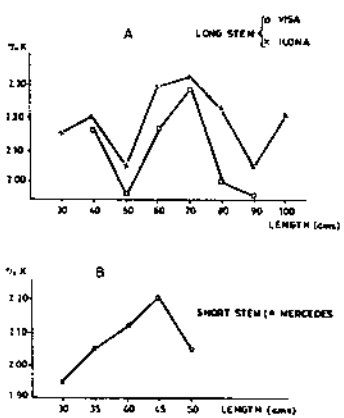
Phosphorus. — As can be seen in graph 2A the behavior of the varieties Visa and Ilona with respect to P is different. While in Visa the foliar P concentrations undergo a clear descent as the stem length increases, in the variety Ilona a definitive tendency is not noted. Nevertheless in both cases a certain stabilization of the foliar concentrations for stem length two long-stemmed between 60 and 80 cm. is seen.

The difference in the behaviour of the two long-stemmed varieties becomes very clear when the total amount of P extracted by the flowering stems of different lengths is plotted against the total weight (see graph 3). It can be seen that in the variety Ilona there is a linear increase of the P amounts extracted with the weight of the flowering stem, while in Visa there is a noticeable descent of the slope in the last stretch of the curve (stems of superior quality) which may be attributable to a dilution phenomenon.

It is noteworthy that in the variety Visa a foliar sampling carried out on a 50 cm stem and a 90 cm. may mean a 28% difference as far the foliar P concentrations are concerned. In the variety Mercedes (graph 2B) the P concentrations do not vary appreciably with the length of the flowering stem. If the total P contents are plotted against the weight of the flowering stem a straight line is obtained.



GRAPH N. 3. — Variation of total phosphorus contents with dry weight of flowering stem.



GRAPH N. 4. — Variation of the foliar K concentrations with stem length.

Potassium. — The two long-stemmed varieties studied followed similar patterns as far as K is concerned as can be seen in graph 4A. A maximum foliar concentration is noted for a 40 cm. stem length followed by a sharp descent in the concentration for longer stems. This decrease of the concentrations is possible due to a dilution phenomenon which is shown by a descent of the slope of the curves in graph 5 in which total K contents are plotted against stem weight as in the case of the nutrients previously studied.

In view of the curves in graph 4A the critical importance of stem length, at the time of taking the sample for foliar diagnosis, is obvious, since a leaf taken from a 50 cm. stem and another from a 40 cm. can have K concentrations that differ by up to 16% in the case of long-stemmed varieties. Moreover a leaf of Ilona taken from a stem 90 cm. long has the same potassium concentration as another from a 50 cm. stem.

In graph 4B it can be seen that in the variety Mercedes the foliar K concentrations increase linearly up to a stem length of 45 cm. from which point there is a descent, the foliar concentration for a 50 cm. stem being equal to that of a 35 cm.

Calcium-Magnesium. — In the variety Ilona the foliar calcium concentrations do not seem to vary appreciably with stem length. In the variety Visa the foliar concentration in stem lengths below 40 cm. are constant, while the maximum concentration is found in 80 cm. lengths, and those of 90 cm. have foliar levels somewhat lower than those of stems less than 40 cm. In the variety Mercedes the foliar Ca concentrations do not seen to be much affected by the length of the flowering stem although a slight increase for the longer stems is noted.

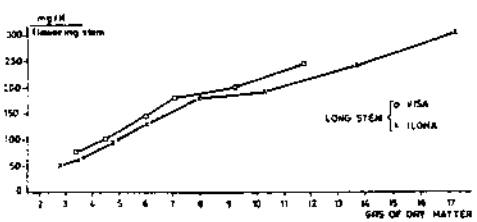
The Mg levels in the leaf for the varieties Visa and Ilona seem to fluctuate irregularly for the small and medium stems, while for the long (> 70 cm in Ilona and > 80 in Visa) there is a drop in the concentrations with an increase in the length of the flowering stems, possibly as a result of a dilution phenomenon. In the variety Mercedes there is a drop in the concentration for stems longer than 45 cm., and this tendency is maintained when total contents are taking into account.

Micronutrients. — The Fe foliar concentration plotted against

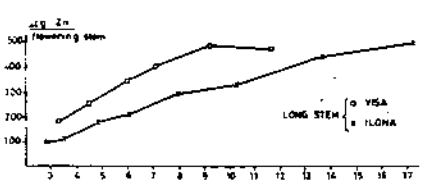
length although fairly irregular show, in general, a descending tendency, with the stretch of maximum stability in stem lengths between 50 and 70 cm. Nevertheless, the relation total Fe contents stem weight shows a linear form in both cases. In the variety Mercedes the concentration variations are very wide, and a definite behaviour cannot be deduced.

In the variety Ilona an irregular increase of foliar Mn concentrations up to a maximum for 70 cm. stems is noted, followed by a decrease for longer lengths. Something similar occurs in Visa with the exception of the extraordinarily high value corresponding to the 40 cm. stem. We attribute the concentration descent in the last stretch of the curves to a dilution phenomenon. The variations of the foliar Mn concentrations with stem length for the variety Mercedes are shown in table 3, where it can be seen that they increase gradually with an increase in quality.

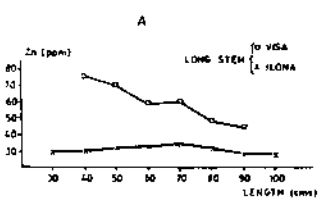
As regards the Zn (graph 6A), the foliar concentrations of Ilona show a slight increase with stem length up to a maximum for 70 cm. after which they descend, the minimum values being shown by 90-100 cm. lengths. In the variety Visa the foliar concentrations move within a much wider range (between 43 and 75 ppm as against a 28-35 ppm interval for Ilona) so that the variations are seen more clearly a pronunced downward tendency with

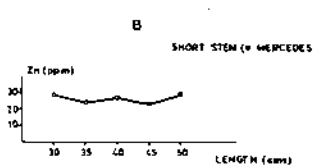


GRAPH Nº 5 Variation of total potassium contents with dry weight of flowering stem



GRAPH N. 7. — Variation of total Zn contents with dry weight of flowering stem.





GRAPH N. 6. — Variation of foliar concentrations of Zn stem length.

stabilization between 60 and 70 cm. In graph 7 it can be seen that a dilution phenomenon takes place in the variety Visa, whereas in Ilona the total Zn contents in the flowering stem increase linearly with stem lenght.

The irregularity of the tendencies noted in the micronutrients could be attributed to the fact the roses bushes receive frequent micronutrient applications by leaf spray so that the concentrations of these in the leaf are affected to a high degree by this factor which it was not possible to control in our study, since it was carried out in commercial greenhouses.

CONCLUSION. — On occasion there are great differences in the foliar concentrations according to stem length. The size of these differences depends on the nutrient considered and the nutritional status of the plant. The differences between the two long-stemmed varieties studied cannot be attributed to the variety 'per se', but rather to cultivation conditions, particulary soil and fertilizer use. In the short-stemmed varieties the differences are smaller, evidently because the stem-length interval is also small.
Although in some cases an irregular behaviour is noted, generally there is a certain stability of the foliar concentrations (in the three cases studied) in the intermediate lengths, followed by a descent in the longer stems which we attribute to a dilution phenomenon.

The stem length is then a critical factor in the taking of samples for foliar diagnosis. From the results obtained it appears advisable to carry out the sampling on stems of about 70 cm in the long-stemmed varieties and 40 cm in the short stemmed. This seems to be a practical conclusion of inmediate use by rose growers.

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SUMMARY. — It is studied the variations of mineral composition of the leaves with stem length in the cultivars Visa, Ilona (long stemmed) and Mercedes (short stemmed). The variations found are important in several cases, specially for potassium in the long stemmed cultivars. It's

concluded that stem length is a critical factor for foliar diagnosis of the rose bush. From the results obtained, it appears advisable to carry out the sampling on stems about 70 cm in the long stemmed varieties and 40 cm in the short stemmed.

RÉSUMÉ. — On a étudié la variation de la composition en éléments des feuilles selon la longueur du tige dans les varietiés de roses Visa, Ilona (a tige court) et Mercedes (a tige long). Les variations trouvées sont importantes dans quelque cas, notamment le potassium dans les varietiés à tige long. On conclut que la longueur du tige est un facteur critique dans le but du diagnostic foliaire. Selon les résultats, le échantillnage des tiges d'environ 70 cm (longueur moyen) dans les varietés à tige long et 40 cm dans les varietés à tige court, sont les plus à conseiller.

ZUSAMMENFASSUNG. — Es wurde eine Forschung über die Änderungen, die mit der Mineralzusammensetzung der Blätter mit der Länge des Blumenstiels der Rosen des Gewächsortes Visa, Ilona (mit langem Stiel) und Mercedes (mit Kürzen Stiel) durchgeführt. Einige Änderungen die hier hervorgegangen sind, in einigen Fällen, von grosser Wichtigkeit sind auf allen Fällen für den Kalium auf den Züchtorten mit langem Stiel. Man vollendet, dass die Länge des Stiels eine Kritische Rolle spielt, bezüglich auf die Folierungsmusterung als Diagnose. Aus den erhaltenen Resultaten ist es ratbar, die Musterung auf Stiele mit einer Länge von circa 70 cm (Durchschnittslänge) auf der langen Sorte, und von circa 40 cm (Durchschnittslänge) auf der kurzen Art, auszuüben.

RESUMEN. — Se ha estudiado la variación que experimenta la composición mineral de las hojas con la longitud del tallo floral de rosas en los cultivares Visa, (Ilona (de tallo largo) y Mercedes (de tallo corto). Las variaciones encontradas son importantes en algunos casos, especialmente para el potasio en los cultivares de tallo largo. Se concluye que la longitud del tallo es un factor crítico en el muestro foliar con fines de diagnóstico. De los resultados obtenidos parece aconsejable realizar el muestro sobre tallos de alrededor de 70 cm en las variedades de tallo largo (longitudes intermedias), y de alrededor de 40 cm en las de tallo corto (longitudes intermedias).

RIASSUNTO. — Si è studiata la variazione della composizione minerale delle foglie con la lunghezza del gambo delle rose delle cultivar Visa, Ilona (a gambo lungo) e Mercedes (a gambo corto). Le variazioni riscontrate sono importanti in alcuni casi, specialmente per il potassio nella cultivar a gambo lungo. Concludendo, la lunghezza del gambo è un fattore critico per la diagnosi fogliare. Dai risultati ottenuti si consiglia di sperimentare su gambi di circa 70 cm nella varietà a gambo lungo, e di circa 40 cm nella varietà a gambo corto.

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Effect of silicate and pumice stone on the P adsorption capacity of variable charge soils

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INTRODUCTION. — A tempting remedy for extensive P sorption by variable charge soils is to add materials other than phosphate, to block adsorption sites.

Several studies (DEB, DATTA, 1967, NAGARAJAH *et al.*, 1970, PARDO *et al.*, in press) have shown that the application to the soil of organic anions, capable of competing with phosphorus for the adsorption sites may be on appropriate way of reducing the fixation of P and consequently increase its assimilability for the plants.

Among the inorganic anions, silicate was also used for this purpose (OBIHARA and RUSSELL, 1972; SILVA, 1973; SMYTH and SÁNCHEZ, 1983).

It is known that the silicate anion is capable of inactivating hydroxyl groups of soil colloids through anionic interchange mechanisms (LAWS, 1950). What is more, silicate is capable of inactivating exchangeable cations through the formation of compounds of low solubility (ALBRITTON and ELLIS, 1957).

ROY *et al.*, (1971) have found that the adsorption capacity of a wide range of Hawaiian soils decreased when silicate in the form of basic slag was previously added to the soil. However, the effect was reduced as the P adsorption capacity of the soils increased. Apparently, the calcium silicate hydrolized to form monosilicic acid in solution, which was partially adsorbed by the soil surface and thus reduced the number of sites available for phosphate adsorption.

OBIHARA and RUSSELL (1972) also found that the use of silicate may contribute to increase P availability in the soils, particularly whit a pH close to neutrality; UEHARA and GUILMAN (1981) also underline the beneficial effect of adding calcium silicate to higly weathered soils, especially its effect on the reduction of the P adsorption capacity, on the increase of pH in the soils and its contribution to increase the calcium as well as the cation exchange capacity.