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

Registration during winter 1998/1999



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CONTENTS

1. INTRODUCTION	4
2. SPREAD OF THE REGISTRATION	4
2.1. Lettuce	4
2.2. Spinach	4
3. SOIL ANALYSIS AND NITROGEN RECOMMANDATION	4
4. NITROGEN SUPPLY	8
5. NITROGEN RECOMMANDATION VERSUS SUPPLY	8
6. NITRATE IN LETTUCE	9
7. CONCLUSION AND SUMMARY	13
LITERATURE	13
Appendix	14

1. INTRODUCTION

The first criticism of registration for GAP of lettuce under glass during 1995 – 1998 was that the registration was per period of 4 weeks (De Kreij, 1998). In this way it was difficult to follow a growing cycle. The second criticism was that not all growers supplied the registration sheets to the auctions.

Both aspects have been improved in the winter period 1998 – 1999. Growers registered per growing cycle and could not sell lettuce at the auctions without the supply of the registration sheet. An example of a sheet is given in the appendix.

The auctions (the Greenery with several locations and auction Zuid-Oost Nederland) received the registration sheets from the growers (by fax) some days before the expected harvest date. They ordered the TNO Nutrition and Food Research Institute to analyse the lettuce with sampling-help of the Stichting Milieubewuste Teelt (Environment-Conscious-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 1920 sheets were processed of which 1600 lettuce and 320 spinach. Results are in this report.

2. SPREAD OF THE REGISTRATION

2.1. LETTUCE

The 1600 registration sheets from 385 growers of lettuce referred to an area of 320 ha. Combining data of Anonymous (1996) and Van den Berg and De Groot, (1998) the total area of lettuce under glass can be estimated at about 320 ha. That means that the registration covers 100 % of the area.

Registered data concerned lettuce planted from August 1998 until April 1999.

2.2. SPINACH

Spinach growers registered per month. In total 320 registration sheets were available. The sheets were from April 1998 – May 1999, with the highest amount (63) of April 1998. 70 growers delivered one sheet, 20 growers delivered 2 sheets and a few growers delivered more than two sheets –including one grower with 12 sheets. Unfortunately, it is not clear how large the area of registration is, because the registration was per month and not per growing cycle as for the lettuce. Therefore, processing of the data was assumed not to be valuable.

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), NO₃, Cl and P levels are given in Figure 1, 2, 3 and 5.

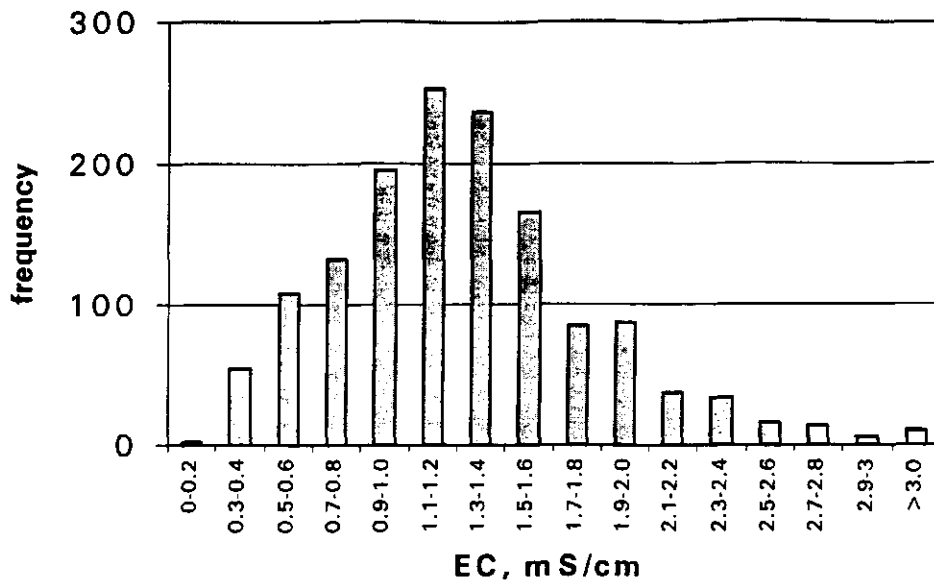


Figure 1. Distribution of EC in soil 1:2 volume extract.

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.

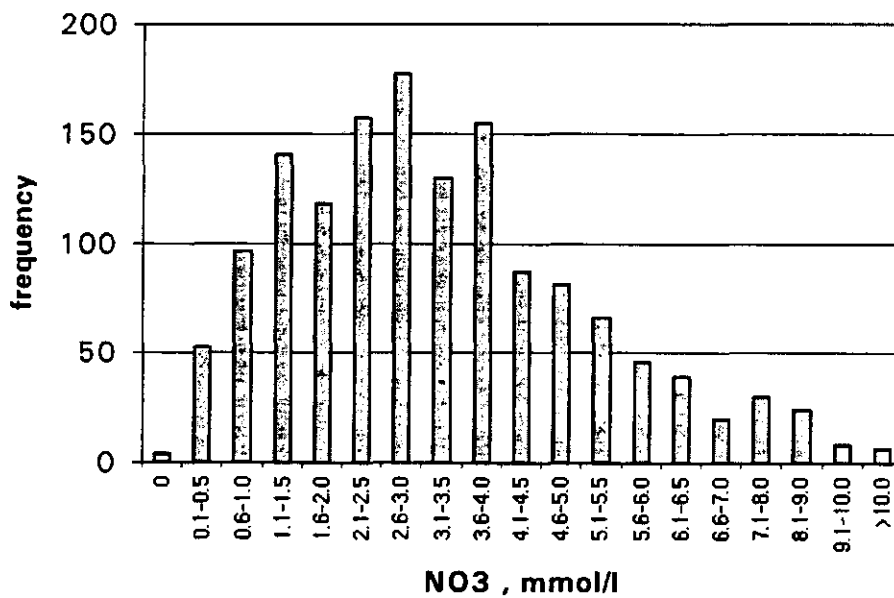


Figure 2. Distribution of nitrate in soil 1:2 volume extract.

Nitrogen recommendation is based on the most recent 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	15/2-5/1/4	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 recommendation 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 recommendation is $(5.0-3.4) * 56 = 90$ kg/ha N. In Figure 3 the distribution of the N recommendation is given.

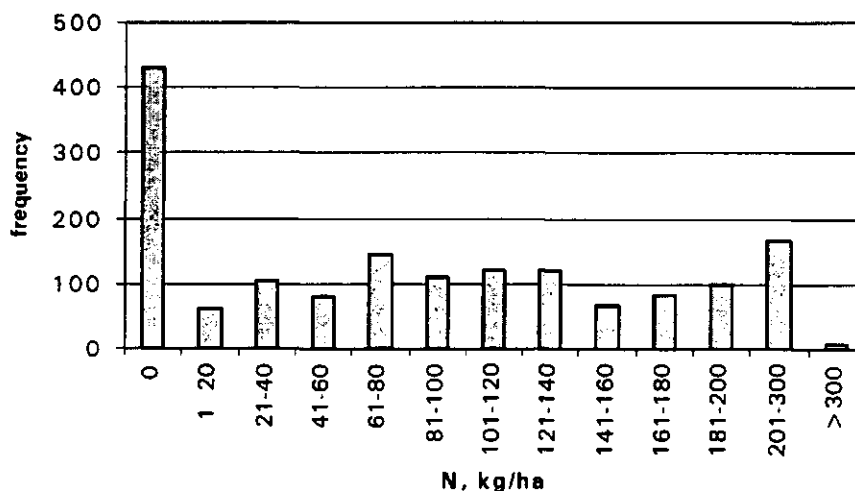


Figure 3. Distribution of N recommendation.

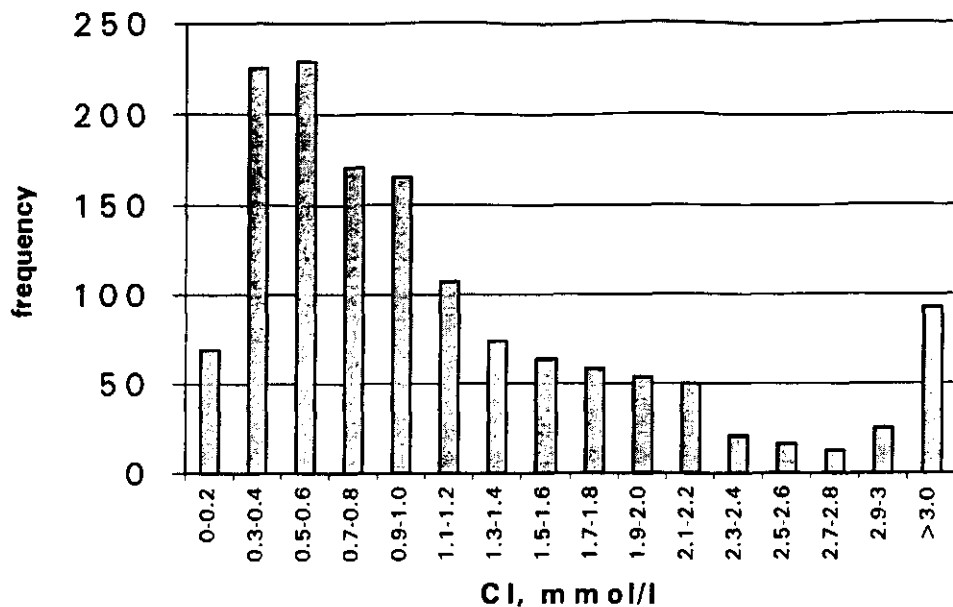


Figure 4. Distribution of Cl in soil 1:2 volume extract.

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

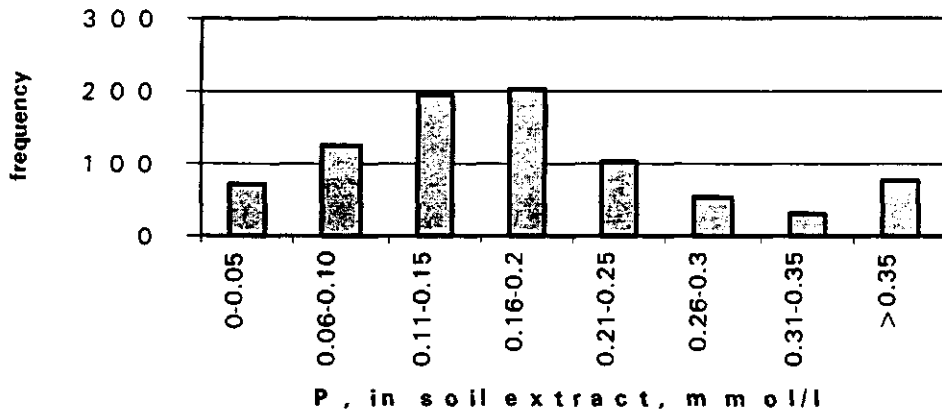


Figure 5. Distribution of phosphorus in soil 1:2 volume extract.

The target value for P in the 1:2 volume extract is 0.15 mmol/l (IKC, 1994). The latest recommendation (Van den Bos, 1999) is 0.10 mmol/l. Many soils have a P content higher than the target.

4. NITROGEN SUPPLY

Nitrogen was supplied before planting in many different fertilisers. The supply is given in Figure 6.

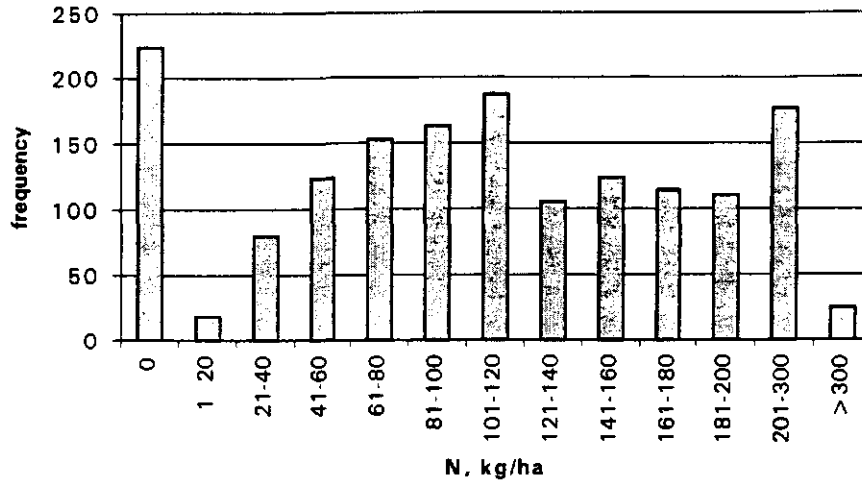


Figure 6. Nitrogen supply before planting.

The range of supply is wide.

During the growing period also N has been supplied. This is always in soluble fertilisers, like KNO_3 , $\text{NH}_4\text{H}_2\text{PO}_4$. The supply is given in Figure 7.

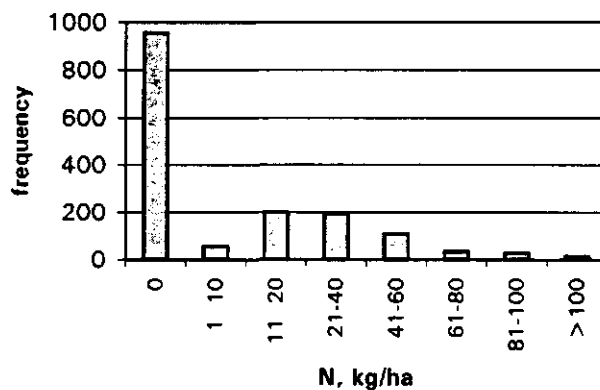


Figure 7. N supply as top dressing (during growing period).

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 8.

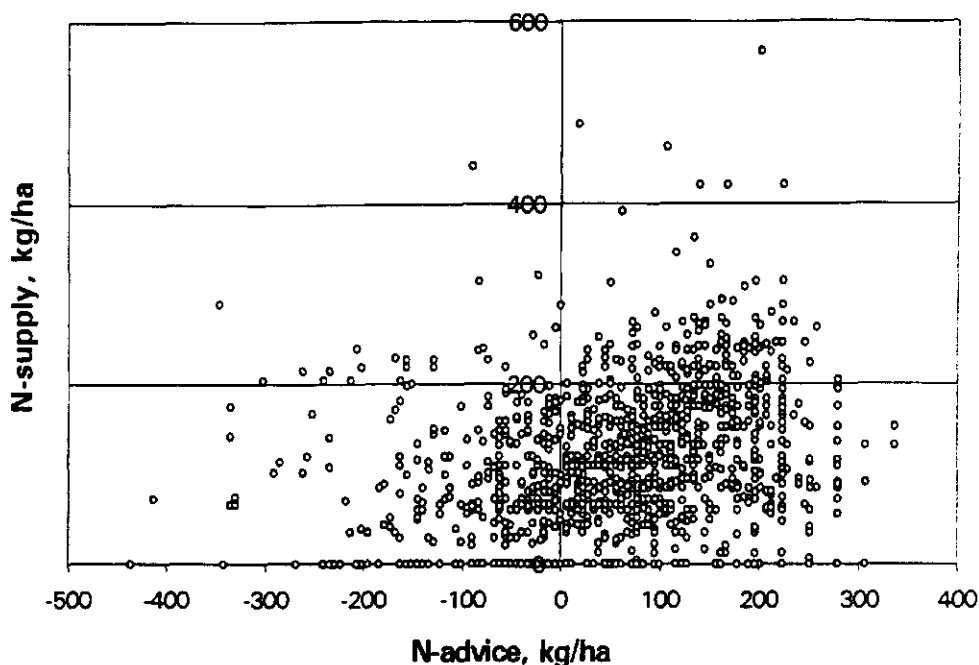


Figure 8. N recommendation and the actual supplied N (both before planting).

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 9. In December, January, February and March samples exceeded the maximum allowed content of 4500 mg/kg fresh weight. This was for these months 2, 26, 10 and 3 %, respectively. For April and May the allowed nitrate content is 3500 mg/kg. In April 31 % of the samples exceeded the allowed value. In May only a few analysis were executed.

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 and 11 the relation between the mean Kipp-solar radiation during 7 days before sampling and the nitrate content in the heads is given. A negative correlation between radiation and nitrate content is found.

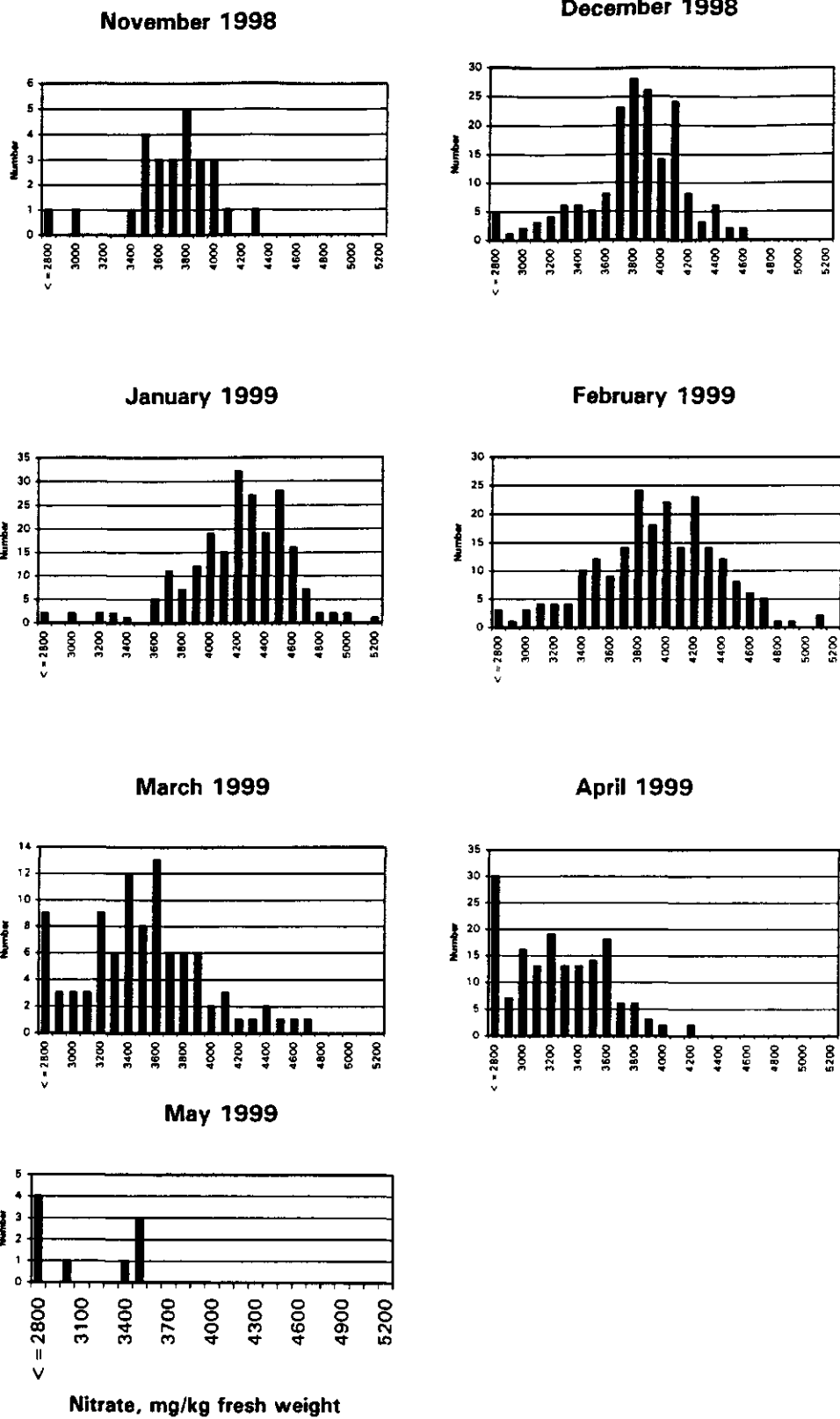


Figure 9. Nitrate content in lettuce in relation to the month of sampling.

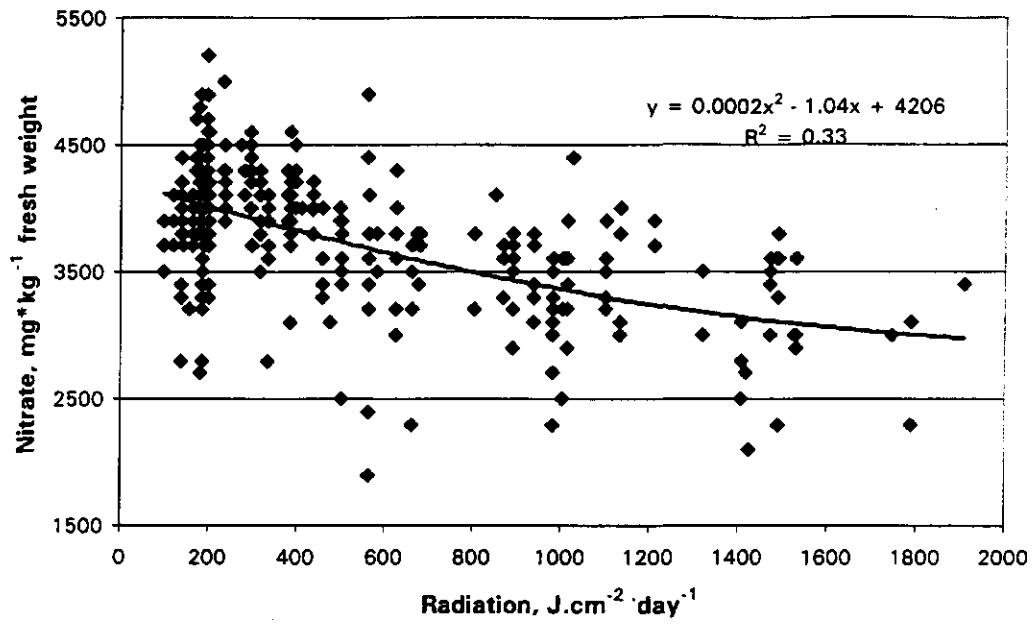


Figure 10. Correlation between mean radiation during 7 days before sampling of the heads and the head nitrate contents.

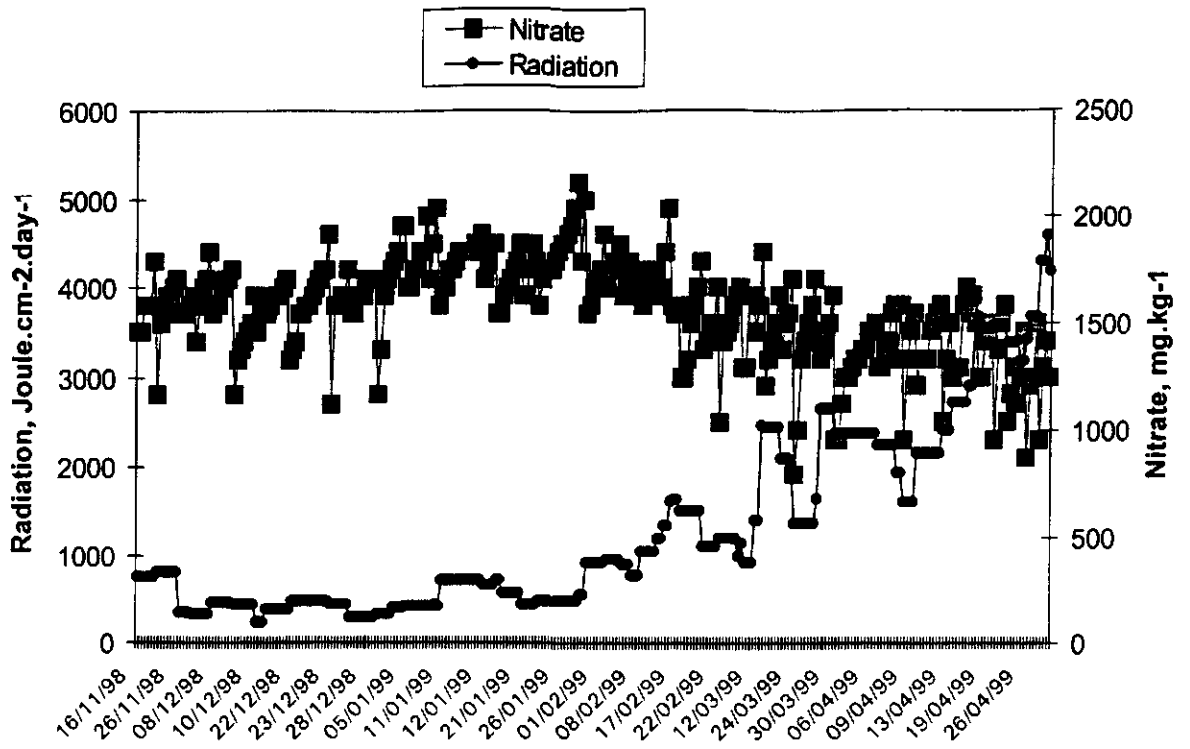


Figure 11. Mean radiation during 7 days before sampling of the heads and the nitrate contents of the heads at the different sampling dates.

7. CONCLUSION AND SUMMARY

In 1998/1999 lettuce growers (385 in total) delivered 1600 registration sheets for GAP to the auctions. This covers 100 % of the area.

The soil analysis 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 (440 of the 1600) no N supply was feasible. Actual in 150 cases no N was supplied as a base fertilisation. However, the correlation between the N recommendation and the actual supplied N was poor. Cl levels in the soil in winter grown lettuce has to be increased. Most Cl contents in the soil extracts were lower than the target of 2 mmol/l in the 1:2 volume extract.

Of the heads nitrate was determined. The correlation between the supplied N and the nitrate content in the lettuce was poor. Also the correlation between the head weight and the nitrate content was poor. 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.

The registration of 320 sheets by spinach growers was difficult to process since the registration was per month and not per growing cycle as for the lettuce.

LITERATURE

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Appendix

Sla-meldings- en GAP-formulier

Naam teler: G. B. Bakker
 Adres: Rodenrijseweg 331
 Postcode/Woonplaats: 2651 BT Berkel-Rodenrijse
 Tuinadres: Zwaikeweg
 Aanvoernummer: 5 1295
 Aanvoerlocatie: Greenery Bleiswijk
 MBT-nummer: 820068
 Tel.: 01051 13046 Fax: _____

nr. _____ dd. _____
 (hierboven niet invullen)

Zaaiselnr.: _____

Afdeling: 1 Ras: Waldo Fior
 Zaidatum: 26-11-98 Plantdatum: 25-1-99
 Oppervlak zaaisel (m²): ~~8-4-99~~
 Geplande 1e oogstdatum: 8-4-99
 Geschat kropgewicht: 232g 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
200122	5-1-99	1.8	6.5	<0.1	1.4	4.8	4.4	1.9	2.6	3.6	5.3	0.13

EC beregeningswater: _____



Bemesting

voorraadbemesting			bijbemesting		
meststof	kg/are of l/are	MBTcode	meststof	kg/are of l/are	MBTcode
23.23-0	9 kg/are				
actent hali	10 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	
30-1-99	Romlan								S
Totaal:	600 liter H ₂ O								
gr of ml	400								
N-nummer									

*) toepassingmethode G=gewasbehandeling R=ruimtebehandeling S=substraat-/grondbehandeling **30 MRT 1999**

Datum: 27-1-99 Handtekening: G. Bakker

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(184)