

Effect of NaCl on Asparagus Quality, Production and Mineral Leaching

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Keywords: *Asparagus officinalis* L., *Fusarium* spp., decline, Asparagus Salt, marketable yield, number of spears, spear weight

Abstract

Previous research has shown that the incidence of *Fusarium oxysporum* and *F. redolens* on asparagus roots was reduced by field applications of NaCl.

F. oxysporum and *F. redolens* are important diseases in asparagus crops causing physiological rust (brown discoloration on the harvested spears), reduced yields, smaller spears, plant losses and may be implicated in asparagus decline. Since 2001 research has been carried out in Lelystad with asparagus plants grown in large wooden containers filled with a typical asparagus replant soil to study the effect of applications of Asparagus Salt (NaCl with addition of Mg) on asparagus quality, production and mineral leaching. In 2003 and 2004 the trial was harvested for a period of 35 days each year. In 2004 spears were graded into standard sizes to identify differences between treatments and to start with an economic evaluation. In both years Asparagus Salt had a positive effect on total yield, marketable yield and number of spears. Field applications of NaCl stimulated earliness in production. The higher loss of Mg due to leaching is compensated by adding Mg to the salt. In this experiment leaching of Mn was also studied in combination with adding Mn to Asparagus Salt.

INTRODUCTION

Fusarium oxysporum and *F. redolens* are important diseases in asparagus (*Asparagus officinalis* L.) crops because they are held responsible for causing physiological rust (brown discoloration on the harvested spears), reduced yields, smaller spears, plant losses and may be implicated in asparagus decline (Baayen et al., 2000; Blok, 1992).

Previous research, carried out on the effects of NaCl application on asparagus, has shown that the incidence of *F. oxysporum* and *F. redolens* on asparagus roots was reduced (Poll, 1999). Yield increases occurred after addition of NaCl to asparagus grown in wooden containers but sometimes severe leaching of certain minerals e.g magnesium (Mg) took place (Poll and Titulaer, 2000). For that reason Mg is added to the NaCl at the rate of 60 kg/tonne of NaCl. This salt is known as Asparagus Salt.

Asparagus Salt (NaCl with additional Mg) also has a positive effect on controlling certain weeds (Poll and Bleeker, 2002) and slugs (Ester and Van Rozen, 2003) in green asparagus fields.

The objective of this research is to study the effects of Asparagus Salt application on yield and quality of asparagus. Leaching of Mn (manganese) in combination with the addition of Mn to Asparagus Salt was also investigated.

EXPERIMENTAL PROCEDURES

One year old 'Gijnlim' crowns were transplanted during March 2001 into wooden containers (5 crowns per container). The containers (120 cm x 120 cm x 140 cm) were filled with 1.15 m³ of sandy replant soil suitable for asparagus production (Fig. 1). Between 1990 and 2001 'Thielim' had been grown in this soil. The trial consisted of three treatments in 4 replications (containers):

1. Control (no NaCl);

2. Asparagus Salt at 1 + 1 t/ha;
3. Asparagus Salt + Mn (at 0.45 kg Mn/tonne of Asparagus Salt) at 1+1 t/ha.

Asparagus Salt with and without Mn was applied on May 13 (1 t/ha) and on July 3 (1 t/ha), 2002; on March 4 (1 t/ha) and May 23 (1 t/ha) in 2003 and on March 5 (1 t/ha) and on June 6 (1 t/ha) in 2004. Plant nutrition, irrigation, weed and disease control were carried out according to normal horticultural practice.

Drainage water was collected regularly from the wooden containers during autumn, winter and spring in 2002, 2003 and 2004 when the soil in the containers reached field capacity. pH and EC (electric conductivity) of the drainage water was determined and a sample of the drainage water was analysed for major and minor elements.

In 2003 for the first time harvesting as green asparagus took place during 35 days between April 18 and May 23. The spears were trimmed at a length of 22 cm, weighed and graded into marketable and non-marketable (irregular shaped) green spears. In 2004 spears were also harvested for a period of 35 days, between April 22 and May 28, and besides being evaluated the same as in 2003, also graded into the diameter classes <10 mm, 10-12 mm, 12-16 mm, 16-20 mm and 20-28 mm. Statistical analysis of the data was carried out using Genstat (ANOVA).

RESULTS AND DISCUSSION

Total weight, marketable yield and number of spears showed significant differences between treatments over the two harvest periods in 2003 and 2004 (Table 1). There was a significant interaction of year x treatment effect for total weight, total number of spears, marketable yield and non-marketable yield.

The development of the production in 2004 is shown in Figure 2. Asparagus spears emerged earlier in both NaCl treatments compared to the control treatment by 5-6 (standard NaCl + Mg) and 4 days (NaCl + Mg + Mn) respectively at 0.6 kg/container yield level. Na (Sodium) apparently influences the carbohydrate metabolism (Bergmann, 1992) in certain crops. NaCl applied may therefore start carbohydrate metabolism in asparagus earlier in the season leading to earlier production.

Average Mn losses in the control treatment were 1219 μmol per container and in the NaCl + Mg + Mn treatment the loss was 2081 μmol (Table 2). Where no Mn was added (the standard NaCl + Mg treatment) the loss was higher at 2811 μmol compared to the Mn treatment. It appears that the rate at which Mn is added when salt is applied can compensate the extra leaching of Mn. There might be an interaction between Mg and Mn in the soil and the uptake by the asparagus plants.

The application of Asparagus Salt has increased the average yield over the two seasons by 37% compared to that of the control treatment. Based on the average yield of green asparagus at 5500 kg per ha (at 26,700 plants/ha) this would mean a 2035 kg increase. For white asparagus it would mean a 2512 kg increase on top of the average yield of 6790 kg per ha at 18,770 plants. The yield of the Asparagus Salt + Mn treatment was not significantly different on average over the two seasons compared to the average control yield. There was no effect on spear diameter from application of Asparagus Salt.

CONCLUSIONS

1. Although the experiment was carried out in containers with a relative high plant population per m^2 it is clear that the Asparagus Salt treatments have shown significant positive effects on total yield, marketable yield and advancement of season (earliness) compared to no salt (control) application.
2. Due to the higher yield obtained with the Asparagus Salt treatments in both years and the previous results from experiments carried out since 1997 it is clear that application of Asparagus Salt improves yield, can reduce *Fusarium* incidence and apparently also gives an earlier crop under controlled circumstances.
3. Compared to the standard Asparagus Salt the yield of the Asparagus Salt + Mn treatment was significant lower but not different from the control. From this it would appear that by adding Mn to the Asparagus Salt, a yield reduction may occur.

4. Adding Mn to the Asparagus Salt can compensate the leaching of Mn. There may be an interaction between Mg and Mn in the soil and the uptake by the asparagus plants that can influence yield.

ACKNOWLEDGEMENTS

This research was funded by Akzo Nobel Salt BV, Deventer, The Netherlands.

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Tables

Table 1. Averages of total weight (g), marketable yield (g), spear weight (g) and number of spears per m² container surface ('Gijnlim') of different salt treatments. Lelystad-the Netherlands, 2003-2004 harvest periods.

Yield data	Control	NaCl +Mg	NaCl+Mg+Mn	LSD	Fprob
Total weight (g)	636	873	678	89	< 0.001
Marketable yield (g)	601	818	628	87.5	<0.001
Spear weight (g)	18.9	17.2	17.9	4.0	ns
Number of spears	34.4	55.0	40.0	15.4	0.036

Table 2. Leaching of Mn in μmol during the period October 2001 - March 2004 in green asparagus 'Gijnlim' grown in a sandy replant soil in wooden containers. Lelystad, the Netherlands.

Treatment	Average leaching per container
Control (no NaCl)	1219
NaCl +Mg (Asparagus Salt)	2811
NaCl +Mg+Mn	2081

Figures



Fig. 1. Asparagus containers used in the trial, Lelystad-the Netherlands, 2004.

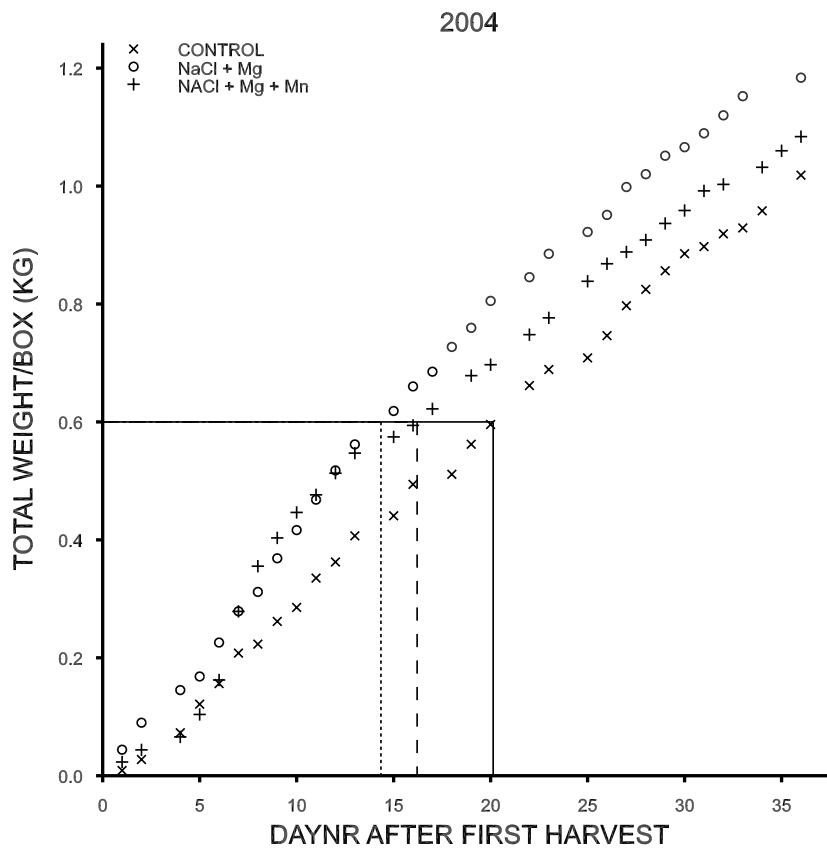


Fig. 2. Earliness of green asparagus ‘Gijnlim’ yield, grown in wooden containers (boxes) under 3 NaCl treatments, Lelystad-the Netherlands 2004.