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Dry matter yield response of pasture grass to application of Nemafos (thionazin)

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Summary

Results of field trials on the response of pasture grass to application of the biocide Nemafos are discussed. It appeared that if nitrogen was the main growth-limiting factor, Nemafos plots grew better than controls owing to an increase in available soil nitrogen. But when nitrogen was in full supply, growth was improved, because Nemafos directly stimulated regrowth after cutting the high-yielding sward. This direct effect of Nemafos was apparently due to a favourable effect of longer duration in successive cuts on the development and vigour of tillers. No relation was found between yield response to Nemafos and the kill of nematodes.

Introduction

In an earlier paper (Ennik, 1968) it was shown that the yield of pasture grass was raised by about 15 % when Nemafos, a biocide with O,O-diethijl O-2-pyrazinyl phosphorothionate (thionazin) as the active ingredient, was applied to the sward.

A more detailed investigation has since been made in terms of dry matter yield, nitrogen uptake, and supply of nitrogen. The results are discussed in the present paper.

Design and management

Trials IBS 903 to 908 were set out in 1966 on grass-clover swards two or several years old on sandy soil, with pH-KCl ranging from 4.1 to 5.5, and soil organic matter from 3.7 to 4.6 %. The following treatments were applied in triplicate:

1. control: no Nemafos applied;
2. single application of 16 ml m^{-2} Nemafos concentrate in spring, a total of 16 ml m^{-2} per annum;
3. cut-wise application of 8 ml m^{-2} Nemafos concentrate, a total of 32 ml m^{-2} per annum.

Use was made of a 46 % emulsifiable concentrate of Nemafos. The concentrate was dispersed in water. 16 ml or 8 ml concentrate per 2.25 l water m^{-2} was applied to the subplots from a watering can, and washed down with another 2.25 l water m^{-2}. The control plots received 4.5 l m^{-2} water added in the same way.

Four subplots of 0.9 m^2 were marked on each whole-plot of 8 m × 2.5 m. Four of the trials continued into 1968, three into 1969. To establish any aftereffects of treatment, two of the trials remained under observation into 1970 with no further application of Nemafos.

In spring of each year all fields were adequately fertilized with superphosphate, muriate of potash and magnesium sulphate. Additional P and K were supplied in summer 1968, and 1969.

At first, little N was applied to avoid the depression of clover inherent to heavy dressing. In 1966 3 fields received 2.5 g N m^{-2}, in 1967 all fields 4.5 g N m^{-2} in two dressings, in 1968 9 g N m^{-2} in four dressings. Yields of clover and grass were estimated separately for the 4 subplots together.

When it was found that Nemafos had no effect on the yield of clover two N levels were superimposed in 1969 and 1970. Of each whole-plot, 2 subplots received 14 g N m^{-2}, the other two 46 g N m^{-2} in 4 dressings per annum as ammonium nitrate limestone. From then, little clover remained, and the yield as a whole was determined for the 2 subplots with the same dressing.

The plots were mown 4 times per annum.

Trials IBS 1161 and 1162 were set out in triplicate in 1968, and continued into 1969. A basic dressing with P and K was supplied each year. The plots were 2 m × 2 m, net area 0.8 m^2. N was applied to the gross plots. Net plots were treated with either 16 ml m^{-2} Nemafos in spring of each year, or 8 ml m^{-2} before each cut. Controls received no Nemafos.

The fields were mown 5 times in 1968, and 4 times in 1969. The grass mown in 1969 was analysed for nitrogen. There was no clover in these fields.

IBS 1161 was situated on a several-years old grass sward on a sandy soil near Wageningen (pH-KCl 5.5, soil organic matter 6 %). N was applied as ammonium nitrate limestone at the rates of 2.3 g N m^{-2}, 6.9 g N m^{-2}, and 11.5 g N m^{-2} before each cut. Cut 5 1968 was not treated with Nemafos.

IBS 1162 was on a half-year old grass sward on loam soil (organic matter 4 %) in the new polder Oostelijk Flevoland. N was applied as nitrochalk and potassium nitrate at the rates of 2.1 g N m^{-2}, 7.2 g N m^{-2}, and 12.2 g N m^{-2} before each cut.

Trial IBS 1393 was set out in triplicate on permanent pasture on peat soil in spring 1970 (pH-KCl 5.1, soil organic matter 28 %). P and K were liberally supplied in spring of each year. The plots were 1.5 m × 1.5 m, net area 0.8 m^2. N was applied to the gross plots as ammonium nitrate limestone at 3.5 g N m^{-2} and 14 g N m^{-2} before each cut. Gross plots were treated with either 16 ml m^{-2} Nemafos in spring of each year, or 8 ml m^{-2} before each cut. Controls received no Nemafos.

Trial IBS 1432 was originally set out in 1970 to maximize grass yield by optimum growing conditions. Nemafos plots were superimposed in spring 1971. The two-year old sward, almost entirely perennial ryegrass, was situated on loam soil (organic matter 4 %) in Oostelijk Flevoland. The plots were 10 m × 2 m, net area 12 m^2. Two levels of N as nitrochalk were included, also in the preceding year 1970. At the high level of 8 to 12 g N m^{-2} before each cut, N was in full supply as shown by the presence of more than 0.6 % NO_3 in the dried grass. The lower level of 6 to 8 g N m^{-2} was sub-optimum.

Nemafos was applied before each cut at the rate of 8 ml m^{-2}. Controls received no

Nemafos. Some plots were pre-treated with Nemafos late in 1970, before the scheduled treatment began in spring 1971.

Results

In Fig. 1 results are shown for IBS 903 to 908. For Cut 1 and Cut 2 (which was hit by drought) 1966 there was no measurable effect of Nemafos on yield. From then, grass response was invariably positive, and in 1969 the effect was positive both at high and at low nitrogen level. Even with a single application in spring the effect lasted throughout the year, though at the end of most years it slightly diminished compared with cut-wise applications. Nemafos had no effect on clover.

Year totals of dry matter for grass plus clover are given in Table 1. Yield increase by Nemafos was considerable and persisted when treatment continued. The effect of 8 ml per cut was somewhat greater than of a single spring application of 16 ml.

Nemafos was not applied in 1970. At high N the after-effect lasted up to Cut 3 (Fig. 1). For the plots with a single treatment in spring one and a half year elapsed since the last application.

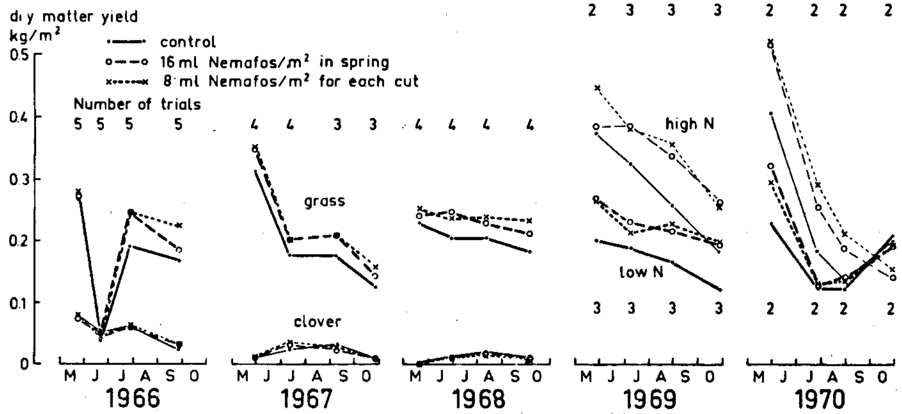

Fig. 1. Trials IBS 903 to 908. Effect of Nemafos on dry matter yield per cut of grass and white clover with low or high (1969 and 1970) N supply. No Nemafos was applied in 1970.

Table 1. Trials IBS 903 to 908. Dry matter yield of grass plus clover per year, absolute (g/m²) and in percentage of control (in brackets). No Nemafos was applied in 1970.

	1966	1967	1968	1969		1970	
				low N	high N	low N	high N
Control	883(100)	864(100)	870(100)	674(100)	1136(100)	679(100)	924(100)
16 ml Nemafos/m² in spring	964(109)	975(113)	969(111)	907(135)	1365(120)	782(115)	1098(119)
8 ml Nemafos/m² each cut	1014(115)	1011(117)	998(115)	900(134)	1436(126)	751(110)	1173(127)
Applied N (g/m²)	1.5	4.5	9	13	46.5	14.7	45.4
Number of trials included	5	4	4	3	3	2	2

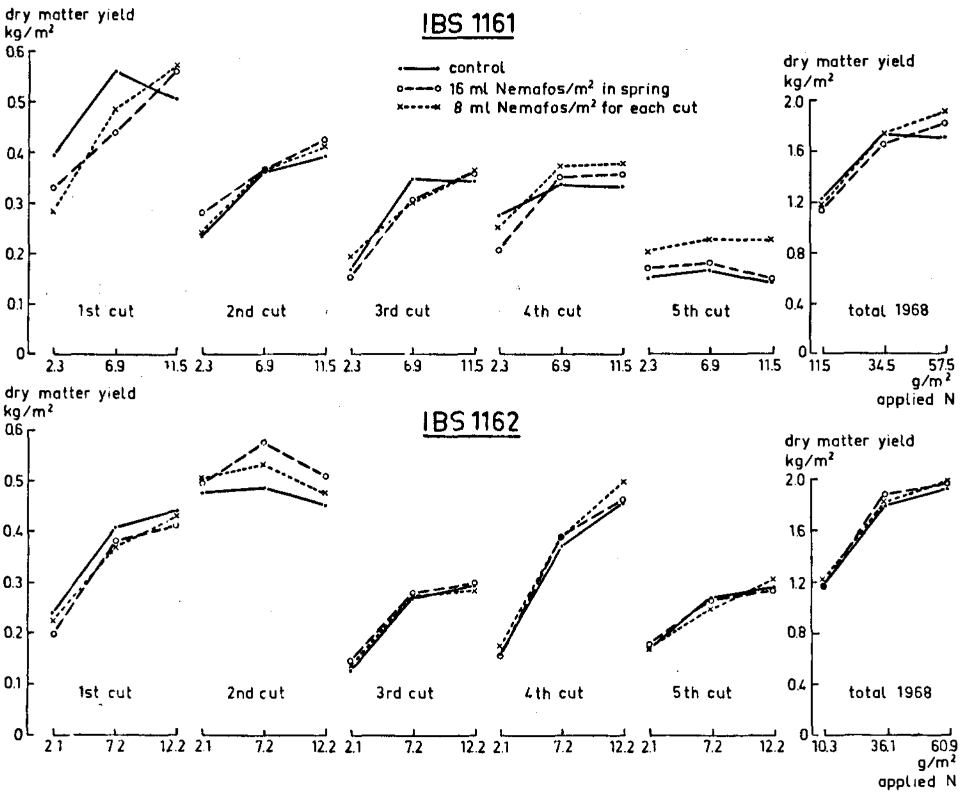

Fig. 2. IBS 1161 and 1162. Effect of Nemafos on dry matter yield of grass at three nitrogen levels in its first year of application (1968).

The relation between Nemafos effect and N level was studied further in the trials IBS 1161 and 1162. The yield of the first year is shown in Fig. 2. At the moderate nitrogen level the yield increased with N, but in a few of the control plots, especially in IBS 1161, the heaviest N dressing yielded less dry matter than the medium dressing. Nemafos had a negative effect on yield of Cut 1 in both trials. In most of the other cuts the effect was small and erratic, and over the whole year insignificant. It can be seen, however, that, at high N, the yields were higher on the Nemafos plots, and did not decline with increasing N as in the control plots.

N uptake was estimated for IBS 1162, and for two cuts of IBS 1161 in 1969. Fig. 3 relates rate of application, uptake, and dry matter for IBS 1162. The values for application refer to fertilizer plus the small amount of nitrogen carried by Nemafos. The non-coincidence of the curves in the range of low nitrogen application in Fig. 3a suggests that in Cut 1 nitrogen from Nemafos was not available to the grass.

Fig. 3a shows that more N was taken up in the Nemafos plots with high N dressings than in controls. In the control plots, the yield fell with the increase in N level from medium to high, as in IBS 1161 in 1968. Uptake and yield were greater with cut-wise application of Nemafos than with a single application in spring. For the other cuts (except for Cut 2), and for the year total, similar pictures were obtained.

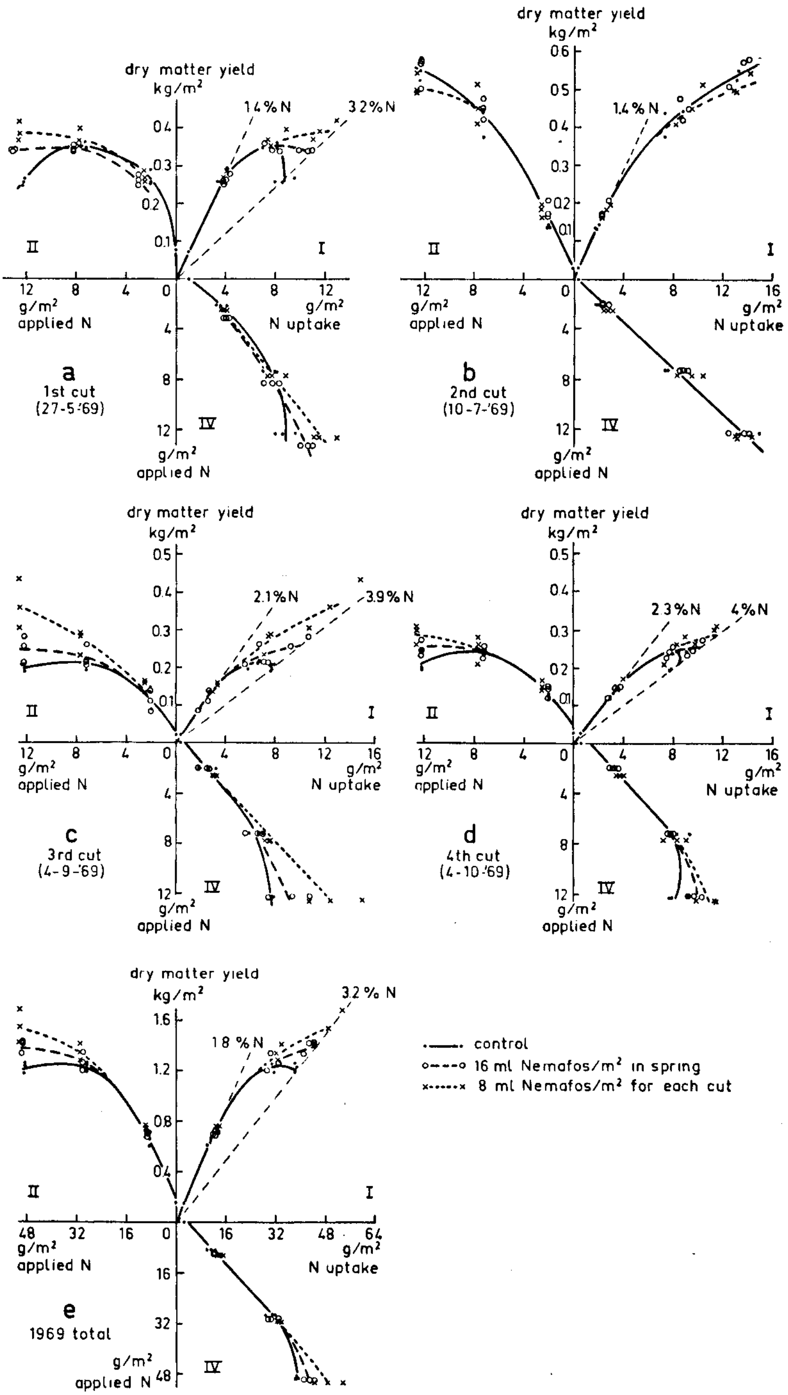

Fig. 3. IBS 1162. Effect of Nemafos on the relation between N supply, N uptake and dry matter yield of grass for the different cuts and the year total in the second year of application (1969).

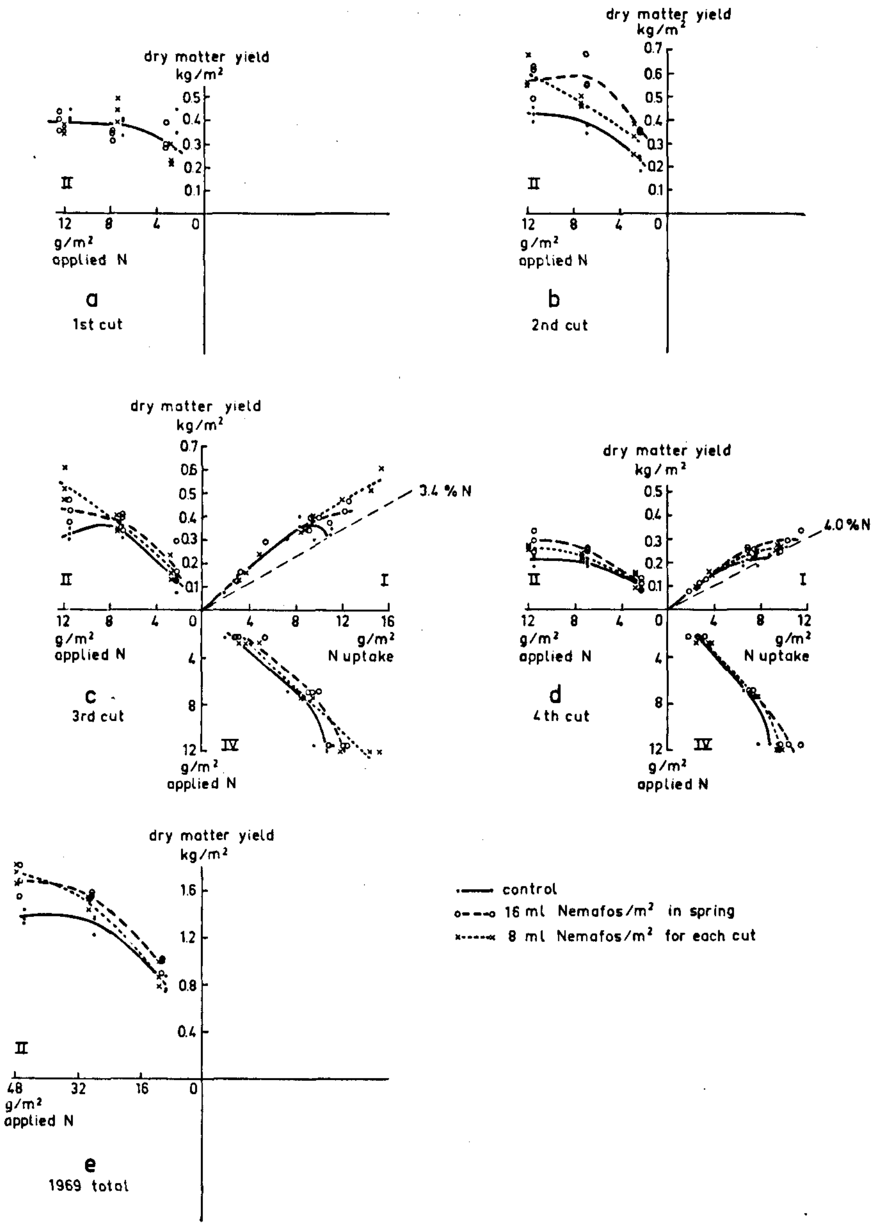

Fig. 4. IBS 1161. As Fig. 3.

Fig. 4 summarizes the results of IBS 1161 which were similar to those of IBS 1162, apart from some differences between trials within similar cuts.

The trials IBS 905 and 908, which continued into 1969 at two levels of nitrogen application, are summarized in Fig. 5. The data refer to year total minus Cut 2 which

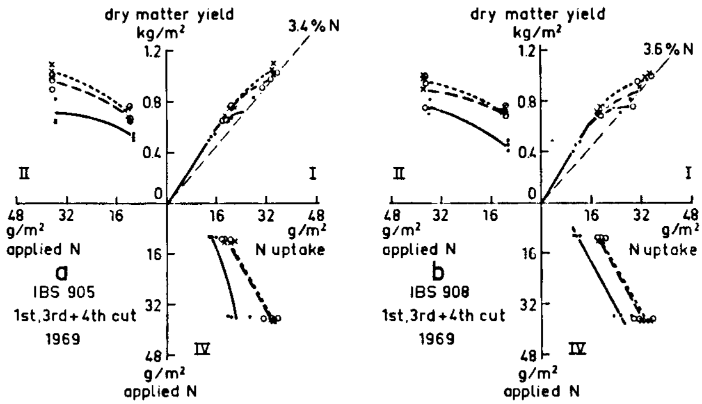

Fig. 5. IBS 905 and 908. Effect of Nemafos on the relation between N supply, N uptake and dry matter yield of grass in the fourth year of application (1969).

was not analysed for nitrogen. Although only two levels of N were applied, continuous curves fitting to the points were drawn conforming to the general trend of the lines in the other graphs. Is is seen that not only at high, but also at low N, more nitrogen was absorbed in the Nemafos plots than in the controls.

In trial IBS 1393 in permanent pasture on peat soil, established in 1970, Nemafos had a distinctly adverse effect on the yield of Cut 1 (Fig. 6). A few days after treatment some yellowing of leaf tips indicated toxicity. In later cuts Nemafos had a positive effect, which hardly compensated for the loss in the first cut as shown by the totalled yield for all cuts.

For 1971 only fresh yield records were kept (Table 2). The effect of Nemafos was positive, except for Cut 1 at the high rate of nitrogen dressing.

In trial IBS 1432 fresh yield was markedly increased by Nemafos at both rates of nitrogen supply (Table 3), even in Cut 1. Application of extra Nemafos in the autumn preceding the scheduled treatment in spring did not increase the response.

Table 2. IBS 1393. Effect of Nemafos on fresh yield (kg/m²) of permanent pasture on peat soil in the second year of application (1971).

Cut	low N supply			high N supply		
	control	Nemafos		control	Nemafos	
		16 ml/m² in spring	8 ml/m² per cut		16 ml/m² in spring	8 ml/m² per cut
25 May	1.95	2.17	2.40	3.74	3.08	3.27
9 July	1.08	1.37	1.49	1.50	1.88	1.60
26 August	0.75	1.23	1.17	1.25	1.30	1.53
Total	3.78	4.77	5.06	6.49	6.26	6.40

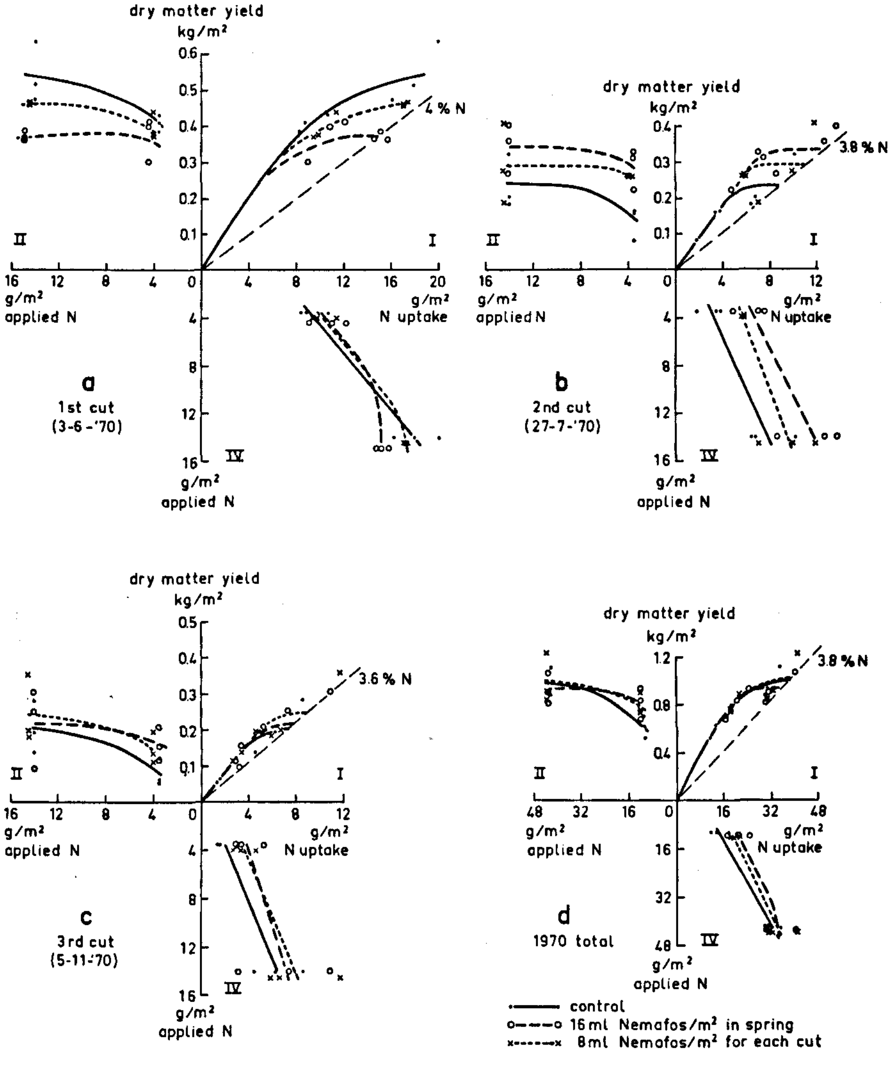

Fig. 6. IBS 1393. Effect of Nemafos on the relation between N supply, N uptake and dry matter yield of permanent pasture on peat soil for the different cuts and the year total in the first year of application (1970).

Discussion

Nemafos effect at low nitrogen level

In most trials Nemafos had a negative or no effect on yield, when applied for the first time on plots grown at low supply of nitrogen (Fig. 1, 2 and 6a).

Table 3. IBS 1432. Effect of Nemafos on fresh yield (kg/m²) of perennial ryegrass on loam soil in the first year of application (1971).

Cut	suboptimum N supply			full N supply		
	control	1st time Nemafos		control	1st time Nemafos	
		spring '71	autumn '70		spring '71	autumn '70
12 May	1.78	1.98	1.95	1.98	2.01	2.14
16 June	2.12	2.43	2.46	2.42	2.70	2.60
21 July	0.86	1.06	1.17	0.87	1.11	1.14
8 September	0.83	1.29	1.34	0.96	1.52	1.47
25 October	0.66	1.04	1.10	0.98	1.30	1.30
Total	6.25	7.80	8.02	7.21	8.64	8.65

Where data on nitrogen uptake were available (Fig. 6a) it appeared that, in the range of low nitrogen applications, more nitrogen was absorbed in the Nemafos plots than in the controls. Although nitrogen was the main growth-limiting factor in the controls, the fall in yield caused by Nemafos bore no relation to change in available nitrogen.

In this particular trial the grass in the treated plots showed a yellow discoloration a few days after Nemafos application. This toxic effect may have been responsible for the poorer growth in the treated plots. It seems, however, unlikely that where a negative effect occurred in the other trials, toxicity of Nemafos was responsible, because generally cut-wise application of later cuts increased the yield (Fig. 1, 4, 5 and 6).

At lower N level the availability of N was the main growth-limiting factor. This is shown by the fact that in Quadrant I of most graphs (cf. Fig. 3, 4 and 5) the points are located along a straight line through the origin with a slope indicating a concentration of nitrogen in the dry matter, ranging from severely (1.4 %) to moderately (2.3 %) deficient. This is also evident from the very small pool of unmetabolized nitrate in the grass (Table 6). It means that better growth will result from more nitrogen, and the increase in yield caused by Nemafos is related to an increase in available soil N. This is suggestive of evidence on increase in available nitrogen by partial sterilization of soil (e.g. Gasser and Peachy, 1964).

The increase in available soil nitrogen caused by Nemafos raised the uptake of nitrogen to an extent equivalent to a dressing of 1.2 g N m^{-2} for Cut 3 in 1969 of IBS 1161 (Fig. 4c), of 10 g N m^{-2} in 1969 for 3 cuts of IBS 905 and 908 (Fig. 5), and of 9 g N m^{-2} in 1970 for all cuts of IBS 1393 (Fig. 6d).

In IBS 1162 there was no increase in available nitrogen (Fig. 3). Any other mode of action of Nemafos could not be expected because nitrogen was limiting growth.

Nemafos effect at high nitrogen level

At higher N levels the yield output declined with the increase in uptake, especially in the control plots. In some cases the yield in the control plots was reduced when the N dressing was raised from the medium to the highest level. Such a decline at high N was never observed on the Nemafos plots. It is shown by the graphs that cut-wise Nemafos treatment was more effective in this respect than single treatment in spring.

At the heaviest dressing, the grass of all plots showed nearly the same concentration of N in the dry matter. For example, in Quadrant I of Fig. 3a the uptake-yield curves of the 3 treatments diverged above medium dressing at a higher yield in the Nemafos plots, but eventually attained the same concentration line of 3.2 % N at the heaviest dressing. Moreover, the pool of unmetabolized nitrate in the grass was higher than 0.6 % at the heaviest dressing (Table 6), which indicates a full supply of N from the soil (van Burg, 1966).

This evidence shows that at high N the positive effect of Nemafos on yield bore no relation to changes in available N.

Since the lines of all treatments in Quadrant I of, for instance, Fig. 3a terminate on the same concentration line, this presumably is the maximum possible concentration in this stage of growth (Dijkshoorn, 1958). This would mean that at the heaviest dressing growth entirely determined the quantity of N absorbed.

From this it is evident that the greater absorption of N from the Nemafos plots with the heaviest dressing (Quadrant IV) resulted from better growth.

If at the highest rate of N dressing, available N is enough to meet the demand of the control, but not of the extra growth with Nemafos, the increase in available soil N caused by Nemafos will support its effect on the yield of grass. This situation occurred in the trials of Fig. 5.

Interpretation of the effect not related to nitrogen

Earlier work (Ennik, 1968) showed that nematode counts were considerably reduced by Nemafos for a longish period. But nematode counts in controls and treatments showed no correlation with the response of grass yields to Nemafos.

In October 1968 counts of free-living root nematodes in the 0-5 cm soil layer were made in all treatments of IBS 1162. Plant parasitic nematodes were not found, so the large increase in yield by Nemafos in spring 1969 bore no relation to the kill. This was confirmed by counts of free-living nematodes made in IBS 1432 in September 1971. Apart from saprophagans the parasites *Paratylenchus* and *Criconemoides* were found, but only at low densities known as harmless.

Nemafos eliminates a great number of other soil organisms, such as worms and insects, but for common rates of application it is reported not to kill bacteria. Though the effect of Nemafos on grass yield may be related to the kill of unrecognized root parasites, as stated for other pesticides by Clements et al. (1970, 1971) and Henderson (1971) these parasites were certainly not responsible for the decline in grass yield in most of the control plots with the heaviest N dressing.

With Nemafos the soil eventually acquired a dead appearance and a poor, compact structure. Worms were eradicated, and moles did not penetrate into the treated plots. Whether the increase in grass yield is related to the reduction in soil biomass and the change in soil structure is unknown.

In some trials Nemafos treatment led to some change in botanical composition, but not in a uniform way. In the trials with perennial ryegrass only (e.g. IBS 1432), botanical composition was not affected, showing that the effect of Nemafos on yield bore no distinct relation to changes in botanical composition.

The decline in yield by the heaviest N dressing in the controls has been found by other workers, and has been attributed to osmotic stress or to lack of vigour for regrowth of the sward after mowing.

Arnold Bik (1970) showed that yield of gloxinia, a salt-sensitive species, declined at application rates higher than 1.2 g N/5.4 l soil, equivalent to 40 g N m^{-2} when depth of the soil layer is put at 20 cm.

In the present trials no more than 14 g N m^{-2} was applied before each cut. Therefore, it is unlikely that nitrogen *per se* caused osmotic stress in any of the present trials.

Mulder (1949) supplied ammonium nitrate limestone at rates up to 420 kg N ha^{-1} for each cut to grassland harvested 3, 4 or 6 times per annum. Cut 1 never showed yield depression at the heaviest dressing, but in subsequent cuts the grass yield was often seriously depressed at rates of 100 kg N ha^{-1} and higher (Fig. 7). The yield decrease was greater as the preceding cut had received more N and was harvested at an older stage of growth. The decline in yield at heavier N dressings was conditioned by the previous harvesting of a heavy cut, resulting in a poorer restoration of growth capacity of the sward.

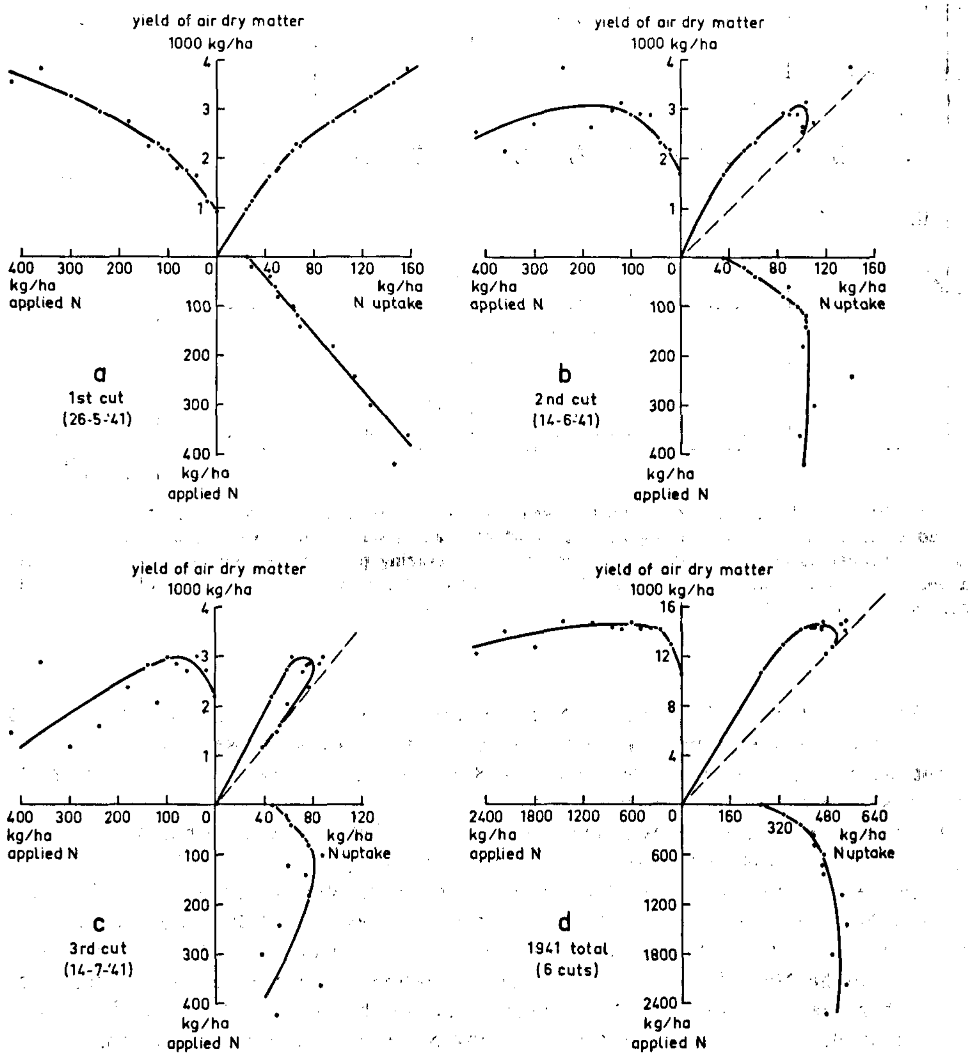

Fig. 7. Effect of high nitrogen application on N uptake and the yield of air dry matter of grass of the first three cuts and the year total (=6 cuts) in the first year of application. Data from Mulder (1949), trial Pr 640, 1941, 6 cuttings.

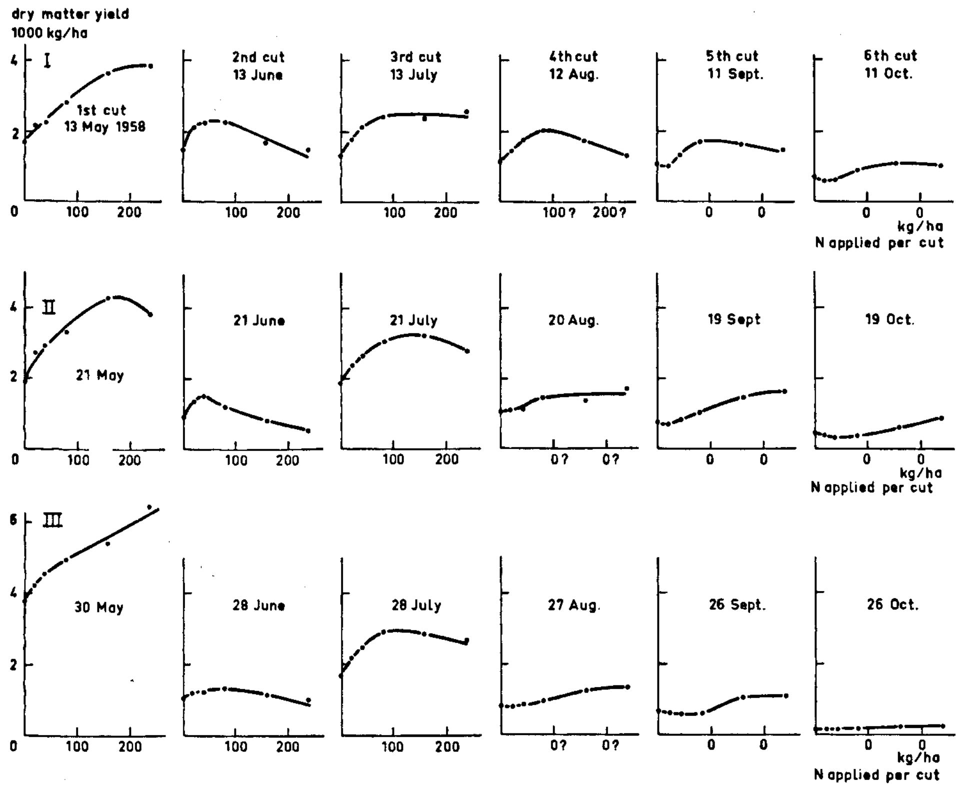

Fig. 8. Effect of high nitrogen in the first year of application on dry matter yield of three monthly grazed pastures (I, II, III) differing in date at which grazing was started (about one week after each other). Nitrogen supply was restricted to the first three grazing periods. Temporarily caged plots were mown for yield estimation. Notice that later mowing of Cut 1 caused lower yields of Cut 2. Data from Kreil et al. (1961).

Kreil et al. (1961, 1964) supplied N to pasture up to 744 kg N ha^{-1} $year^{-1}$ in 3 to 4 equal doses. The yield depressing effect of heavy dressings was absent or small in Cut 1, but often considerable in later cuts (Fig. 8 and 9). Again, lower yields at heavier N dressings were restricted to regrowth after cutting.

A similar conclusion applies to the present results. Only in one case heavy N dressing caused a drop in yield when applied for the first time (Fig. 2, IBS 1161, Cut 1). The drop in yield in the controls in Cut 1 of Fig. 3 refers to plots which were heavily dressed with N in the preceding year. But in all further cases a yield decrease with increasing N application to the highest level refers to later cuts in the control plots. This never occurred in the Nemafos plots, and Nemafos treatment improved grass growth, especially when heavy dressing with N followed by cutting had led to inhibition of regrowth in the control, even if dressing and cutting took place in the preceding autumn.

Representative samples of the fresh material of Cut 3 1971 of IBS 1432 were taken to the laboratory for morphological analysis. Subsamples for investigation corresponded to 1 % of the fresh weight of grass per plot (Table 4).

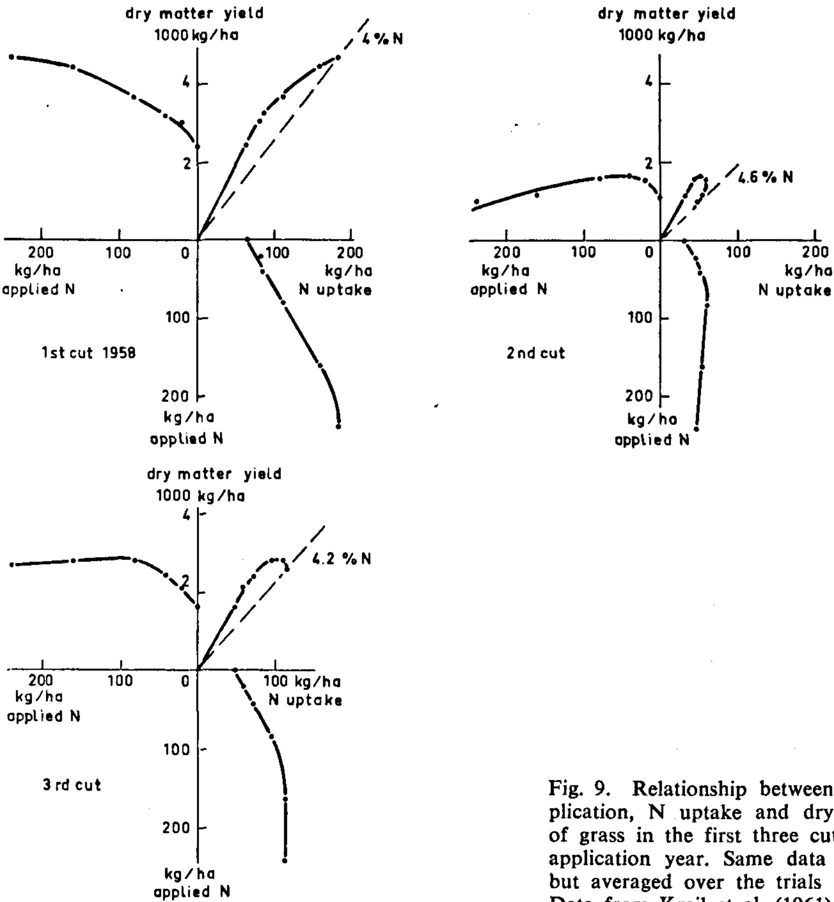

Fig. 9. Relationship between nitrogen application, N uptake and dry matter yield of grass in the first three cuts of the first application year. Same data as in Fig. 8 but averaged over the trials I, II and III. Data from Kreil et al. (1961).

Leaves per tiller was the same, but tiller number per unit plot area was considerably greater for Nemafos than for the control. Weight per tiller was unchanged so that the fresh yield increased in proportion to the increase in tiller number by treatment with Nemafos.

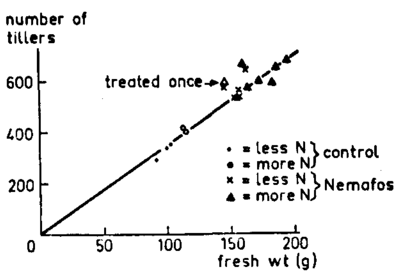

Fig. 10. IBS 1432. Relationship between fresh weight (1/100 of net plot area) and number of tillers in Cut 4 1971 at two slightly different N levels and with or without Nemafos treatment before each cut. The plot represented by the open triangle was treated once, one month before Cut 4. Before that time its yield level corresponded with that of the open dots.

Table 4. IBS 1432, Cut 3 1971. Effect of Nemafos on some morphological properties of the grass harvested.

Plot	Per 1/100 of net plot area		Wt per tiller (g)	Stem length (cm)	Leaves per tiller
	total fresh wt (g)	number of tillers			
Control					
3	101			2.83	2.85
5	95	314	0.30		
7	110	292	0.38		
10	102	387	0.26		
13	96	358	0.27		
17	114			3.01	2.78
Average	103	338	0.30	2.92	2.82
Nemafos					
2	150			2.57	2.77
4	114	344	0.33		
9	141	455	0.31		
11	133	487	0.27		
14	141	458	0.31		
16	145			2.98	2.78
Average	137	436	0.31	2.78	2.78

Ten days after Cut 3 the grass in the Nemafos plots had a more glossy appearance than that in the controls. The sward, of mainly perennial ryegrass, was unchanged in botanical composition, so that the difference in gloss was due to a difference in structure of the foliage. The leaves were longer on the Nemafos plots and this raised the proportion of reflected light. Tussocky growth due to heavy nitrogen dressing made tiller counting in the field in small areas unreproduceable, and in larger areas it was too laborious.

Laboratory analysis of Cut 4 showed that fresh matter yield increased in proportion to tiller number (Fig. 10). Measurements of leaf and stem length showed an increase of about one-third of the values of the control when Nemafos had been applied (Table 5).

Table 6. IBS 1162, Cut 1 1969. Content of dry matter and, content of protein, nitrate, crude fiber and total

Applied N	Dry matter (%)			Protein (% of DM)			Nitrate
	control	Nemafos		control	Nemafos		control
		16 ml/m² in spring	8 ml/m² each cut		16 ml/m² in spring	8 ml/m² each cut	
No N	27.2			8.0			0.04
Low N	23.7	22.3	22.5	8.4	9.5	9.0	0.04
Medium N	18.1	17.7	17.6	13.5	13.8	13.4	0.12
High N	15.9	15.7	15.3	19.9	18.5	18.2	1.38

Table 5. IBS 1432, Cut 4 1971. Effect of Nemafos on average weight and length of tillers and stems, and of the blades of the last and last but one mature leaf in the grass harvested. Of Plot 13 three different samples were examined. In brackets the number of specimens.

Plot	Per 1/100 of net plot area		Fresh wt per tiller (g)	Tiller length (cm)	Stem length (cm)	Blade length last leaf (cm)	Blade length last leaf but one (cm)
	total fresh wt (g)	number of tillers					
Control							
3	92	292	0.32	22.0(261)	3.2(132)	17.8(129)	16.7(75)
5	100	337	0.30				
7	103	349	0.30	21.1(315)	3.0(128)	17.7(127)	16.6(82)
10	115	399	0.29				
17	114	414	0.28	22.3(403)	2.7(173)	18.1(183)	15.5(101)
Weighed mean	105	358	0.29	21.9(979)	2.9(433)	17.9(439)	16.2(258)
Nemafos for each cut							
1	146	565	0.26				
2	163	635	0.26	27.0(575)	5.1(135)	25.2(137)	20.4(83)
4	157	527	0.30				
6	157	554	0.28				
8	156	526	0.30	27.5(489)	3.7(175)	23.1(171)	19.4(102)
9	158	531	0.30				
11	187	639	0.29				
12	161	650	0.25				
14	196	668	0.29				
15	165	565	0.29				
16	184	585	0.31	30.1(560)	5.1(174)	26.2(185)	21.6(110)
18	174	591	0.29				
Weighed mean	167	586	0.28	28.2(1624)	4.6(484)	24.8(493)	20.5(295)
Nemafos for 4th cut only							
13	147	583	0.25	— —	3.8(124)	21.3(126)	16.4(101
				23.9(193)	3.7(180)	19.8(182)	16.9(110)
				26.0(92)	4.3(90)	20.4(87)	16.3(47)
Weighed mean				24.6(285)	3.8(394)	20.4(395)	16.6(258)

soluble carbohydrates in the grass harvested. Average of three replicates.

(g NO_3/100 g DM)		Crude fiber (% of DM)			Total soluble carbohydrates (% of DM)		
Nemafos		control	Nemafos		control	Nemafos	
16 ml/m² in spring	8 ml/m² each cut		16 ml/m² in spring	8 ml/m² each cut		16 ml/m² in spring	8 ml/m² each cut
		23.0			25.3		
0.05	0.04	26.4	27.7	27.8	16.6	15.5	16.6
0.06	0.08	28.1	28.6	27.9	11.0	9.8	11.5
0.99	1.13	26.7	27.5	27.9	7.8	7.1	7.4

The open triangle in Fig. 10 refers to a control plot which was erroneously treated with Nemafos one time 10 days after Cut 3 which was 4 weeks before Cut 4. It is seen that fresh weight and tiller number of Cut 4 correspond to the data of the plots continuously treated with Nemafos. From this it seems that the positive effect of Nemafos on growth is not restricted to the early stage of regrowth.

Capacity of regrowth is often considered in relation to nutrient reserves. Analysis was made of a few main constituents of Cut 1 1969 of IBS 1162 (Table 6). The data show that in spite of an increase in yield of 50 % due to Nemafos at high N (Fig. 3a), there was no difference in concentration of these nutrients in the dry matter for each level of N application.

A tentative explanation for the increase in tiller number by Nemafos would be that this systemic organophosphorus compound had a stimulating effect on dormant tillers. With another organophosphate, TEPP, Hall (1951) found that the terminal growing point of tomato was completely inhibited, apical dominance discontinued, and outgrowth of the lateral buds stimulated.

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