4 Hose nozzles kept off the nursery floor (yes or no)

5 Utensils, containers, trolleys and barrows confined to nursery area and regularly disinfested with chemicals (comments)

6 Floors of nursery and hardening-off area sealed (yes or no)

7 Nursery bench tops - at least 30 cm off floor level (yes or no)
- wire mesh or disinfested wooden slat (specify)

8 Waste soil and plant material regularly washed or taken away (yes or no)

9 Security - public and stray animals restricted entry (comment)
- loading area isolated from nursery (yes or no)
- foot baths at entrances properly maintained and installed (comment)

10 Plants from non-accredited nurseries excluded (yes or no)

11 Dust about nursery suppressed (comment)

12 Root systems (sample of a minimum of 10 containers) sound or otherwise (comment)

13 Assay for soil-borne pathogens
(bulk sample of a minimum of 30 containers).

14 General comments on nursery hygiene and/or plant health

Signed(Technical Officer)(date)

The avocado industry also aims to become established on virus-free lines. Conventional indexing takes 2 years, but is being supplemented by quicker D.N.A. methods. Grafting knives, secateurs etc. must be sterilised with hypochlorite.

Seed Division. As seed supply is restricted and expensive, seed may be divided. With care, eight plants may be gained from each seed, but simply halving of seeds is most common.

HIGH TEMPERATURE RELEASE CHARACTERISTICS OF RESIN-COATED SLOW RELEASE FERTILIZERS

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Abstract. Two types of slow-release resin-coated fertilizers, which control the release rate by coating thickness (Type A) or a release agent (Type B) were tested for their high temperature stability. Heating different formulations (various N-P-K ratios and/or release rates) to 25, 60 or 70°C in water for 30 minutes had little effect on their subsequent release characteristics in water at 25°C for 1 week followed by 45°C for 9 weeks Two different formulations of each fertilizer type were also held in water for 10 weeks at 25, 30, 35, 40 and 45°C The increase in release rate with increasing temperature was lower for type B fertilizers than type A fertilizers The per-

centage cumulative increase in the release rate after 6 weeks of the type A fertilizers between 30 and 35°C was 23% and 16%, and between 35 and 40°C it was 62% and 60% respectively For type B fertilizers the increase between 30 and 35°C was 12% and 20%, and between 35 and 40°C it was 23% and 37% respectively

REVIEW OF LITERATURE

Use of resin-coated slow-release fertilizers in Australia is increasing. Their use as part or all of the nutrient requirements of container-grown plants offers many advantages to the grower. However, a problem of excessive salinity in the potting medium has been encountered in their use, especially in summer when container-grown plants may be exposed to high ambient temperatures. Media temperatures may exceed 45°C under certain conditions which will greatly accelerate the release rate of the fertilizer (1,2). Steam pasteurisation of media containing slow-release fertilizers also exposes them to high temperatures, although for short periods only. This may contribute to later salinity problems.

Two types of resin-coated slow-release fertilizers are available in Australia. One (type A - manufactured by Sierra Chemical Co.) relies on coating thickness (1), and the other (type B - manufactured by Chisso Asahi Fertilizer Co. Ltd.) relies on a release agent in the coat to control the release rate (2). The release period of the two fertilizers is determined by the manufacturers at 21° and 25°C, respectively.

The release rate of resin-coated fertilizers may be conveniently determined in water although this gives a higher rate (1.2 to 1.5 for type B fertilizers) than if it was determined in soil or other media (2).

One aim of this experiment was to determine the effect of short periods of high temperatures (such as those encountered in soil pasteurisation) on the short and long-term release rates of the slow release fertilizers. The other was to examine the effects of continued high temperatures (such as those found in container-grown plants in the field) on the release rates of resin-coated slow-release fertilizers.

MATERIALS AND METHODS

(a) Effect of Short-Term High Temperatures on the Release Rate of Fertilizers

Fifty g of each of 3 formulations of type A fertilizer (14N-6. 1P-11.6K, 3-4 month; 15N-5.2P-12.5K, 3-4 month, 18N-4.8P-8.3K, 8-9 month) and 3 formulations of type B fertilizer (16N-4.4P-8.3K, 4-5 month; 16N-4.4P-8.3K, 8-9 month; 13N-5.7P-9.1K, 8-9 month) were held in sealed flasks containing 100 ml of distilled water at 25°, 60°, or 70°C for 30 minutes. The fertilizer/water mixture was then held at 25°C for 1 week then at 45°C (to accelerate the rate of release) for 9 weeks. The release rate was determined by filtering and washing of the fertilizer prills (small granules) after 30 minutes (for the 60°C and 70°C treatments) and then at approximately 1 week intervals (for all treatments). The filtrate was then evaporated at 80°C and the amount of fertilizer solubilised determined by weight. Duplicate samples were used and 100 ml of water was added to the fertilizer after each filtering.

(b) Long Term Temperature Effects on the Release Rate of the Fertilizers.

The method was as described in part (a) except that the samples were held at 25°, 30°, 35°, 40° and 45°C for the duration of the experiment and the 30 minute sampling was omitted.

Two type A (14N-6.1P-11.6K, 3-4 month; 18N-2.6P-10K, 8-9 month) and two type B (16N-4.4P-8.3K, 4-5 month; 13N-5.7P-9.1K, 8-9 month) fertilizers were used in this experiment.

RESULTS

(a) Effect of Short Term High Temperatures on the Release Rate of Fertilizers

The results are presented in Table 1. Heating of the slow-release fertilizers to 60° or 70°C for 30 minutes had little effect on their subsequent release rates compared to those held at 25°C.

(b) Long Term Temperature Effects on the Release Rate of Fertilizers

The results are presented in Figure 1. The release rate of all fertilizers increased with increasing temperature. The percentage increase in the release rate was much greater between 35° and 40°C than between 25° and 30°, or 30° and 35°C. The percentage increase between 35° and 40°C was also much greater for type A fertilizers than type B fertilizers.

DISCUSSION

The temperature regime simulating the conditions experienced when soil is pasteurized had little effect on the release characteristics of the slow-release fertilizers tested. This indicates that they may be safely incorporated into media before it is pasturized (at 60° or 70°C) greatly simplifying their use, provided the medium is quickly cooled after pasturization to prevent a significant release of nutrients, possibly creating a salinity problem. Another reason for use of the medium as soon as possible is that the prills soften with time and become

Table 1. Effect of initial (30 min) temperature treatment on the release rates of various resin-coated fertilizers in water

Fertilizer			Initial Temperature °C	Cumulative percentage released after				
Type	N-P-K formulation	Release period (mths)		20 min	7 days	14 days	30 days	65 days
A	15-5 2-12.5	3-4	25	—	15	39	65	77
			60	1 1	16	40	70	75
			70	0 9	16	38	71	77
A	14-6 1-11 6	3-4	25	—	13	25	64	73
			60	3 0	14	26	68	74
			70	2 4	13	24	67	74
B	16-4 4-8 3	4-5	25	—	6	37	56	63
			60	0 1	9	39	60	63
			70	0 1	8	36	58	62
A	18-4 8-8 3	8-9	25	—	8	27	63	74
			60	0 6	9	31	67	74
			70	0 5	9	27	66	72
B	16-4 4-8 3	8-9	25	—	4	22	43	54
			60	0 3	6	24	46	54
			70	0 2	6	21	46	53
B	13-5 7-9 1	8-9	25	—	5	13	31	43
			60	0 3	6	16	33	46
			70	0 4	6	13	35	43

much more susceptible to mechanical damage during potting operations

The release rate of the fertilizers, especially the type A, increased dramatically with temperatures exceeding 35°C. This indicates why salinity may become a problem in container-grown plants in the summer, expecially if slow release fertilizers are applied to the surface of the pot. This is often the highest temperature area of the container.

Clearly there is a need for further research into controlled-released fertilizers, especially on the effect of temperature on their release characteristics. Salinity in potting media is a problem that may arise at high temperatures. This may be corrected by leaching. However, if this is done it may lead to nutrient deficiences later if the nurseryman expects the fertilizer to last for its stated "life."

These experiments also demonstrated that although resin-coated fertilizers may be rated for the same time period, their release rates can be very different. This should be taken into account when designing a fertilizer programme.

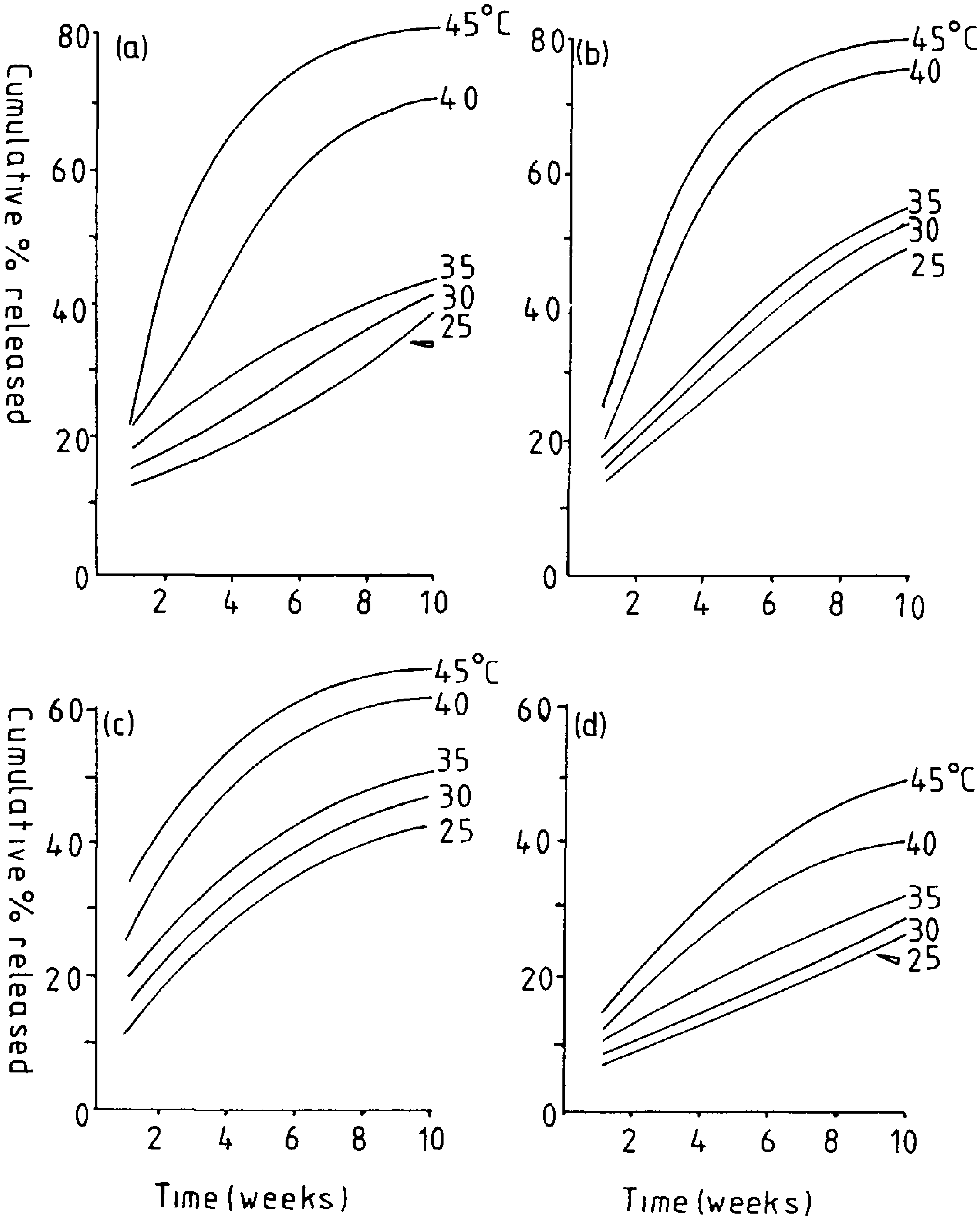

Figure 1. Release rates of resin-coated fertilizers in water at 25°, 30°, 40° and 45°C (a) Type A 14N-6 1P-11.6K, 3-4 month formulation (b) Type A 18N-2 6P-10K, 8-9 month formulation (c) Type B 16N-4 4P-8 3K, 4-5 month formulation (d) Type B 13N-5 7P-9 1K, 8-9 month formulation

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RAPID PROPAGATION OF POTATO: WHY? HOW?

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Why? Potatoes (*Solanum tuberosum*) are normally propagated as tubers. The use of tubers gives this crop the major advantage of rapid crop development, leading to higher yields in a short period (3 to 4 months from planting) than any other major crop. However, the use of tubers leads to two major problems:

1. Plants very readily become infected with serious tuber-borne diseases such as leaf roll virus, which are then passed on to subsequent crops. These crops give low yields. The spread of the most serious diseases is via aphids and, for this reason, "seed" tubers are typically produced in areas low in aphids — for example the highland areas of New South Wales. It is also possible to eliminate the most serious virus diseases from individual shoot tips using apical meristem culture.

2. The second major problem with tubers is slow propagation, normally 7 to 10 fold per year, in field conditions. This severely limits the rate of introduction of new selections, or of apparently virus-freed cultivars.

As a consequence of the previous two factors many countries operate a "pathogen-tested" "seed" potato scheme. A very small number of plants of each cultivar are grown from clean tubers in rigorous isolation. Each year about 30 tubers from these are tested for pathogens. Provided they are shown to be free of diseases, they are propagated, year by year, at first in "foundation seed" farms, then in "mother seed" farms, and finally in "certified seed" farms, until their progeny are numerous enough to provide the planting material for one crop in one year in the region. The next year a completely fresh lot of seed is used, and so it goes, in a continuous flush out system The propagation from the pathogen-tested tubers to the farmers "seed" takes about six years. Propagation is expensive, in that the prime clones must be maintained in specially