TOWARDS METRICATION

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Summary

The reasons for change to the metric system are discussed and the salient features of the rationalized international version of the system (SI) briefly described. A broad outline of the way in which the changeover is being planned is given, and some practical implications for weed and pest control are mentioned.

WHY CHANGE?

IN February 1969 the New Zealand Government announced its intention of encouraging a change to the metric system in New Zealand. This decision arose from a study, first by the Standards Association of New Zealand, and later by a committee of Government officials, of the probable effect on the economy of New Zealand of the growing use of the metric system overseas. Both of these committees came to the conclusion that a change for New Zealand was inevitable. The British decision to go metric had really turned the scale; by the end of 1975 when the British changeover will be complete, the United States will be the only industrialized nation that is not either metric or changing to the metric system. If New Zealand did not decide to go metric, non-metric imports, custom-made for us, would command premium prices; non-metric New Zealand exports would produce increasing customer resistance.

However, economic considerations apart, most scientists and technologists will welcome the simplified calculations that will result from the decimal relationship between units and their multiples, and the coherent nature of the International System (SI). The metric system is simple and logical in contrast to the imperial system, which is neither.

COST OF THE CHANGE

Much has been written (often with a lively but pessimistic imagination) about the cost of the change, but in fact no reliable estimate can be made. Lord Ritchie-Calder, Chairman of the U.K. Metrication Board, has said that the Board can "find no statistical model on which an estimate of the overall cost to the nation could be calculated, and, with the policy already determined by the sober judgment of Government and industry we regard the exercise as futile. . . ."

One matter on which there can be little disagreement, however, is that careful programming will minimize costs, especially if in individual organizations full advantage is taken of normal obsolescence of plant. All new plant ordered should be metric-based, so that repairs and replacements will be readily available in the years to come. Manufacturing equipment should be capable of working with raw or semi-manufactured materials in metric sizes, and usually, of producing finished products to metric designs.

PROGRAMMING FOR THE CHANGE — THE METRIC ADVISORY BOARD

As a first step in encouraging the change, the Government set up, in November 1969, a Metric Advisory Board which is responsible for promoting and co-ordinating planning for a voluntary changeover throughout the national scene. To do this the Board has set up 14 Sector Committees each of which covers a different branch of the New Zealand economy. Many Sector Committees have set up Divisional Committees, each of which represents a different branch of industry within the sector, and Divisional Committees are setting up Working Groups representative of the various organizations within the industry. Programmes for the changeover are being produced.

The Sector Committees that are of most interest to the New Zealand Weed and Pest Control Society are those on agriculture, on the manufacturing and processing industries, on the engineering and engineering services industries, on weighing machines, and on standardization. (The availability of metric weighing machines, usually by conversion of imperial machines, will be an important factor governing the rate of the changeover in most industries.)

The Standardization Sector Committee, which consists of three members of the Standards Council and four members of the Standards Association staff, is involved in programming the conversion of New Zealand standard specifications and codes of practice into metric terms, working in an order of priority indicated by the programmes for the other sectors. It also has another important task. This is to ensure that, during the changeover, full advantage is taken of rationalization by limiting the ranges of standard sizes of components and raw materials to the practicable minima. (One company in Britain, on changing from its traditional range of non-metric fasteners to a rationalized metric range, has been able to reduce its holding in stock by 80%.) In New Zealand a start has already been made in rationalization; a preferred list of wire ropes in metric dimensions was published by the Standards Association recently.

THE INTERNATIONAL SYSTEM (SI)

An early decision of the Metric Advisory Board was to adopt the International System of units. This system has six basic units:

metre (m)	for length
kilogram (kg)	for mass
second (s)	for time
ampere (A)	for electric current
kelvin (K)	for thermodynamic temperatures*
candela (cd)	for luminous intensity

All other SI units are derived from these basic units by simple multiplication or division without the use of conversion factors.

SI units form a fully coherent system described in a recent New Zealand Provisional Standard (NZS 6501P, 1971). This means that the product or quotient of any two unit quantities in the system leads to the

*The degree celsius (formerly centigrade) is written as °C. It is derived from the kelvin and is accepted by the International System.

unit of the resulting quantity. For example, when unit length (1 metre) is divided by unit time (1 second) the result is unit velocity (1 metre/second). The main advantage of a fully coherent system is that it simplifies calculation and so reduces the possibility of mistakes.

The basic SI units and SI units derived from them are, however, sometimes too large or too small to be used conveniently. It is generally desirable to be able to express quantities in figures not larger than 1,000 or smaller than 0.1. Thus the metre is too small for measuring distances between towns, and too large for measuring the diameter of wire. International agreement has therefore been reached that multiples and submultiples of SI units, separated by factors of 1,000, should be the preferred larger or smaller units. For example, 1 megametre is 1 000 000 metres; 1 kilometre is 1 000 metres; 1 millimetre is 1/1 000; and 1 micrometre is 1/1 000 000 of a metre.

SOME RECOGNIZED NON-SI UNITS

The International Standards Organization (ISO) recommends that any metric unit already internationally recognized and used should be retained (at any rate for the time being) even though it may not be a basic or derived SI unit, or may be a non-preferred multiple or submultiple of an SI unit. Thus the minute, hour, day, week and year will remain, though the second is the only true SI unit of time; and although the SI unit of velocity is metre/second, most of us will think of velocities in terms of kilometres per hour.

SOME PRACTICAL CONSIDERATIONS

In many technologies, particularly in the various branches of engineering, introduction of SI units will simplify calculations enormously. This will save time and reduce considerably the possibility of mistakes. Unfortunately there are several industries for which the advantages of the introduction of the metric system are less apparent. However, it must be accepted that metrification is good for the country as a whole and no industry can stand aside from it.

While manufacturers of application equipment will share in the considerable benefits to the engineering industry, weed and pest control will receive only indirect benefits. Manufacturers of pesticides and weedicides almost invariably give application rates in weights or volumes per acre and the calculations involved in their use are simple and straightforward whether in the imperial system or the metric system. The main advantage to the industry is to the manufacturers or packers. These will receive their raw materials in metric packs, such as the 50 kilogram bag or the 200 litre drum. When compounding or processing, mistakes in weighing and measuring are less likely when working from "round number" packs rather than packs of such amounts as 112 lb or 44 gallons. Manufacturers and packers will also benefit from the mass production of rationalized sizes of cans and containers; this should lead to reduced costs for packaging their products.

The units used most frequently at present in weed and pest control are shown in Table 1, with the nearest corresponding SI units or their official abbreviations. It seems probable that traditional imperial units of area and probably also of length and capacity will be remembered and used in farming and horticulture well after the time that pesticide and weedi-

TABLE 1: COMMON IMPERIAL UNITS AND THEIR NEAREST METRIC EQUIVALENTS

(Basic SI units are shown in Capitals. Conversion factors taken from a British Standard (BS 350: Part 1: 1959) have been rounded to three significant figures).

LENGTH:	
Inch	= 25.4 millimetres (mm) or 2.54 centimetres (cm)
Foot	= 0.305 METRES (m) or 30.5 cm or 305 mm
Yard	= 0.914 m or 91.4 cm or 914 mm
Chain	= 20.1 m
Mile	= 1610 m
AREA:	
Square foot	= 0.0929 SQUARE METRES (m ²)
Square yard	= 0.836 m ²
Acre	= 0.405 hectares (ha) or 4.05 decares (daa)
Square mile	= 259 ha or 2.59 square kilometres (km ²)
VOLUME OR CAPACITY:	
Cubic foot	= 28.3 cubic decimetres (dm ³) or 28.3 litres (l)
Cubic yard	= 0.765 CUBIC METRES (m ³) or 765 l
Fluid ounce*	= 28.4 cubic centimetres (cm ³) or 28.4 millilitres (ml)
Pint*	= 568 cm ³ or 0.568 l
Gallon*	= 4.55 dm ³ or l
Bushel*	= 0.0364 m ³ or 36.4 l
WEIGHT (STRICTLY "MASS"):	
Ounce	= 28.4 grams (g)
Pound	= 454 g or 0.454 KILOGRAMS (kg)
Hundredweight	= 50.8 kg
Ton	= 1020 kg or 1.02 tonne (t)
TEMPERATURE:	
Degree	
Fahrenheit	degree celsius (°C)
(x + 40)°F	= [5/9 (x + 40) - 40] °C
(This equation holds because -40° F = -40° C and 1° C = 5/9° F)	

*Fluid ounce, pint, gallon and bushel are all U.K., not U.S. units.

cide manufacturers start to pack their products in millilitres or litres, grams or kilograms. In Table 2 combinations of metric and imperial units that may well be used in this interim period are shown in the middle column. In both tables, factors have been rounded to three significant figures; these will give results correct to within 0.5%.

It will be noted that the unit of area shown in Table 2 is the decare. It is believed that this will be adopted as the legal unit of land area in New Zealand. It has the great advantage of being almost exactly ¼ acre.

THINKING METRIC

One of the greatest difficulties facing us in metric conversion is to visualize metric quantities without recourse to tables or to difficult calculations. It is, however, easy to remember a few relationships that help us in this visualization. Very roughly a metre is 10% more than a yard;

TABLE 2: COMBINATIONS OF IMPERIAL UNITS AND THEIR NEAREST EQUIVALENTS

(Rounded to three significant figures)

<i>Imperial</i>	<i>Metric/Imperial</i>	<i>Metric</i>
oz/acre	28.4 g/acre	7.01 g/daa
lb/acre	0.454 kg/acre	11.2 g/daa
fl oz/acre	28.4 ml/acre	7.01 ml/daa
pints/acre	0.568 l/acre	140 ml/daa
gals/acre	4.54 l/acre	1.12 l/daa
oz/cu. yd	28.4 g/cu. yd	37.1 g/m ³
lb/cu. yd	0.454 kg/cu. yd	0.595 kg/m ³
cwt/acre	50.8 kg/acre	12.6 kg/daa
fl. oz/sq. yd	28.4 ml/sq. yd	34.0 ml/m ²
pint/sq. ft	0.568 l/sq. ft	6.11 l/m ²
bushel/acre	36.4 l/acre	8.99 l/daa
m.p.h.	—	1.61 km/h
ft/sec	—	0.305 m/s
oz/100 gal	28.4 g/100 gal	62.5 g/100 l
lb/100 gal	0.454 kg/100 gal	100 g/100 l
fl. oz/100 gal	28.4 ml/100 gal	6.25 ml/100 l
pint/100 gal	0.568 l/100 gal	125 ml/100 l
gal/100 gal	4.55 l/100 gal	1 l/100 l
pint/100 lb	0.568 l/100 lb	1.25 l/100 kg
fl. oz/1,000 lb	28.4 ml/1,000 lb	6.25 ml/100 kg
point of rain	—	2.54 mm
40% w/v	—	400 g/l
1 lb/100 lb	—	1 kg/100 kg
40% w/w	—	400 g/kg

a normal door is very nearly 2 m high; a rugby field is 91 m and a cricket pitch is 20 m long. A kilogram is about 10% more than 2 lb. A metric tonne is about 2% less than an imperial ton. A litre is about 10% less than a quart (*i.e.*, 35 fl. oz). A 5½ gallon drum holds 25 litres, and a 44 gallon drum is really a 200 litre drum in disguise.

All these facts help us to think metric, and if we can do this the change to the metric system will be considerably easier.

REFERENCES

- NZS 6501P: 1971: *The International System (SI) Units and their Application*. Standards Association of New Zealand.
 BS 350: Part 1: 1959: *Conversion Factors and Tables*. British Standards Institution.