Environmental Aspects of Fertilizing Container Plants

Donnchadh Mac Carthaigh
Fachhochschule Weihenstephan, Freising, Germany

INTRODUCTION

The quality of drinking water has been reducing throughout Central Europe for many years. The main source of water pollution is seen as agriculture. The widespread use of pesticides, artificial fertilizers, and very intensive meat production units are causing much damage to water resources. Tree and shrub nurseries represent only a fraction of the land used agriculturally. However, because of the intensive production methods and the large concentration of nurseries in a few areas they are coming under more and more pressure to adopt environmentally acceptable production methods. Lower Saxony has become the first state in Germany to require building permission for container plant production units—others will follow. Water authorities are already monitoring the run-off from some container areas. To date they have been concentrating on the nutrients nitrogen and phosphorus.

A literature review by Alt (1990) showed that the yearly uptake of nitrogen by plants growing in the open ground is relatively small. The range for one-year-old seedlings, for example, ranged from 39 kg for *Acer campestre* (650 thousand plants per ha) to 116 kg for *Fagus sylvatica* (1.2 million plants per ha). Two-year-old *Picea abies* took up on average 32 kg N per year (12 million plants per ha). In his

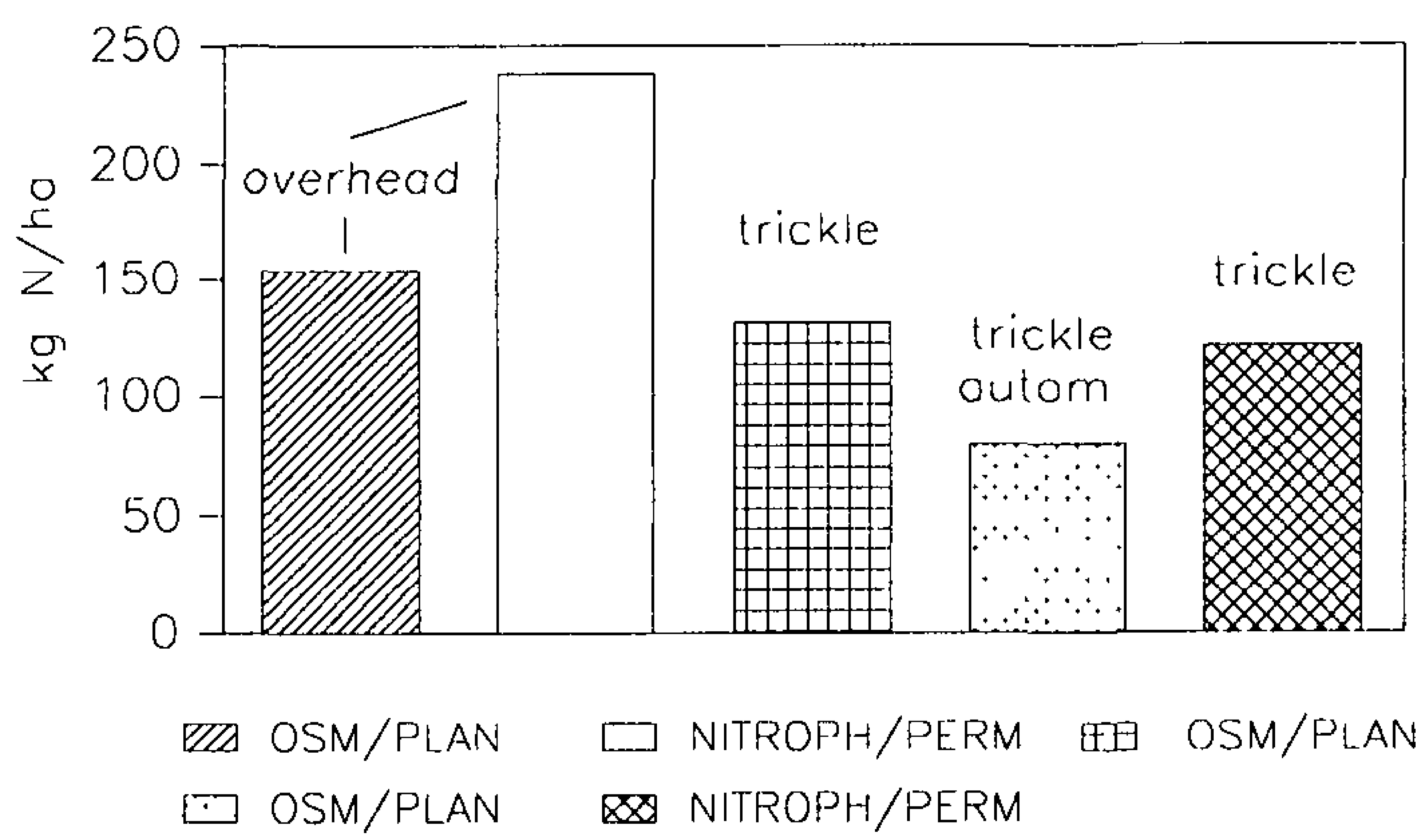

Figure 1. Influence of watering system (overhead, trickle, and trickle automatically controlled with a tensioswitch) and fertilizer type (1 = 3 g Osmocote 8-9 month and 1 g Plantosan, 2 = 2.25 g Nitrophoska Permanent (ca. 1/3 condensed urea) in base dressing and 2.25 g Nitrophoska Permanent as a top dressing, 3 = 1, 4 = 1, and 5 = 2) in container plant production.

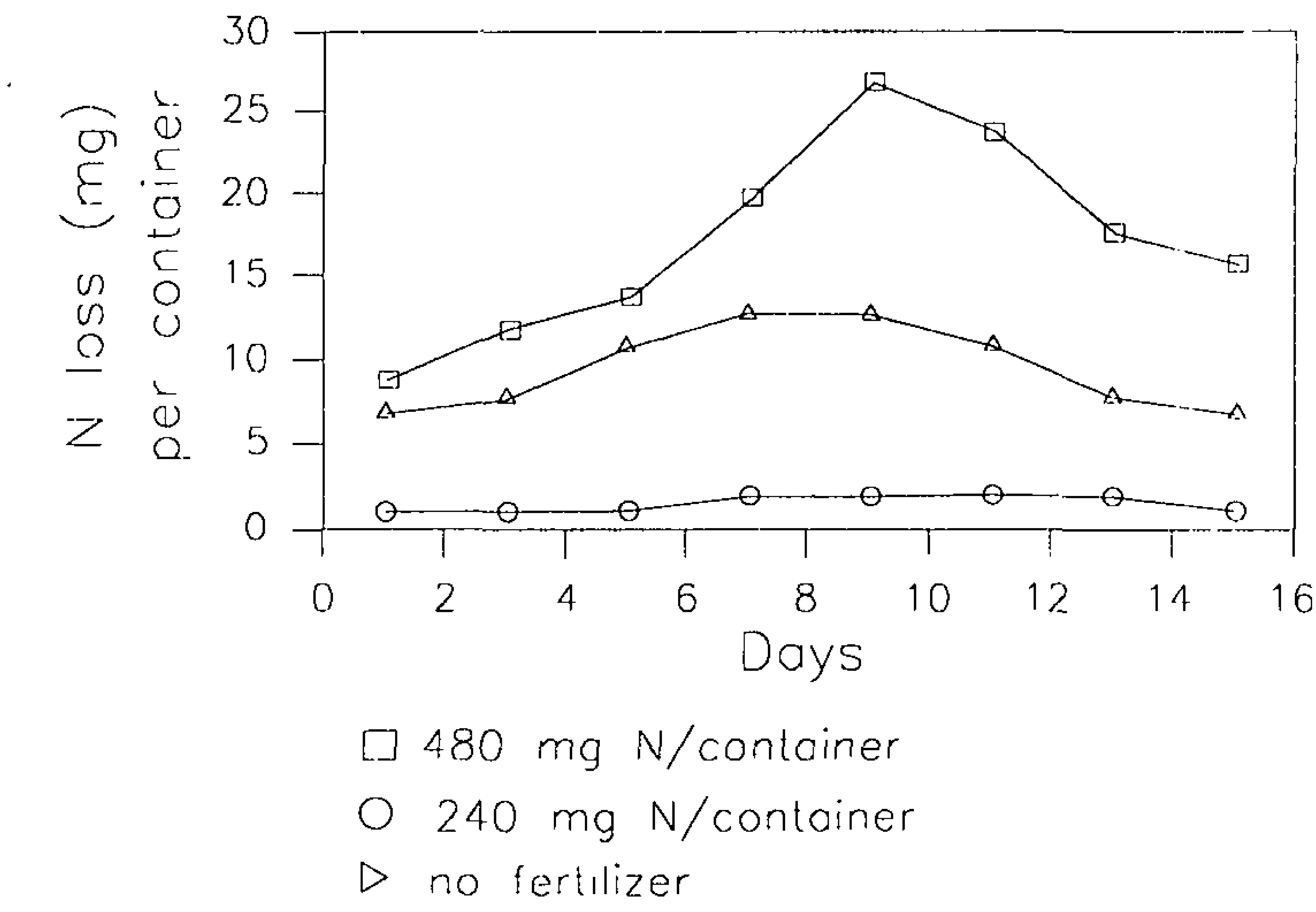

Figure 2. Nitrogen losses in mg/container from container-grown plants during a 15-day period after potting. The growing medium contained 240 or 480 mg in each container. Each day the equivalent of 9 mm rain was applied.

investigations he showed that for a very wide range of plants of different ages the uptake of N seldom reached 100 kg per year. In 80 % of the investigated cases the value was under 75 kg per year. Most plants cultivated in containers are fertilized with slow-release fertilizers. The quantity of nitrogen (N) given is often around 400 kg N per ha or more. Investigations in Germany have shown that using overhead irrigation, up to 150 kg N per ha is lost from the container growing area. Only 70 kg N per ha was lost using tensioswitch-controlled trickle irrigation (Fig. 1). Some N is also lost through denitrification. In this article, an attempt is made to suggest the most environmentally acceptable methods of fertilizing container plants by describing the different types of fertilizers and their uses in central European nurseries.

SALT FERTILIZERS

These are the common fertilizers used in agriculture, such as ammonium nitrate, potassium sulphate, and so on. Nearly all proprietary growing media contain 1 or 2 g of these fertilizers per litre. They are considered to be necessary to give the plants a quick start. They may also compensate for a wide C : N balance, as can be the case with media of high bark content. Many nurseries add them to growing media they make up themselves. However, they are easily leached. Figure 2 shows that nitrogen loss peaks after about 9 days given a daily rainfall of only 9 mm. An 18-mm average daily rainfall (a heavy thunder shower) leads to a peak N loss after 5 days (not shown). In Fig. 3 the cumulative loss as related to the average daily water application is shown. For example, around 150 mg of the total 240 mg applied

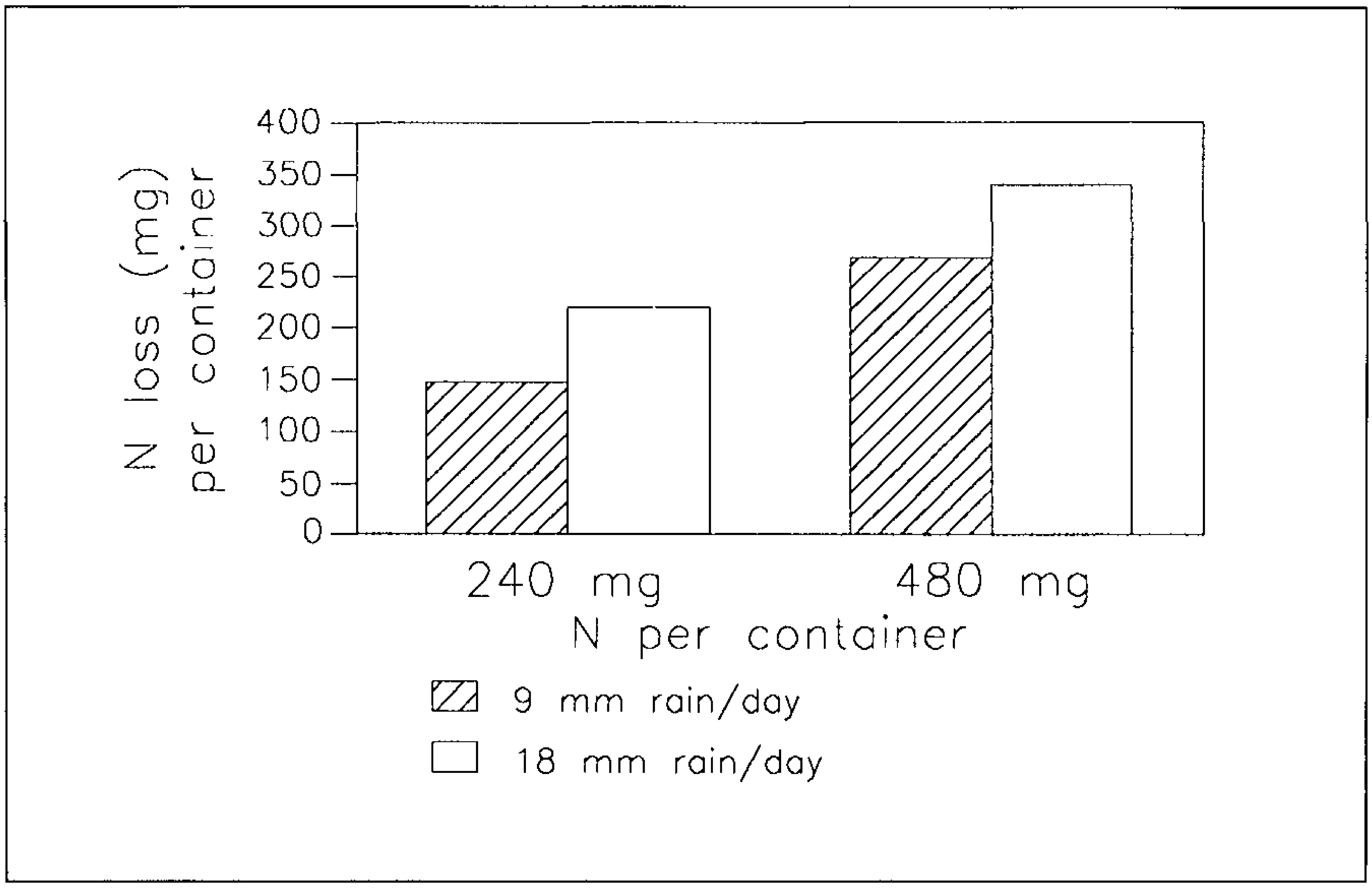

Figure 3. Total nitrogen losses over a 15-day period after potting and simulating a 9 or 18 mm rainfall per day. There was either 240 or 480 N mg per day.

nitrogen is lost within 15 days after a daily shower of 9 mm and 220 mg after a daily shower of 18 mm (Piringer, 1993). Therefore, these fertilizers should not be used, especially in early potting, if the water from the growing area can run into surface or ground water. Furthermore, the plants do not tend to make a lot of roots if there is a large quantity of N in the medium. It is probably better to have a substrate with a low level of nutrition for the first few weeks after potting to obtain faster root growth. A liquid feed for liners a few weeks before potting could be helpful to get root growth started in spring.

A few nurseries broadcast salt fertilizer as a top dressing. This method must be rejected in the future because only a small percentage of the nutrient is actually taken up by the plants, the rest is washed out of the growing medium or falls between the containers.

Salt Fertilizers for Drench and Foliar Feeding. These salt fertilizers are mixed with water. Examples used in central Europe are Alkrisal, Flory, and Hakophos. Plants react very quickly to their application. Foliar application can still be recommended for a quick improvement of the leaf colour but overhead application through the watering system cannot because of large nutrient losses. On the other hand use in trickle irrigation systems can be considered because it is possible to react to the growth pattern of the plant, thereby optimizing the nutrient uptake. During periods of rainy weather, however, the concentration of the nutrient solution must be increased and some losses occur.

Liquid Fertilizers and Suspensions. Examples of liquid fertilizers used in central Europe are Wuxal, Kamasol, and Basfoliar. They are generally used to treat deficiency symptoms, especially of trace elements. They are also used to give the leaves of evergreen plants a good colour. The amounts used are generally so low that any losses are negligible. They are also very suitable for trickle irrigation systems.

Non-Coated Slow-Release Fertilizers. Nitrophoska Permanent, Plantosan, Triabon, and Manadur are examples of this type of fertilizer. One part is quick acting (equivalent to salt fertilizers), and up to 70% of the total nutrient content can be in this category, and the rest is slowly released through microbiological breakdown. They are effective for 2 to 3 months. A standard mixture in Germany is 3 to 5 g of coated fertilizer and 1 to 2 g of non-coated slow-release fertiliser for a "start effect" at the time of potting. This is certainly better than using salt fertilizers for this effect. However, it is better to use these fertilizers for top dressing: they are very effective in this use and nutrient losses should not be high if the irrigation system is good. If these fertilizers are chosen as part of the base dressing then it is important to use a type with a high content of the slow-release material.

Coated Slow-Release Fertilizers. The best known representatives of this group are Plantacote, Osmocote, and Nutricote (Ficote). In general, reports on nutrient loss are low. The rate of loss is, however, dependent on temperature and watering system. Mac Carthaig et al. (1992) showed that the rate of nitrogen loss could be reduced from around 150 kg N per ha by overhead irrigation to around 70 kg N per ha by a tensioswitch-controlled trickle irrigation system. Rathier and Frink (1989) found that some 14% of the applied N was found in the plants, between 20% and 42% was found in the run-off water and often more than 50% simply could not be accounted for.

THE FUTURE FOR FERTILIZING METHODS IN CONTAINER NURSERIES

It is difficult to say how future legislation will change the way container plants are grown. At present in Germany (1994) many nurseries are changing to capillary watering systems because nutrient losses are low. The most common system is capillary matting, and application is controlled by tensioswitch. A number of nurseries are developing closed systems in which the water is collected and recycled. It is very likely that these systems will eventually be enforced by law. According to Behrens (1990) a water storage capacity of 1,000 to 3,000 m^3 ha^{-1} is necessary. Recycled water does not have a high salt concentration and disease problems have not so far been a problem. In the case of trickle irrigation it should be possible to reduce nutrient loss significantly by using a nutrient solution. Growers can increase fertilization when growth is strong or when buds are developing for the coming year in plants with predetermined growth such as *Euonymus alatus* or *Aesculus hippocastanum*. There is little experience of using liquid feeding on hardy nursery stock in Germany. The research centre in Boskoop, Netherlands, has made recommendations (Anon., 1992).

LITERATURE CITED

Anonymous. 1992. Adviesbasis voor de bemesting van boomteeltgewassen, Informatie en Kennis Centrum Akkeren Tuinbouw, Afdeling Boomteelt Boskoop, Netherlands.

Alt, D. 1990. Dungen in der baumschule taspo praxis, Heft 17.

Behrens, V. 1990. Geschlossener wasserkreislauf bei der geholzkultur Gartenbaureport 16(10):38-39.

Mac Carthaig, D, K. Teicher, and **S. Froschl**. 1992. Stickstoffverluste von Containerflachen lassen sich drastisch verringern. Deutsche Baumschule 44:223-224.

Piringer, G. 1993. Nitratauswaschung bei der verwendung von startdunger in containerkulturen. Degree thesis in the Fachhochschule Weihenstephan.

Rathier, T.M. and **C.R. Frink.** 1989. Nitrate run-off water from container grown juniper and Alberta spruce under different irrigation and N fertilization regimes. J. Environ. Hort. 7(1):32-35.