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GOOD AGRICULTURAL PRACTICE (GAP) OF GLASSHOUSE LETTUCE AND SPINACH IN THE NETHERLANDS

Registration during 1998-2000

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1. INTRODUCTION

Earlier registration for GAP of lettuce under glass and spinach have been reported by De Kreij (1999). The present report deals with registration of lettuce during the winters 1998/1999 and 1999/2000. For spinach the registration is during the winter 1999/2000 and the summer of 2000. The registration for spinach has been improved since last year. There is a registration per growing cycle as for lettuce

The auctions (the Greenery with several locations and auction Zuid-Oost Nederland) received the registration sheets from the growers (by fax) some 7 -10 days before the expected harvest date. They ordered the TNO Nutrition and Food Research Institute to analyse the lettuce with sampling-help of Certerra (Environment-Concious-Cultivation). The Productschap Tuinbouw (Board of Horticulture) ordered the Research Station for Floriculture and Glasshouse Vegetables to process the data from the registration sheets.

In total 3726 sheets were processed of which 3476 lettuce and 250 spinach. Results are in this report.

2. SPREAD OF THE REGISTRATION

2.1. LETTUCE

The 3476 registration sheets from 435 growers of lettuce referred to an area of 602 ha. Combining data of Van den Berg and Cadel (2000) and personal communication the area with registration is only half of what is produced. The lettuce sold by growers directly to the super markets and traders, without the help of the auctions, was not registered.

Registered data concerned lettuce planted from November1998 until April 2000.

2.2. SPINACH

Spinach growers improved the registration and registered per growing cycle. In total 250 registration sheets were available. The sheets were from March 1999 - July 2000, with the highest amount (53) of February 2000. Sixty growers delivered one sheet, 25 growers delivered 2 sheets and a 20 growers delivered more than two sheets. The registration was simple, e.g. there was no information on the registration sheets of the nitrogen content of the soil and details about the fertilisers.The area of registration is estimated at 30 ha. It is not known how much this covers of the total area of spinach.

Four growers registered in more detail. Soil analysis data were available from these growers.

3. SOIL ANALYSIS AND NITROGEN RECOMMANDATION

Soil analysis is executed before each planting. Soil is extracted with water in the 1:2 volume extract (Sonneveld and Van den Ende, 1971). The distribution of electrical conductivity (EC), NO_3, and Cl levels are given in Figure 1, 2, and 4, respectively.

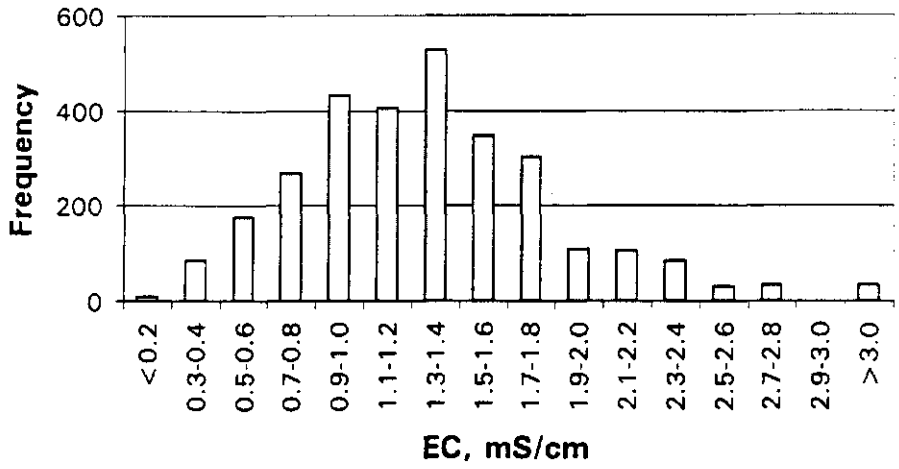


Figure 1. Distribution of EC in soil 1:2 volume extract.

To prevent glassiness in lettuce the EC in soil of winter grown lettuce should be high. The target values are related to soil type and range from 1.2 – 1.5 mS/cm. Most soils had an EC in the range of the target. However, some very low and high EC's occurred.

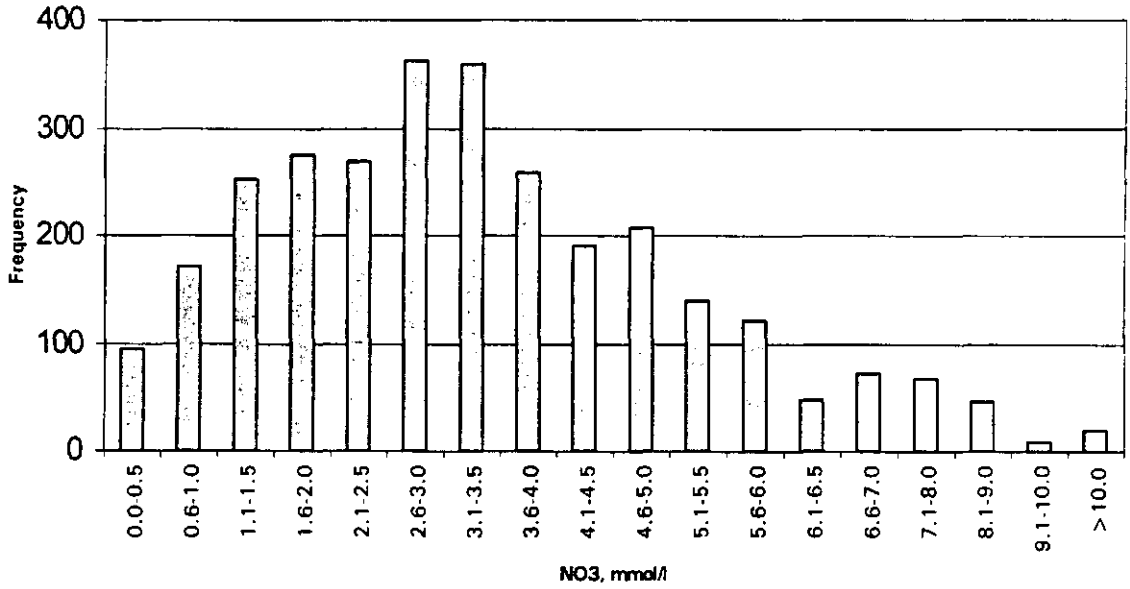


Figure 2. Distribution of nitrate in soil 1:2 volume extract.

Nitrogen recommandation is based on the recommendations from the Research Station for Floriculture and Glasshouse Vegetables and the Laboratory for Soil and Plant Analysis, Naaldwijk (Table 1; Van den Bos et al., 1999).

Table 1 - Nitrogen target values in the 1:2 volume soil extract before planting at different planting dates and (expected/aimed) head weight at harvest.

Head weight at harvest	Nitrogen target value in 1:2 volume extract, mmol/l			
	autumn	winter	spring	summer
g/head	15/8-15/10	15/10-15/2	15/2-15/4	15/4-15/8
<250	3.5	4	3.5	3
250-340	4.5	5	4.5	4
>350	5.5	6	5.5	5

On the basis of the NO_3 in the soil analysis and the N target values the N recommandation can be calculated with the formula that 56 kg/ha N increases the N level in the 1:2 extract with 1 mmol/l. Since the NH_4 contents in the soil extracts were in almost all cases <0.1 mmol/l the NH_4 has been neglected. If for example the target value for a certain planting period and an expected/aimed crop weight at harvest is 5 mmol/l and the analysed content is 3.4 mmol/l, then the N recommandation is (5.0-3.4)*56= 90 kg/ha N. In Figure 3 the distribution of the N recommandation is given.

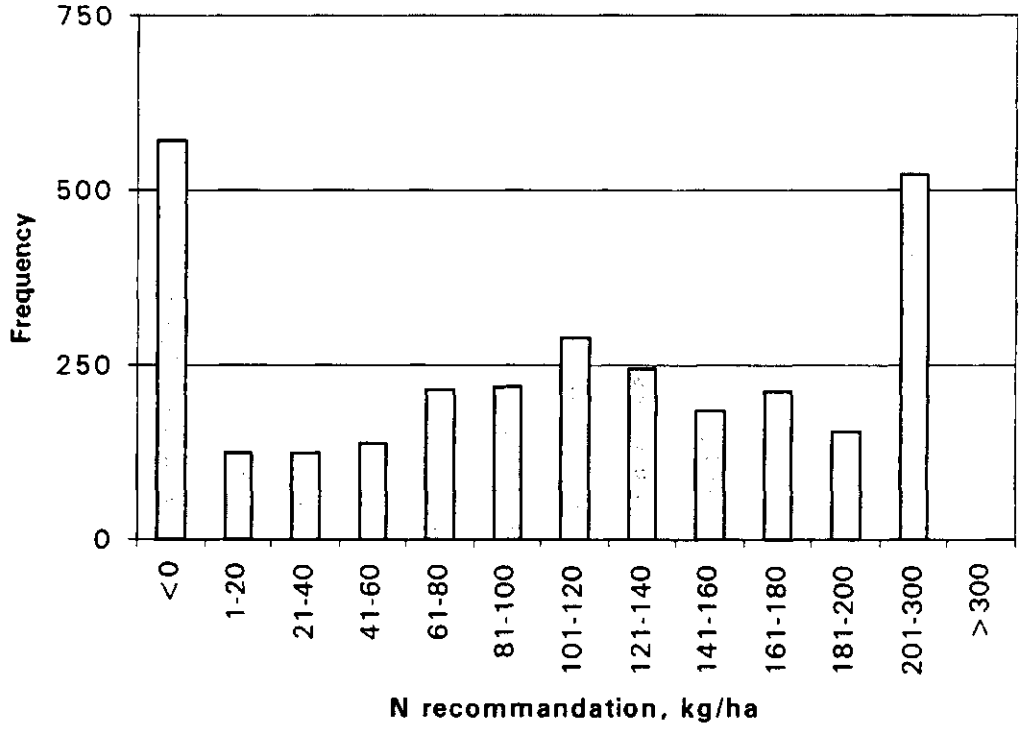


Figure 3. Distribution of N recommandation.

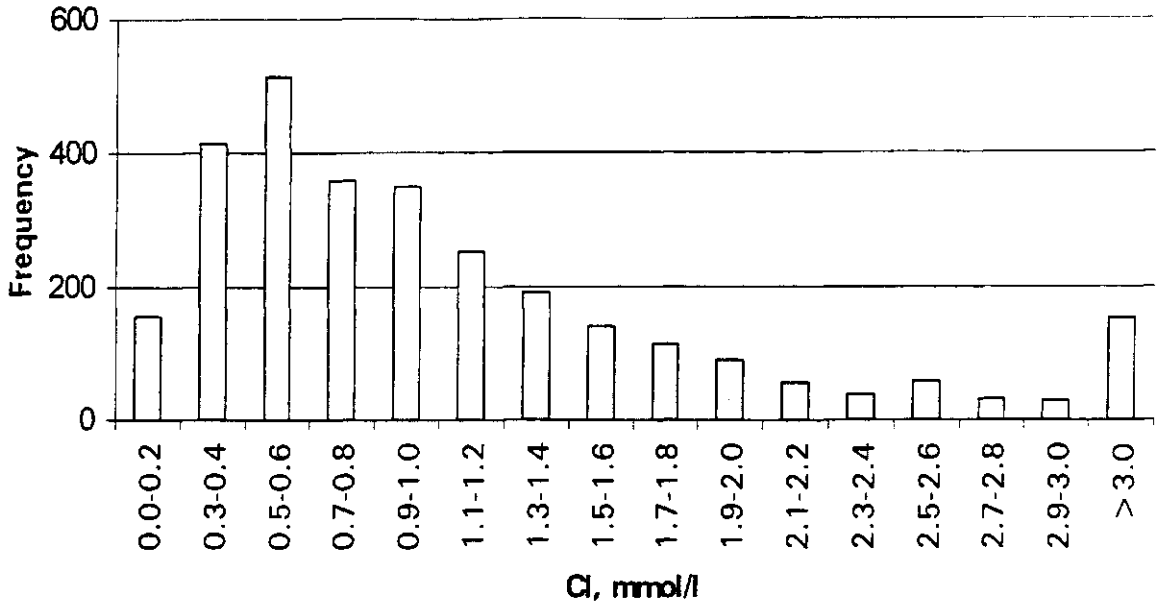


Figure 4. Distribution of Cl in soil 1:2 volume extract.

The Cl-target value in winter grown crops in 2 mmol/l. Most soils had a Cl-level lower than the target (Figure 4).

4. NITROGEN SUPPLY

Nitrogen was supplied before planting in many different fertilisers, e.g. magnesamon (ammonium nitrate with magnesium/calciumcarbonate, calciumnitrate, potassium nitrate, ammonium nitrate, many different compound fertilisers ($N + P_2O_5 + K_2O$) and organic fertilisers. The supply is given in Figure 5. In many cases potassium chloride has been supplied.

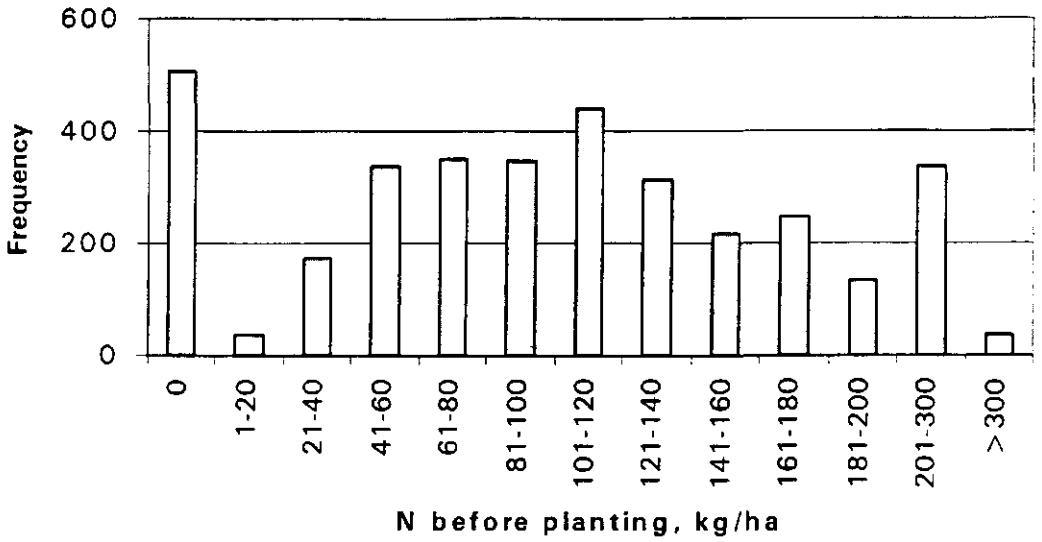


Figure 5. Nitrogen supply before planting.

The range of supply is wide.

During the growing period also N has been supplied. This is always in soluble fertilisers, like KNO_3, $Ca(NO_3)_2$, $Mg(NO_3)_2$ and $NH_4H_2PO_4$. The supply is given in Figure 6.

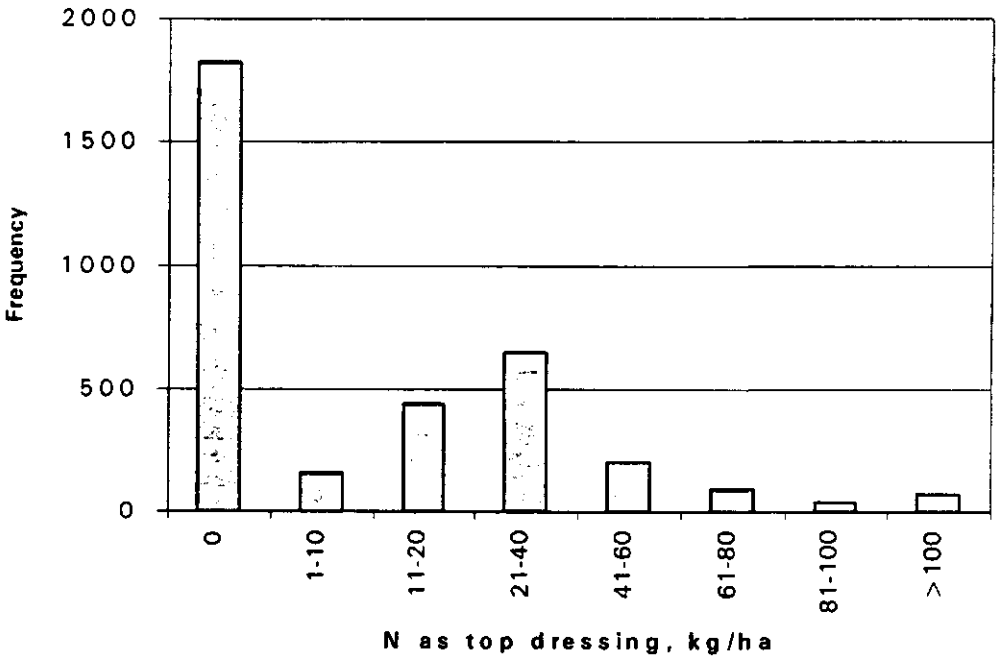


Figure 6. N supply as top dressing (during growing period).

5. NITROGEN RECOMMENDATION VERSUS SUPPLY

From the NO_3 content in the soil analysis and the target values the N recommendation (before planting; base dressing) has been calculated. If the NO_3 content in the soil analysis is higher than the target, the recommendation can be noted as a negative virtual value. In practice the recommendation is zero. The supplied N (as a base dressing) has been correlated to the recommendation. The presentation of both characters is given in Figure 7.

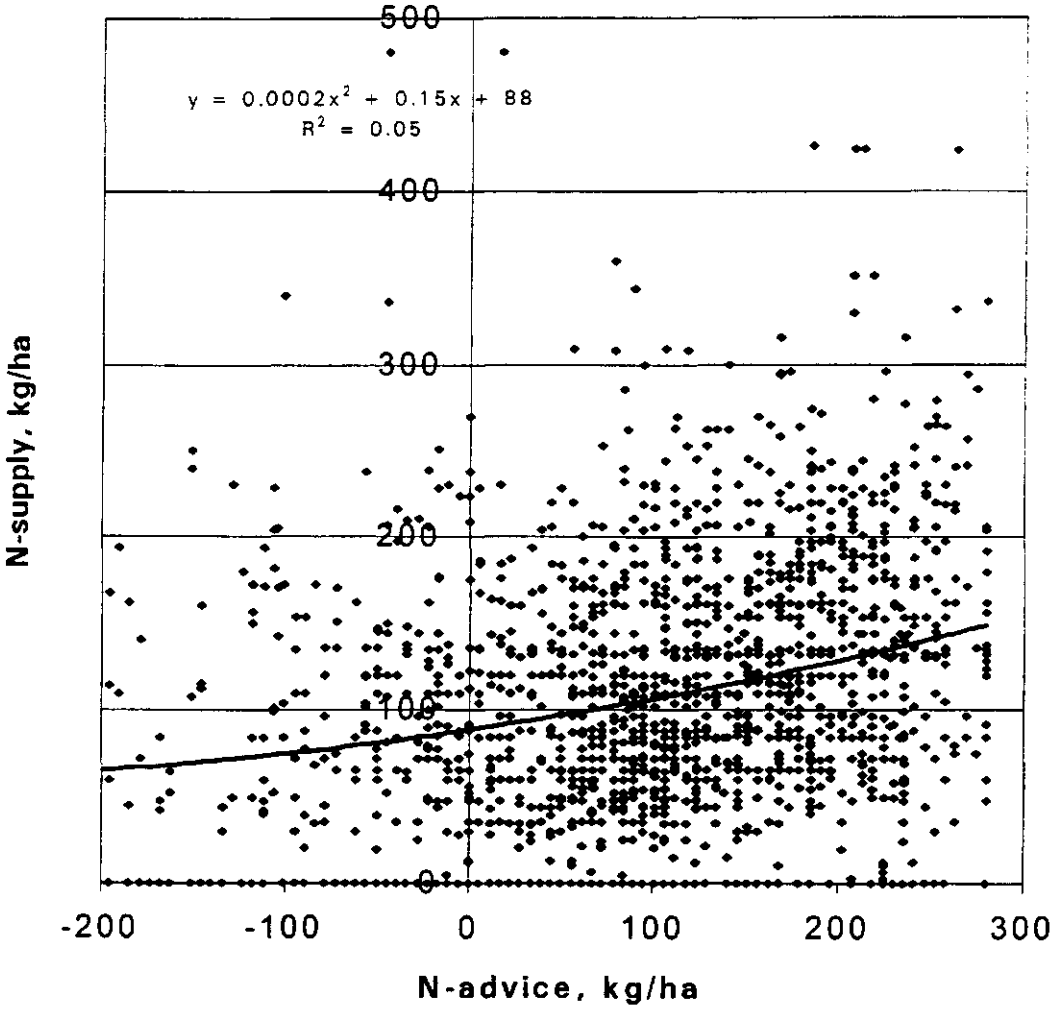


Figure 7. N recommendation and the actual supplied N (both before planting).

The correlation between the N recommendation and the N supply is poor.

6. NITRATE IN LETTUCE

Nitrate content in lettuce in relation to the month of sampling is given in Figure 8. In total 1089 samples of nitrate are given. In Table 2 the number of samples which exceeded the limits are given.

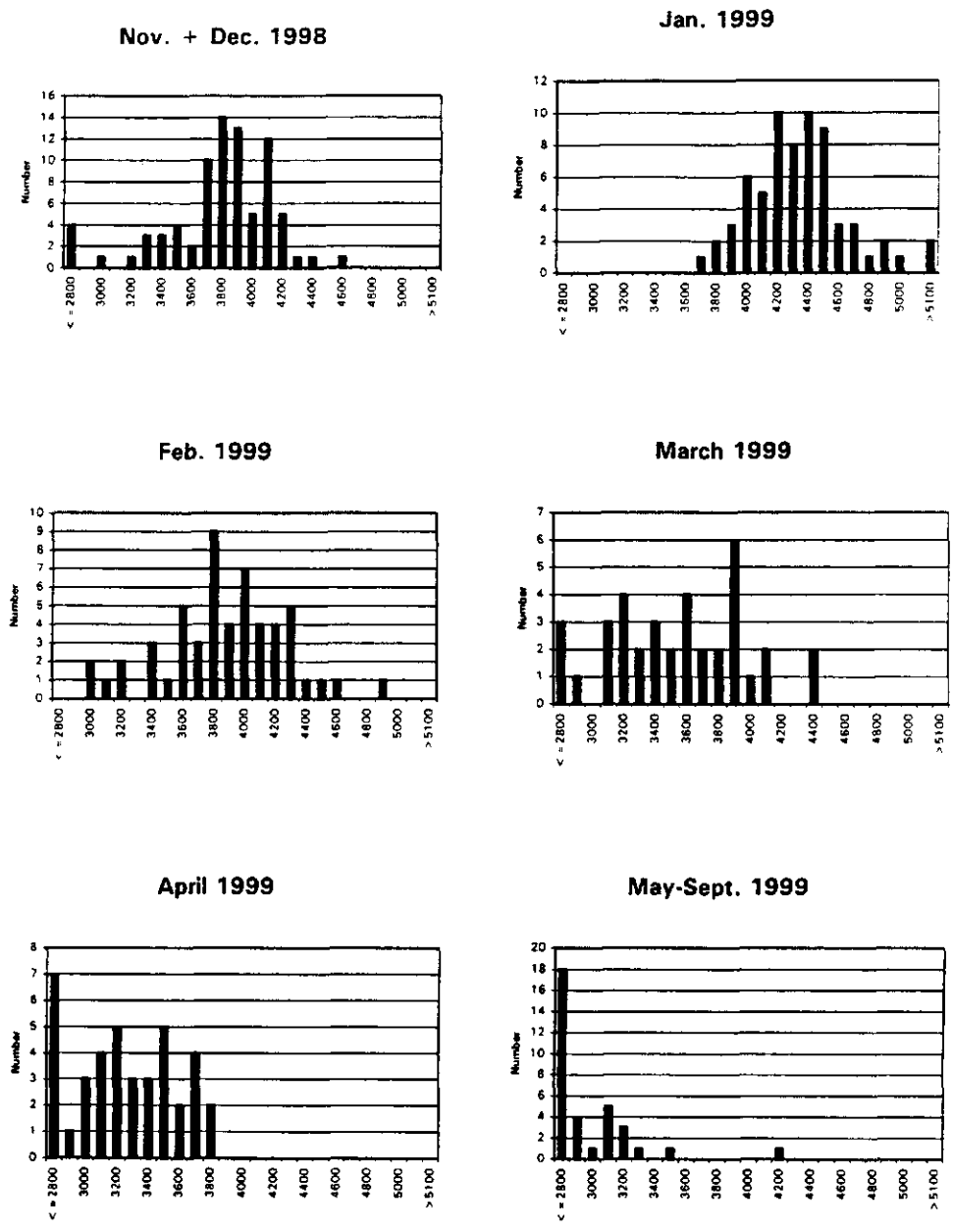
Table 2. Limits and number of samples with too high nitrate content

Month of sampling	Limit of nitrate	Number of samples higher than limit	Fraction of samples higher than the limit
	mg/kg fresh weight	number	%
Nov. + Dec 1998	4500	1	2
Jan. 1999	4500	12	20
Feb. 1999	4500	3	5
March 1999	4500	0	0
April 1999	3500	8	20
May - Sept. 1999	3500	0	0
Oct. + Nov. 1999	4500	0	0
Dec. 1999	4500	3	3
Jan. 2000	4500	5	2
Febr. 2000	4500	0	0
March 2000	4500	1	1
Arpril 2000	3500	41	24
May - July 2000	3500	1	*)

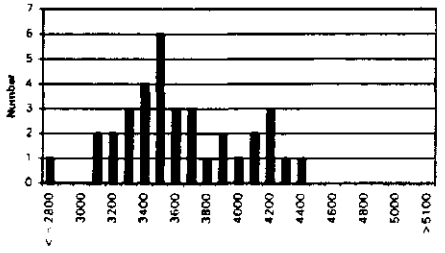
*) too few values

The average nitrate content of the 1089 crop sanples were 3670 mg/kg fresh weight. Of these crops 107 samples (with an average content of 3900) were sampled again after a few days. The average content was then 3600. Of these 107 samples 13 crops were sampled a third time. The average content was than 3450 mg/kg fresh weight.

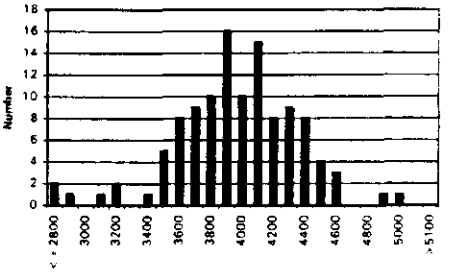
Figure 8. Nitrate content in lettuce in relation to the month of sampling.



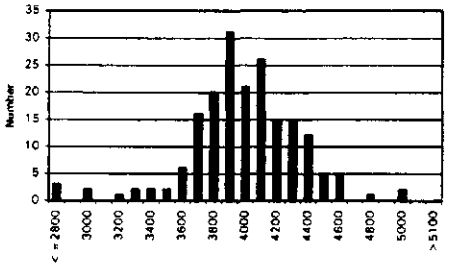
Oct. + Nov. 1999



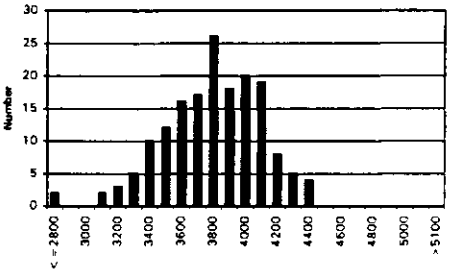
Dec. 1999



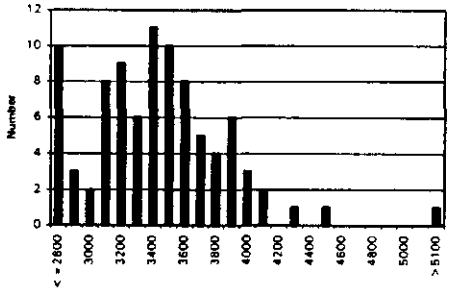
January 2000



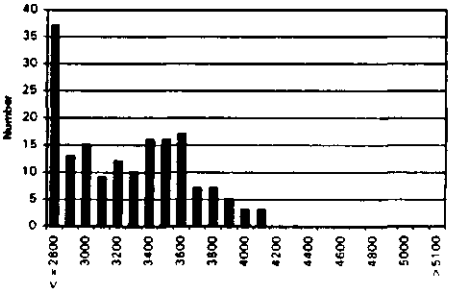
February 2000



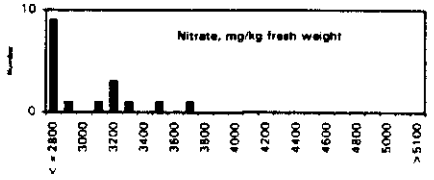
March 2000



April 2000



May - July 2000



The correlation between the first and the second sampling is shown in Figure 9.

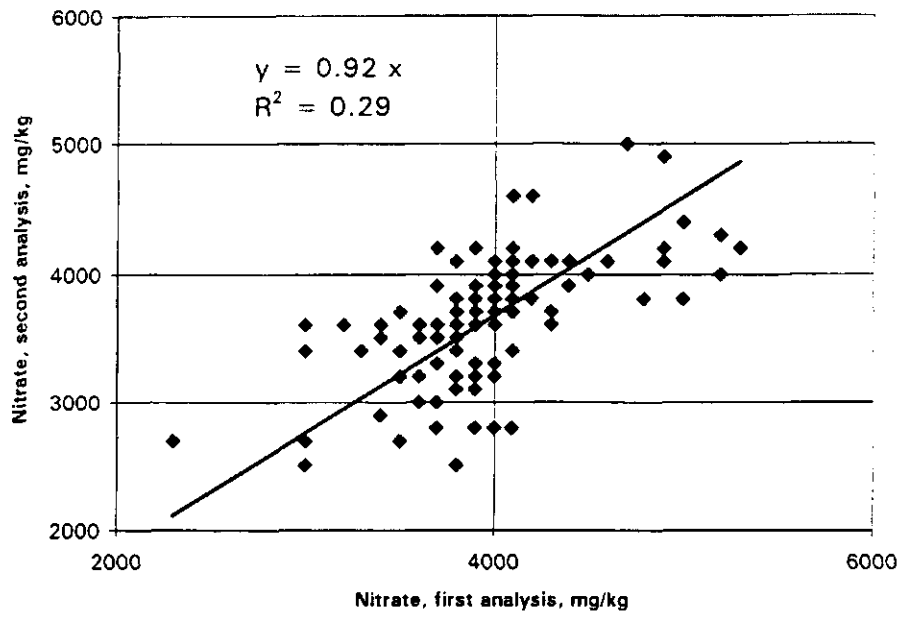


Figure 9. Nitrate in 107 samples, sampled twice with an interval of about 3-4 days.

The correlation between the N supply and the nitrate in lettuce was poor (correlation not shown). Also the correlation between head weight and nitrate content was poor (correlation not shown).

In Figures 10 –13 the relation between the mean Kipp-solar radiation during 7 and 14 days, respectively, before sampling and the nitrate content in the heads in given. A negative correlation between radiation and nitrate content is found. The correlation between the nitrate content and the radiation a number of days before sampling is better for 14 days than for 7 days.

Figure 10. Correlation between mean radiation during 7 days before sampling of the heads and the head nitrate contents.

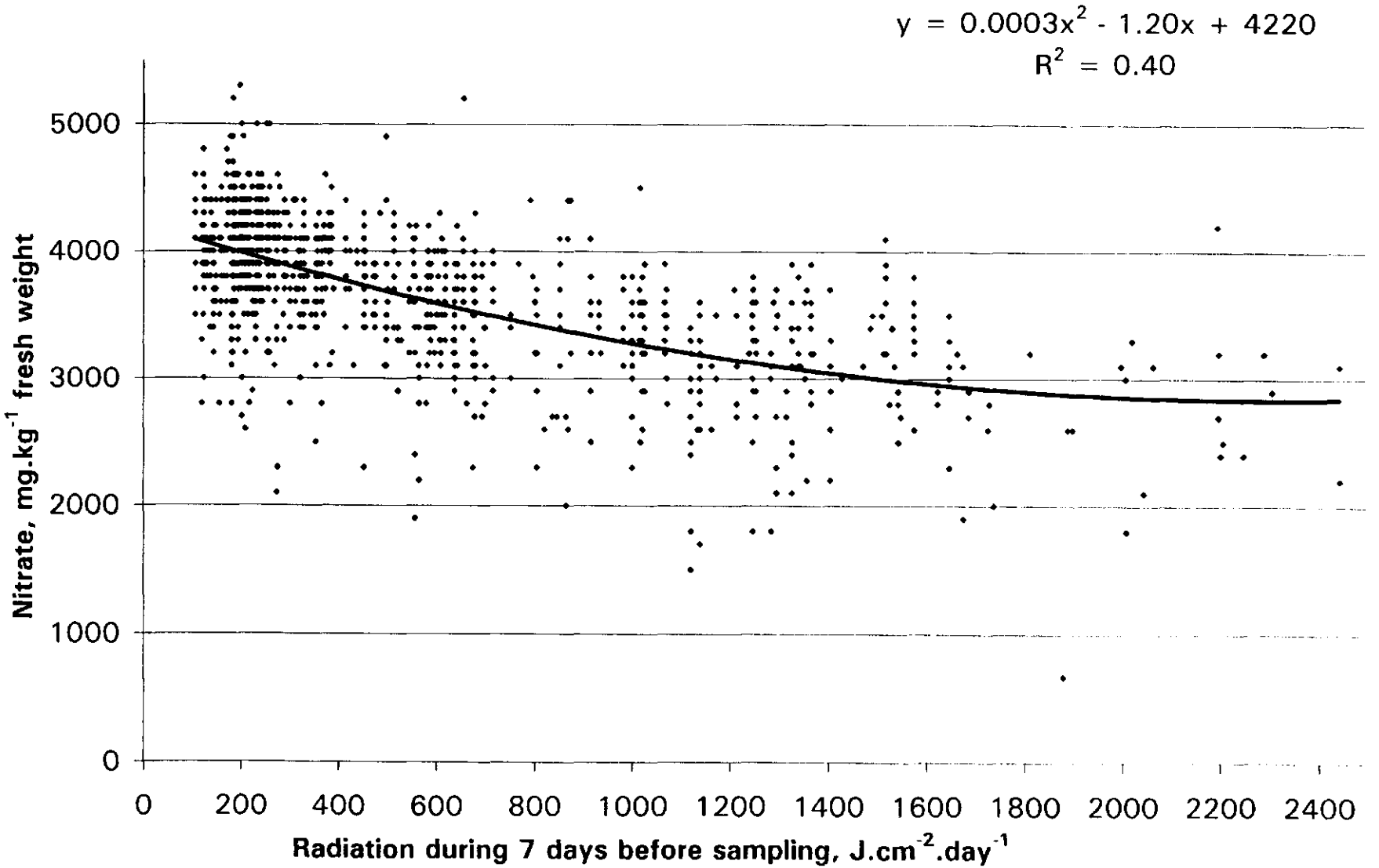


Figure 11. Mean radiation during 7 days before sampling of the heads and the nitrate contets of the heads at the different sampling dates.

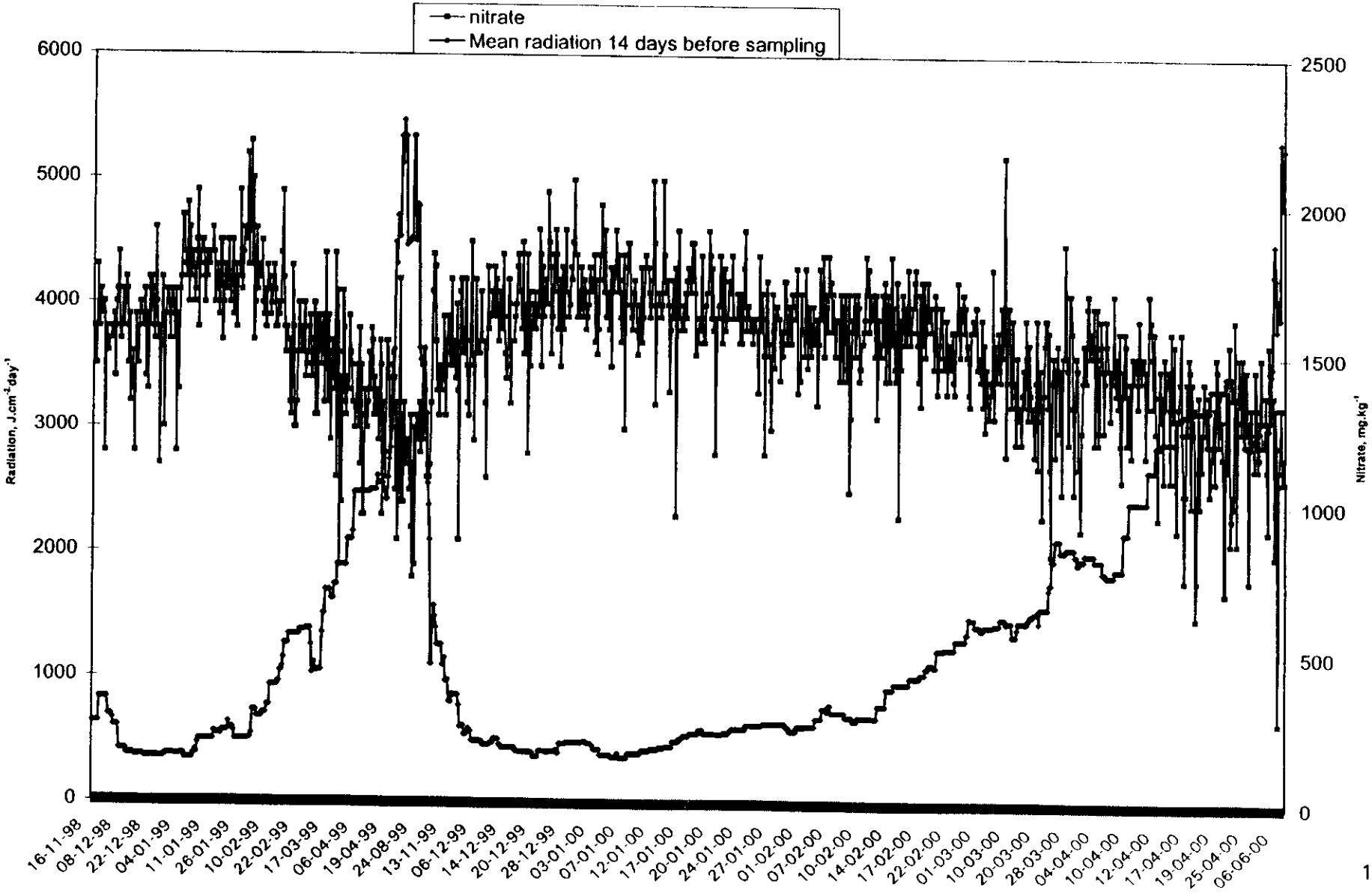


Figure 12. Correlation between mean radiation during 14 days before sampling of the heads and the head nitrate contents

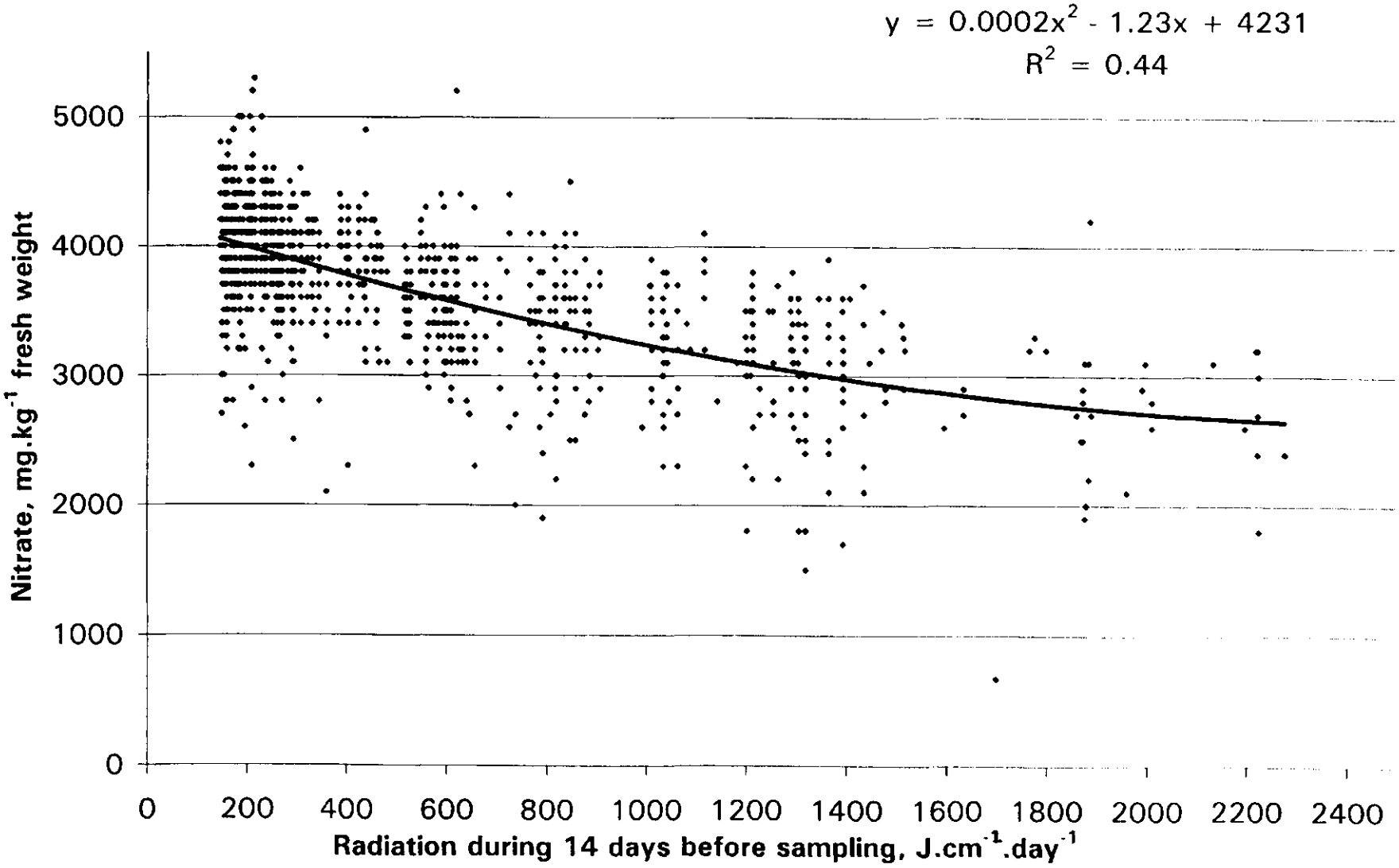
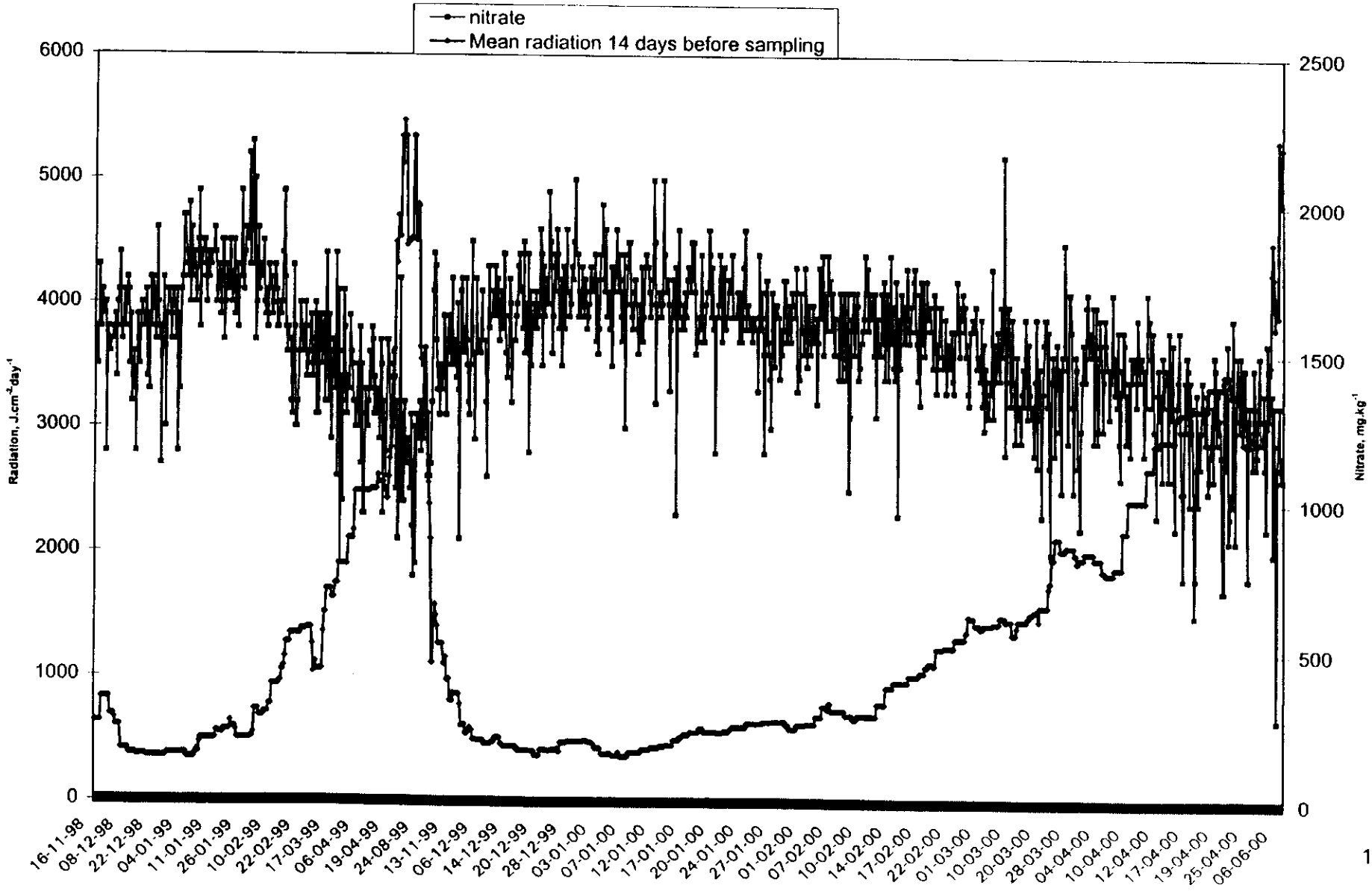


Figure 13. Mean radiation during 14 days before sampling of the heads and the nitrate contets of the heads at the different sampling dates.



7. NITRATE IN SPINACH

In total 73 analysis were performed. This was 43 samples of glasshouse crops and 30 samples of outdoor crops.

For the glasshouse crops the sampling period was February 2000 – April 2000. The data of the winter period (November – March) are shown in Figure 14. Based on the EU-limit of 3000 mg/kg, in total 21 samples (58 %) exceeded the limit. Based on the limits in the Netherlands of 4500 mg/kg, in total 2 samples (6%) exceeded the limit.

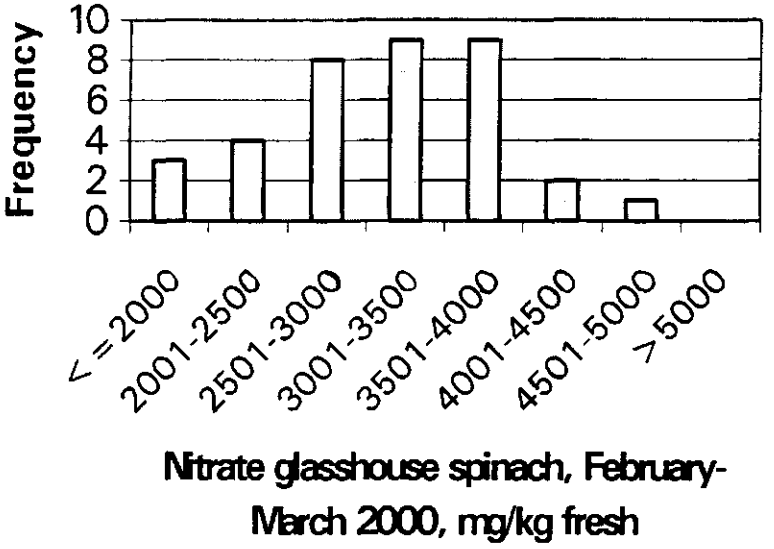


Figure 14. Nitrate content of glasshouse spinach sampled in February – March 2000 (winter period).

The data of the summer period (April-October) are shown in Figure 15. Based on the EU-limit of 2500 mg/kg, in total 5 samples (71 %) exceeded the limit. Based on the limits in the Netherlands of 3500 mg/kg, in total 2 samples (29%) exceeded the limit.

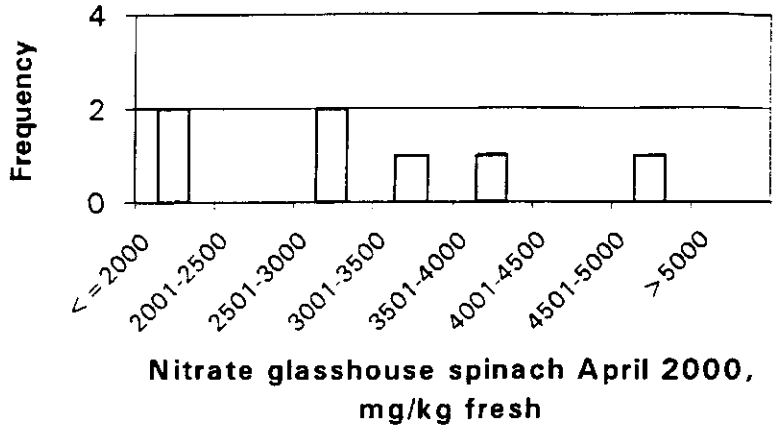


Figure 15. Nitrate content of glasshouse spinach sampled in April 2000 (summer period).

For the outdoor grown spinach the sampling period was April-August 2000 (summer period). The data are shown in Figure 16. Due to the EU-limit of 2500 mg/kg, in total 8 samples (27%) exceeded the limit. Related to the limit in the Netherlands of 3500 mg/kg fresh, in total 2 samples (7%) exceeded the limit.

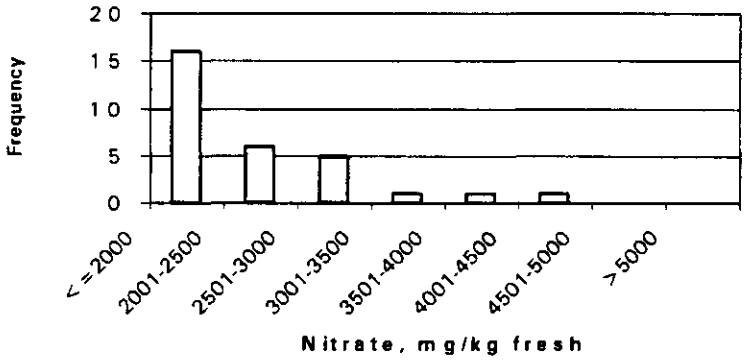


Figure 16. Nitrate content of outdoor grown spinach sampled in April – August 2000 (summer period).

8. CONCLUSION AND SUMMARY

In 1998/2000 lettuce growers (435 in total) delivered 3476 registration sheets for GAP to the auctions. This covers 602 ha. This was only the lettuce handled by the auctions. From an estimate 50 % of the volume of lettuce is sold directly by the growers (without the interaction of the auction). From this lettuce no registration has been executed. This has to be improved in the next year.

The soil analysis for lettuce crops showed that the EC's (for a good quality) were in the right range (1.2 – 1.5 mS/cm in the 1:2 volume soil extract). Nitrate in the soil extracts were in the right range. In many cases (600 of the about 2700) no N supply was feasible. Actual in 500 cases no N was supplied as a base fertilisation. Cl levels in the soil in winter grown lettuce are still lower (about 0.3 to 1.3 mmol/l in the 1:2 volume extract) than the recommended value (2 mmol/l). More growers used KCl as a fertiliser than last registrations. This is an improvement, but it is not enough.

Of the lettuce heads nitrate was determined (in total 1089 samples). Of these crops, in 107 cases there was a second sampling, and in 13 cases a third sampling. A significant correlation was found between the Kipp-solar radiation before sampling of the head and the nitrate contents. A higher radiation means a lower nitrate content. It is better to take the radiation during 14 days as a variate than the radiation during 7 days. Second sampling gave a 8 % lower content than the first sampling.

The registration of 250 sheets by spinach growers was simple. More accurate registration is needed. In total 73 analysis of nitrate contents of spinach were available of which 43 of glasshouse grown crops and 30 of outdoor grown crops. In the winter period the nitrate contents of the glasshouse grown crops exceeded in 58 % and 6 % of the cases the European (3000 mg/kg) and the Duth limit (4500 mg/kg), respectively. Almost the same percentages were found in the summer period. However, only limited data were available.

LITERATURE

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Sla-meldings- en GAP-formulier

nr. 41224 | dd. 4/1/95 4.40c
(hierboven niet invullen)

Zaaiselnr.: 2

Naam teler:
Adres:
Postcode/Wo
Tuinadres:
Aanvoernum
MBT-nummer:
Tel.: Fax:

Appendix

Afdeling: 1 Ras: Trocadero
Zaaidatum: 21-9-[illegible] Plantdatum: [illegible]
Oppervlak zaaisel(m²): 1700 m²
Geplande 1e oogstdatum: [illegible]
Geschat kropgewicht: [illegible] kg/100 stuks

Type sla: ☒ kropsla ☐ ijsbergsla ☐ anders:

Bemestingsonderzoek (Grondmonster) ☒ **vóór-** ☐ **tijdens teelt**

Monster-nummer	Monster-datum	EC	pH	NH_4	K	Na	Ca	Mg	NO_3	Cl	SO_4	P
		1.4c	6.5	[illegible]	3.4	0.7	29	20	3.2	65	46	0.3[illegible]

EC beregeningswater:

Bemesting

voorraadbemesting			bijbemesting		
meststof	kg/are of ~~l/are~~	MBTcode	meststof	kg/are of l/are	MBTcode
12-6-16	5 kg/are				
Kieserit	4kg/are				
Patentkali	4 kg/are				

Totaal waterverbruik: _____ **l/m²**

Soort water: ☐ regenw. ☐ leidingw. ☐ omgekeerde osmose ☒ bronw. ☐ oppervlaktew. ☐ anders _____

Grondsoort: ☒ zand ☐ zand/zavel ☐ zavel ☐ zavel/klei ☐ klei ☐ veen ☐ löss ☐ anders: _____

Gewasbeschermingsregistratie (voor MBT-deelnemers)

Middel(en) hvh= hoeveelheid	1	2	3	4	5	6	7	8	GRS*)
datum	hvh	hvh	hvh	hvh	hvh	hvh	hvh	hvh	
Totaal:									
gr of ml									
N-nummer									

*) toepassingsmethode G=gewasbehandeling R=ruimtebehandeling S=substraat-/grondbehandeling

Datum: 31-12-96 Handtekening:

Sturen naar: Coöp. veiling Zuidoost- Nederland B.A., Afdeling Kwaliteitszor
Postbus 8503 5970 AA Grubbenvorst - Fax: 077-3239509