AGRICULTURAL RESEARCH COUNCIL

WEED RESEARCH ORGANIZATION

TECHNICAL REPORT No. 27

SELECTIVITY OF BENZENE SULPHONYL CARBAMATE HERBICIDES BETWEEN VARIOUS PASTURE GRASSES AND CLOVER

A.M. Blair

Benzene sulphonyl carbamate herbicides eg asulam

October 1973

Price

U.K. and overseas surface mail - £1.05
Overseas airmail - £1.30

BEGBROKE HILL, YARNTON, OXFORD

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NOTE

BLAIR, A.M. Selectivity of benzene sulphonyl carbamate herbicides between various pasture grasses and clover. _Tech. Rep. Agric. Res. Coun. Weed Res. Orgn_, 1973, (27), pp 23.

SELECTIVITY OF BENZENE SULPHONYL CARBAMATE HERBICIDES BETWEEN VARIOUS PASTURE GRASSES AND CLOVER

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SUMMARY

In field experiments extending over the period 1964-68, wettable powder and water soluble formulations of asulam and M & B 8882 (methyl 4-nitrobenzenesulphonylcarbamate) were applied to a range of grass species in summer and autumn. *Phleum pratense* L., *Dactylis glomerata* L., *Holcus lanatus* L., *Agrostis tenuis* Sibth., and *Poa trivialis* L., were more susceptible than *Lolium perenne* L., *Festuca pratensis* Huds., and *Festuca rubra* L. but effects were more persistent on *H. lanatus* than on the other species. *Trifolium repens* L., (white clover) was more resistant to M & B 8882 than to asulam particularly in July. The pattern of selectivity was similar when treatment was made in the summer and autumn but effects were slower to develop in the autumn.

INTRODUCTION

Pastures are traditionally improved either by ploughing and reseeding or by drainage, use of fertilisers and management of grazing. The first is relatively expensive and destroys the soil structure which has been built up over a number of years. Pasture improvement by management needs considerable expertise and may take several years. Pasture composition can however also be improved by the use of herbicides e.g. dalapon (Allen, 1965, 1968) and sulphonyl carbamate herbicides (Cottrell & Heywood, 1965; Ford & Combellack, 1966; Grant, 1968; Allen & Oswald, 1968). All these authors reported improved species composition of the sward after herbicide treatment as judged by traditional ranking of species in order of desirability. This paper reports in detail a series of 6 experiments (A-F) carried out between 1964 and 1968 on the response of grass species to asulam (methyl 4-aminobenzenesulphonylcarbamate) and M & B 8882 (methyl 4-nitrobenzenesulphonylcarbamate). These experiments formed part of a programme designed to find herbicides with selectivity appropriate for sward improvement. A brief account of the results with asulam and M & B 8882 has appeared elsewhere (Blair & Holroyd, 1973).

MATERIALS AND METHODS

All of the experiments described except one were carried out on specially sown swards on a sandy loam soil at Begbroke Hill Farm, near Oxford. Seedbeds were prepared by ploughing, applying fertiliser, two or three passes with spring-tine harrows, and rolling prior to sowing. Details of some meteorological records for the month after spraying are given in Table 1. Each species was broadcast as a separate 2 m strip except in experiment B in which the grasses were drilled in double rows (0.76 m spacing) using a Gloster Seed drill. After establishment the areas were cut regularly either with a rotary scythe leaving the grass cuttings on the swards, or if the grass was long and the cuttings liable to cause damage, they were cut by a 'forage harvester' which collected the herbage in a trailer and carried it off the area. Because of regular cutting none

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* Herbicide Evaluation Section

Table 1. Meteorological data

Expt.	Treatment date	Conditions at spraying: Cloud cover	Conditions at spraying: Approx humidity %	Conditions at spraying: Wind	Rainfall at intervals after treatment (MM): 1 day	2 days	3 days	1 week	4 weeks	Other weather conditions post spraying (2-3 weeks)
A	23.6.64	6/10	60-75%	light	0	0	0	0	14.8	
A	29.9.64	2/10	55%	light, variable	0	0	0	4.5	20.1	
	30.9.64	2/10	65%	8-24 Km/h easterly	0	0	0	7.7	20.1	
B	6.7.64	6/10	60%	westerly	0	2.9	2.9	10.9	17.3	Many hours of sunshine with high temperatures.
B	1.10.64	4/10	60-65%	16-24 Km/h	0	0	0	8.4	20.3	
C	26.7.65	8/10	75%	N.W. light gusting to 8-16 Km/h	0	0.8	3.0	5.3	44.5	
C	21.10.65	0/10	77%	S.E. almost calm	T	T	T	2.7	32.5	
D	22.7.66	0/10	50%	N.W. light with occasional gusts	0	0	5.0	15.4	81.0	
D	7.11.66	9/10	80%	calm	0.9	0.9	0.9	3.9	23.8	
E	7.7.67	8/10	53%	N.W. calm with occasional light period	0.7	0.7	0.7	13.4	74.2	
F	1.7.68	0/10	66%	E. light with occasional gusts	T	T	T	T	115.8	For 1 week after spraying it was particularly warm and humid

of the species were flowering even when treated in the June–July period. Experiment F was on a commercial farm and the grass varieties were maintained in good condition by grazing by sheep and topping over.

Herbicide treatments (Table 2) were applied to a 0.9 m wide plot across all the grass swards, except in experiment A where plots (9.0 x 0.9 m) were sprayed in the same direction as sowing. Table 3 shows the species and strains used in each experiment and the height at spraying. All herbicide treatments, which were replicated twice, were applied at 207 kN/m^2 using an Oxford Precision Sprayer fitted with '00' Allman fan nozzles except in experiment F where '8002' Teejets were used and in experiment A where a logarithmic sprayer fitted with '00' Allman jets was used. Volume rate was 225 l/ha except in experiment A (900 l/ha). The herbicides were as supplied by the manufacturer for field experimentation and made up in a 0.1% v/v Agral 90 solution.

The method of assessment was a subjective score on a 0–9 scale. This score was an estimate of the amount of green material present as compared with untreated controls: 0 indicating that there was no green material on the plot and 9 that the vegetation was the same as on the control. In most cases assessments were made 2 weeks after the start of the experiment and thereafter at 4 week intervals. During the winter period the time interval between assessments was further extended, sometimes to as much as 8 weeks. Plots treated with logarithmically reducing doses were scored at 0.9 m intervals, Each plot was scored independently by two observers. As far as possible assessments were made by the same observers throughout the life of each experiment.

RESULTS

The data from these experiments are presented in graph form (Fig. 1–16) showing development of and recovery from herbicide effects on each species at each application. In the following discussion only the main points are highlighted.

In experiments A and B Holcus lanatus L., Agrostis tenuis Sibth., Poa trivialis L., Phleum pratense L. and Dactylis glomerata L. (experiment B) were somewhat more susceptible to asulam than other species when treated both in June/July and September/October. In experiment C H. lanatus, A. tenuis and to some extent P. trivialis were again the most susceptible weed species and P. pratense and D. glomerata were more susceptible than Lolium perenne L. or Festuca pratensis Huds. The acid (wettable powder) was less active and marginally less selective than the potassium salt (water soluble powder). Responses to M & B 8882 and to asulam were similar. In experiment D which only involved M & B 8882, H. lanatus and A. tenuis were again the more susceptible species. Experiments C and D were both sown on the same date but treated in different years. M & B 8882 applied in 1966 tended on the whole to be less active than in 1965, possibly reflecting the longer establishment period prior to spraying in 1966. There was more rainfall after treatment in 1966 (Table 1). In experiment E the results were similar to those of experiment D in which M & B 8882 had been applied the previous July. There was little difference in the reaction of Poa annua L. and P. trivialis. In experiment F the responses of the following 11 cultivars of perennial ryegrass to asulam varied relatively little: Tetraploid Pasture Perennial, Danish Hunsballe, Dutch Tetraploid Perennial, Dutch Early Presto III, New Zealand Certified Grasslands Ruani, British Certified S24, British Certified S23, Kent Indigenous, British Certified S321, Barenza Tetraploid "Barpastra" Pasture and British Certified S101. There was a visible reduction 3 weeks after spraying but this quickly disappeared.

Table 2. Herbicide treatments and formulation

Expt.	Treatment date	Treatment	Dose (kg ai/ha)	Formulation
A	23.6.64	asulam	logarithmically reducing	w.s.p.
	29.9.64	asulam	doses starting at 8.29	w.s.p.
B	6.7.64	asulam	0.56, 1.12, 2.24, 4.48	w.p.
	1.10.64	asulam	1.12, 2.24, 4.48	w.p.
C	26.7.65	asulam	0.84, 1.68, 3.36	w.s.p.
		asulam	0.84, 1.68, 3.36	w.p.
		M & B 8882	0.84, 1.68, 3.36	w.s.p.
	21.10.65	asulam	1.12, 2.24, 4.48	w.s.p.
		asulam	1.12, 2.24, 4.48	w.p.
		M & B 8882	1.12, 2.24, 4.48	w.s.p.
D	22.7.66	M & B 8882	0.84, 1.68, 3.36	w.s.p.
	7.11.66	M & B 8882	1.12, 2.24, 4.48	w.s.p.
E	7.7.67	M & B 8882	1.12, 2.24, 4.48	w.s.p.
F	1.7.68	asulam	2.24, 3.36	w.s.p.

w.s.p. = water soluble powder (potassium salt)

w.p. = wettable powder (formulation of the acid)

Table 3. Height of foliage (cm) at treatment

EXPERIMENT	A			B			C			D			E		F
Date sown:	24.4.63			23.9.63			12.10.64			12.10.64			14.5.66		16.8.66
Date treated:	23.6.64	29.9.64 *		6.7.64	1.10.64 *		26.7.65	21.10.65 *		22.7.66	7.11.66 *		7.7.67 *		1.7.68+
L. perenne	10–13	13–23	S24	20–23	18–25	S24	20–25	13–15	S23	10–13	10–13	S23	10–13	S23	15–23
F. pratensis	20–23	20–33	S215	25–30	10–18	S215	20–25	15–18	S53	15–18	13	S53	15–20	S53	
D. glomerata	–	–		30–35	15–28	S37	23–28	10–13	S143	15–20	10–13	S143	18–25	S143	
P. pratense	8	8–23	S50	23–25	13–25	S51	10–13	10–13	S48	8–10	10–13	S48	10–13	S48	
T. repens	–	–		8–20	8–18	S100	15–20	13–15	S100	12–15	10–13	S100	13–18	S100	
F. rubra	8–10	12–33	S59	25–28	13–23	S59	18–23	13–15		15–18	15–18		18–23		
F. ovina	5–8	10–23		10	10–15		–	–		–	–		–		
P. trivialis	5–8	5–13		13–15	6–10		5–8	8–10		5–8	5–8		3–5		
P. annua	–	–		–	–		–	–		–	–		4–5		
A. tenuis	8–10	10–20		10–13	8–13		13–18	13		5–8	10		10		
H. lanatus	8–10	8–20		15–20	10–15		15–20	13–15		10–13	10–13		12–15		

* Cultivars of grass and clover

\+ 11 cultivars of L. perenne are listed under results

The experimental results all illustrate the relative resistance of L. perenne and F. pratensis to 3.4-4.5 kg a.i./ha asulam or M & B 8882 when applied either in June/July or in late autumn. P. pratense and D. glomerata were more susceptible. White clover (Trifolium repens L.) was more resistant to M & B 8882 than to asulam particularly in July and it is for this reason that experimental work after 1965 was largely concentrated on M & B 8882. Of the "weed" grasses H. lanatus was the most susceptible to both herbicides, A. tenuis and P. trivialis were reduced initially and Festuca rubra L. and Festuca ovina L. were resistant to 3.4-4.5 kg a.i./ha of both herbicides.

Effects developed more quickly in summer and were sometimes more severe but recovery was generally more rapid. In most cases recovery from the autumn treatments started in April with the next season's new growth.

DISCUSSION

In all experiments the herbicides were applied to pure stands of the various grass species. Inter-specific competition was not a factor and any damage or reduction in growth resulted from the direct effects of the herbicide. However by examining the severity of any damage and the length of its persistence it is possible to infer what may happen under the competitive conditions of a mixed sward. In these experiments the less desirable grasses H. lanatus and A. tenuis were both damaged equally severely but the effects on A. tenuis were less persistent and thus in a mixed sward H. lanatus is likely to be the more easily eliminated.

This is confirmed by the work of Allen & Oswald (1968) who examined the effects of treatments with M & B 8882 on the pasture composition and vegetative production of mixed swards in one season and Grant (1968) who has done similar work with M & B 8882 and asulam in New Zealand. In both sets of experiments H. lanatus was depressed more than Agrostis stolonifera L. or A. tenuis and there was a consequent increase in L. perenne.

The Asulox Technical Bulletin (May & Baker, 1971) states that there is considerable variation in the reaction of different pasture species to asulam, the most tolerant being the ryegrasses and the fescues.

Our experiments under different seasonal conditions (Table 1) illustrate the relative consistency of these herbicides at different times of the year although in the autumn there was a very marked lag after treatment of up to 10 weeks before the herbicides began to show any effects on the sward. In the summer, effects began to develop within two weeks of treatment. However the pattern of selectivity was very similar at both times of the year. The timing of applications of these herbicides does not appear therefore to be critical. This is in direct contrast to dalapon which has a more restricted period of selectivity (Allen & Oswald, 1968).

Both asulam and M & B 8882 give good control of docks (Rumex spp.) as reported by Ford & Combellack (1966), Blair (1968), Evans (1968) and Soper, Terry & Savory (1968) and it is for this purpose that asulam has been marketed initially in Britain. In some situations the beneficial selective activity against some of the less desirable grasses may be an added bonus. These compounds represent also a promising addition to the herbicides available specifically having some potential for selective control of undesirable grasses in swards. However the economic and technical benefits of such use of these and other similarly selective herbicides has yet to be fully evaluated.

ACKNOWLEDGEMENTS

I wish to thank Mr. J. Holroyd and Dr. K. Holly for help and advice, the many other members of WRO who have assisted with the experiments over the years, Messrs. Twyford's Seeds for provision of an experimental site and May & Baker Ltd., for supplying the herbicides.

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FIG. 1

The effect of asulam on grass swards sown on 24.4.63 and treated on 23.6.64 (expt. A)

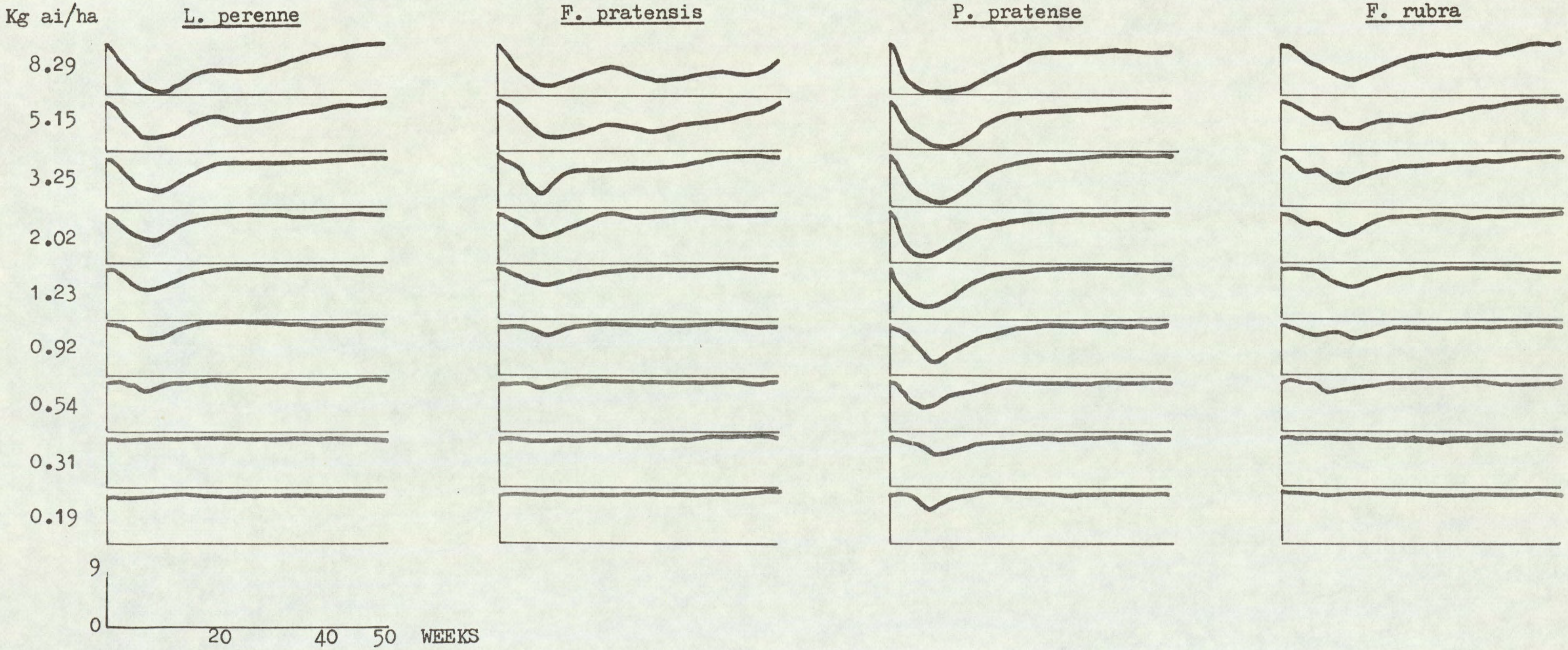


FIG. 2

The effect of asulam on grass swards sown on 24.4.63 and treated on 23.6.64 (expt. A)

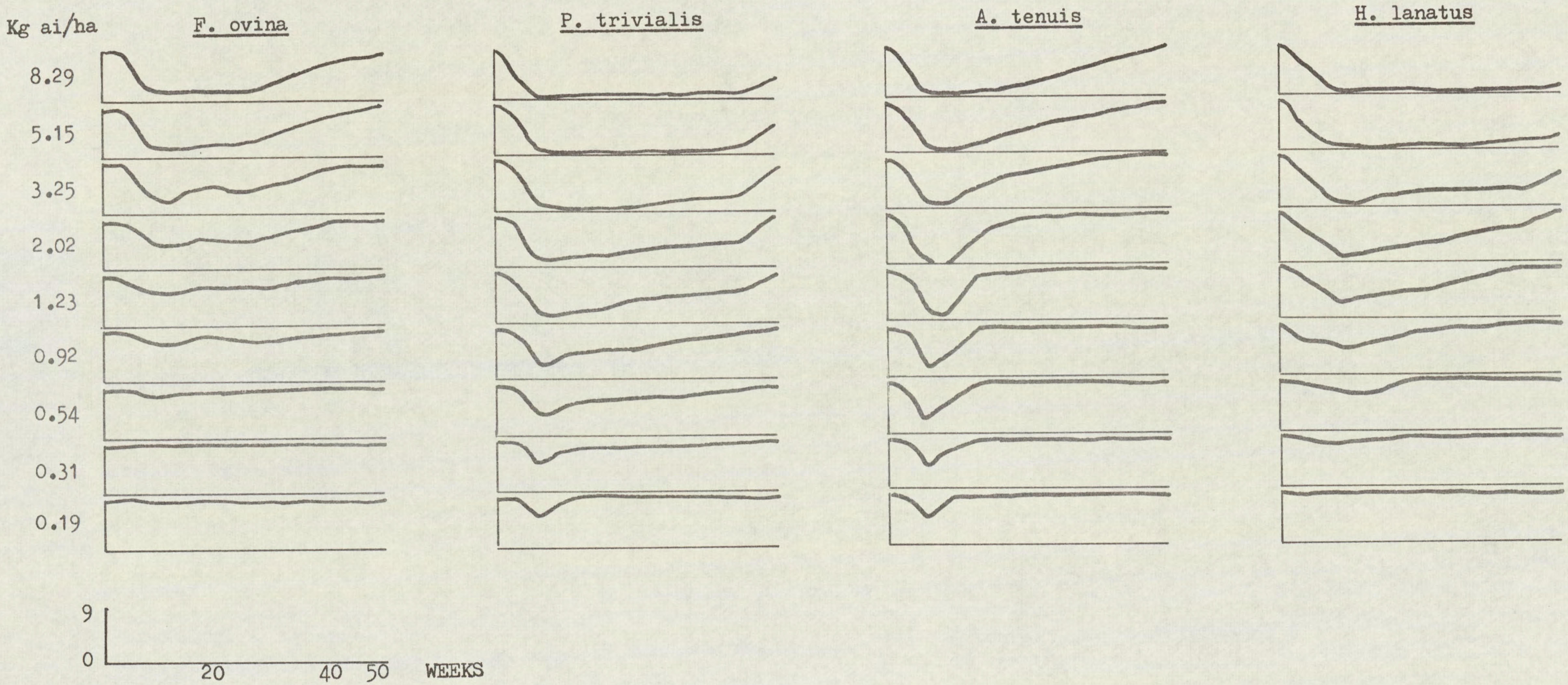


FIG. 3

The effect of asulam on grass swards sown on 24.4.63 and treated on 29.9.64 (expt. A)

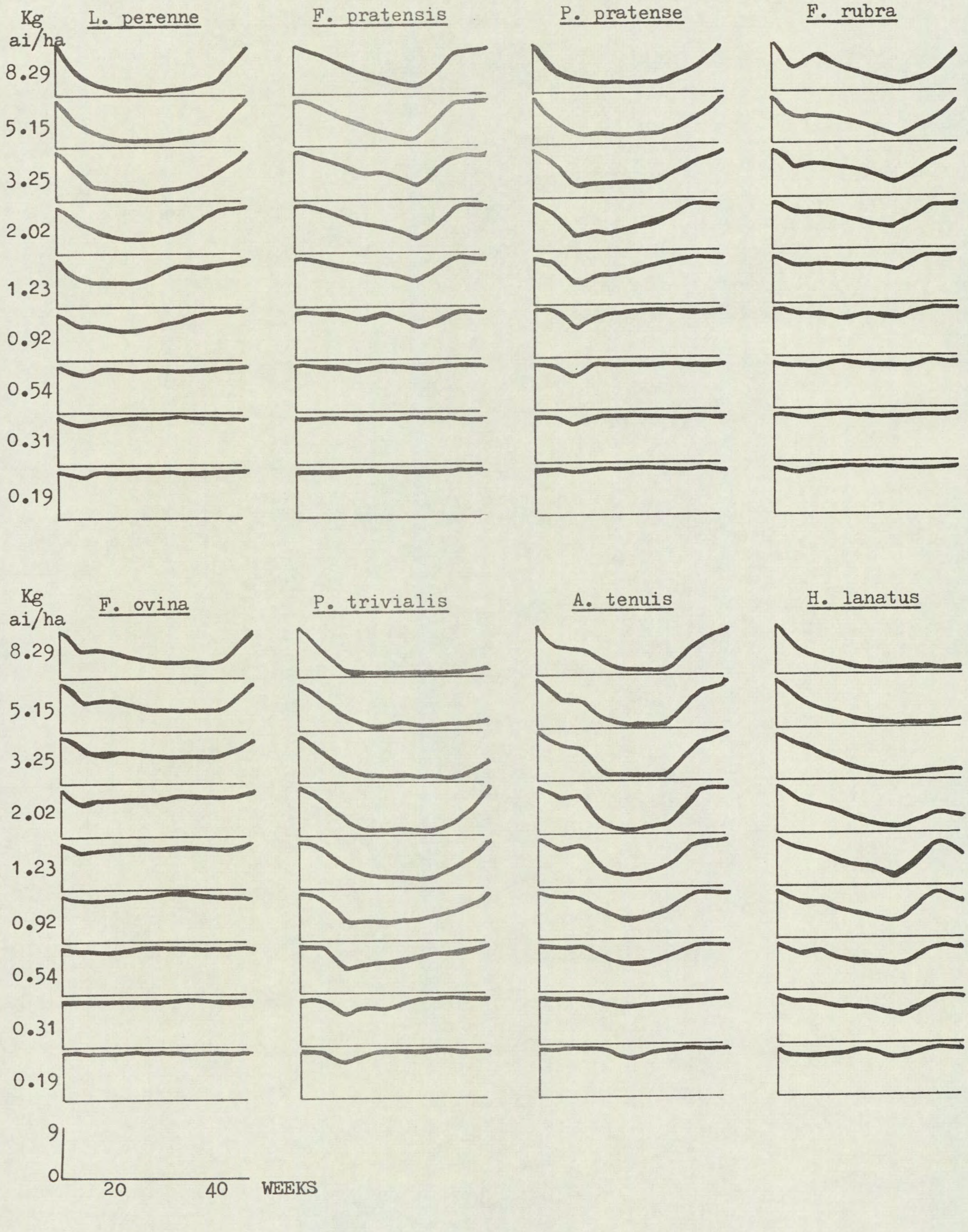


FIG. 4

The effect of the wettable powder formulation of asulam on grass and clover swards sown on 23.9.63 and treated on 6.7.64 (expt. B)

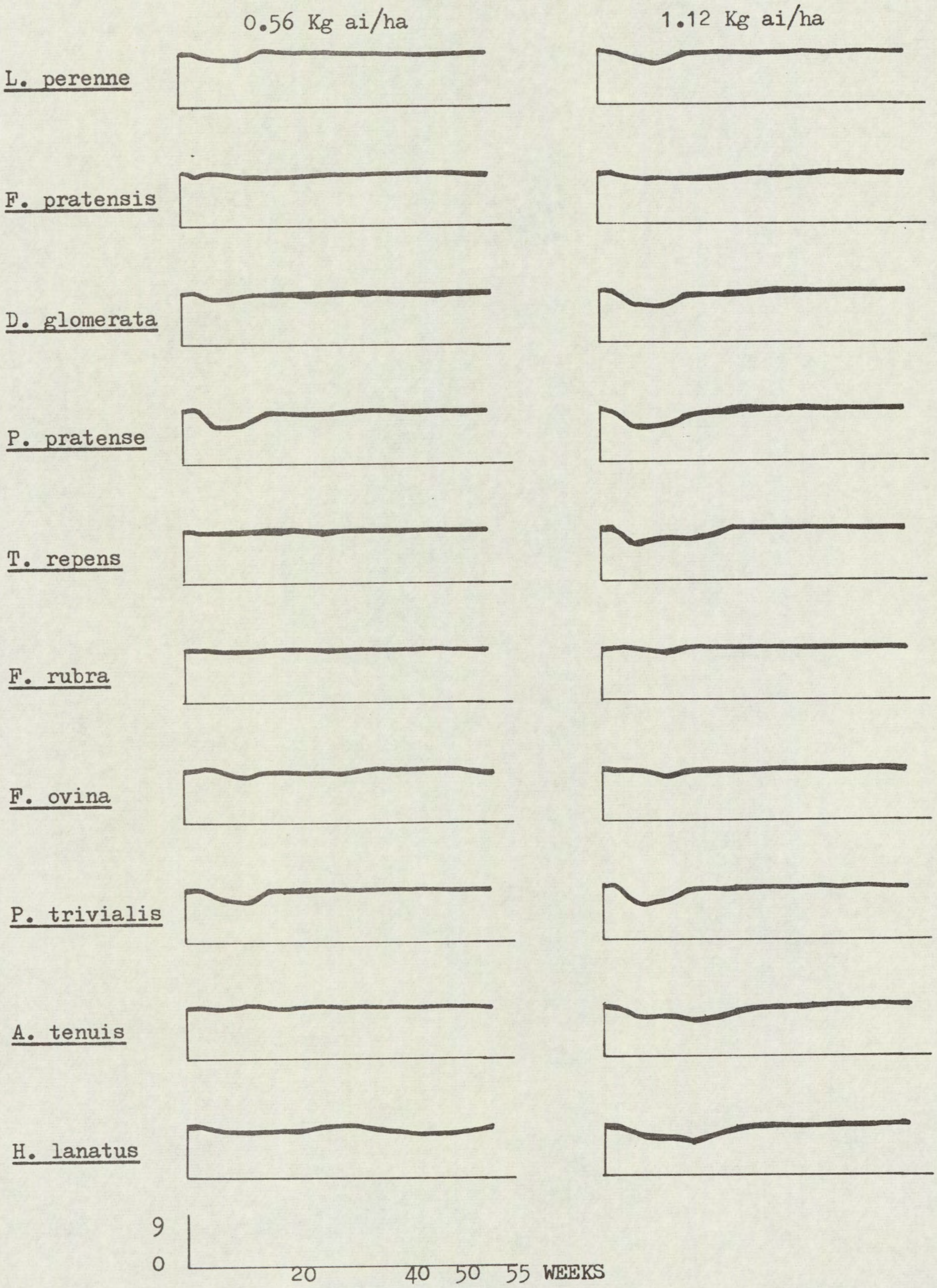


FIG. 5

The effect of the wettable powder formulation of asulam on grass and clover swards sown on 23.9.63 and treated on 6.7.64 (expt. B)

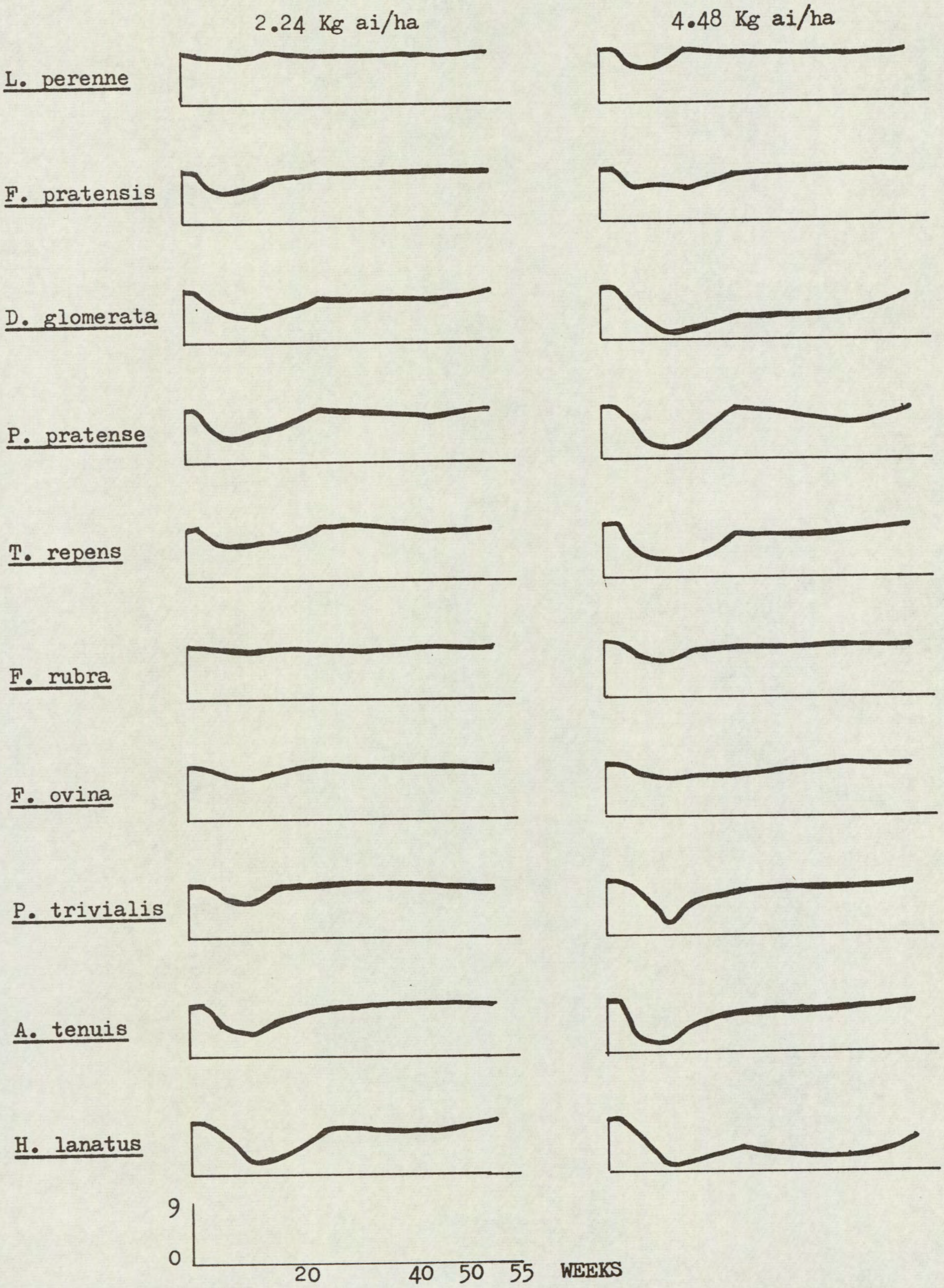


FIG. 6

The effect of the wettable powder formulation of asulam on grass and clover swards sown on 23.9.63 and treated on 1.10.64 (expt. B)

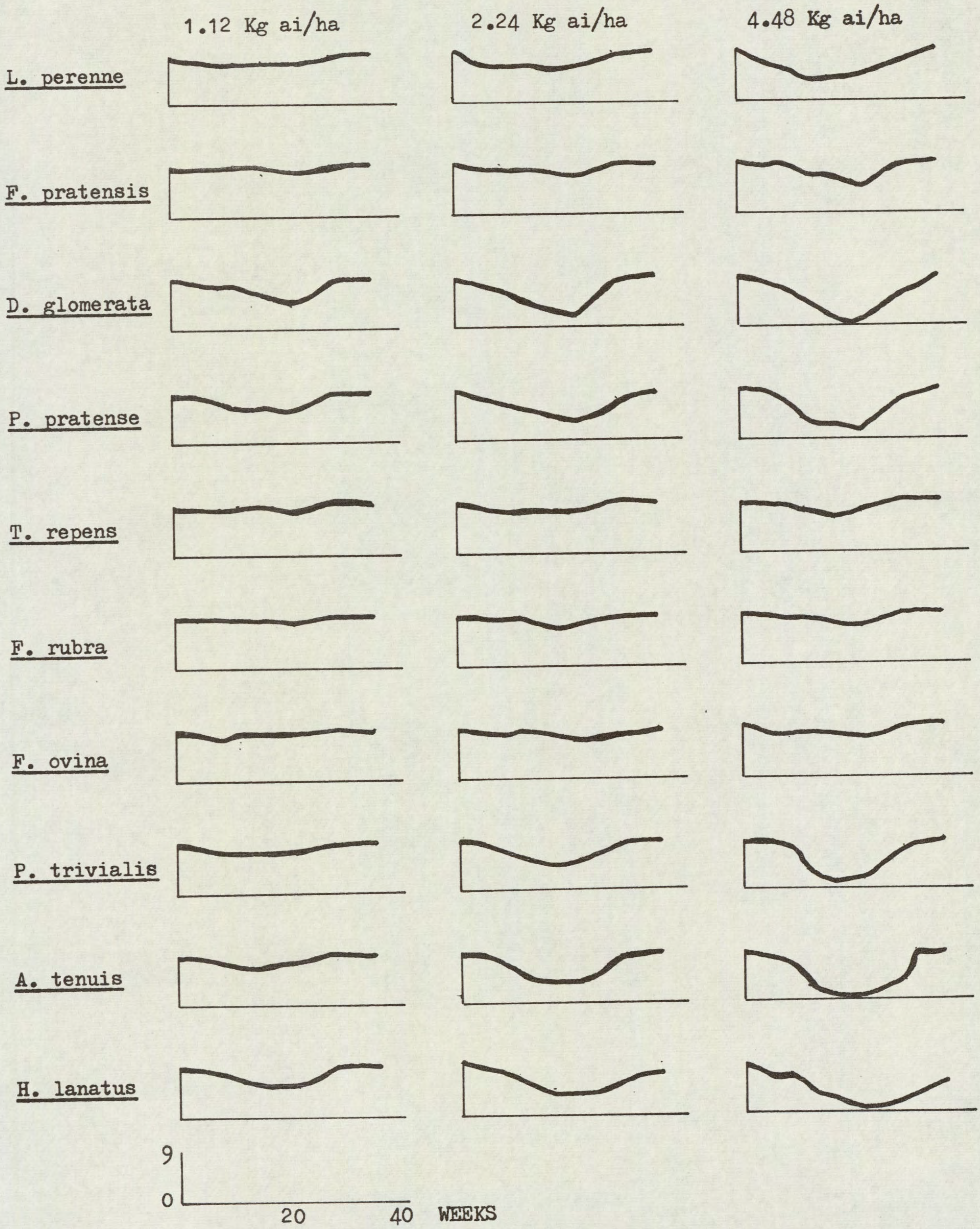


FIG. 7

The effect of the wettable powder formulation of asulam on grass and clover swards sown on 12.10.64 and treated on 26.7.65 (expt. C)

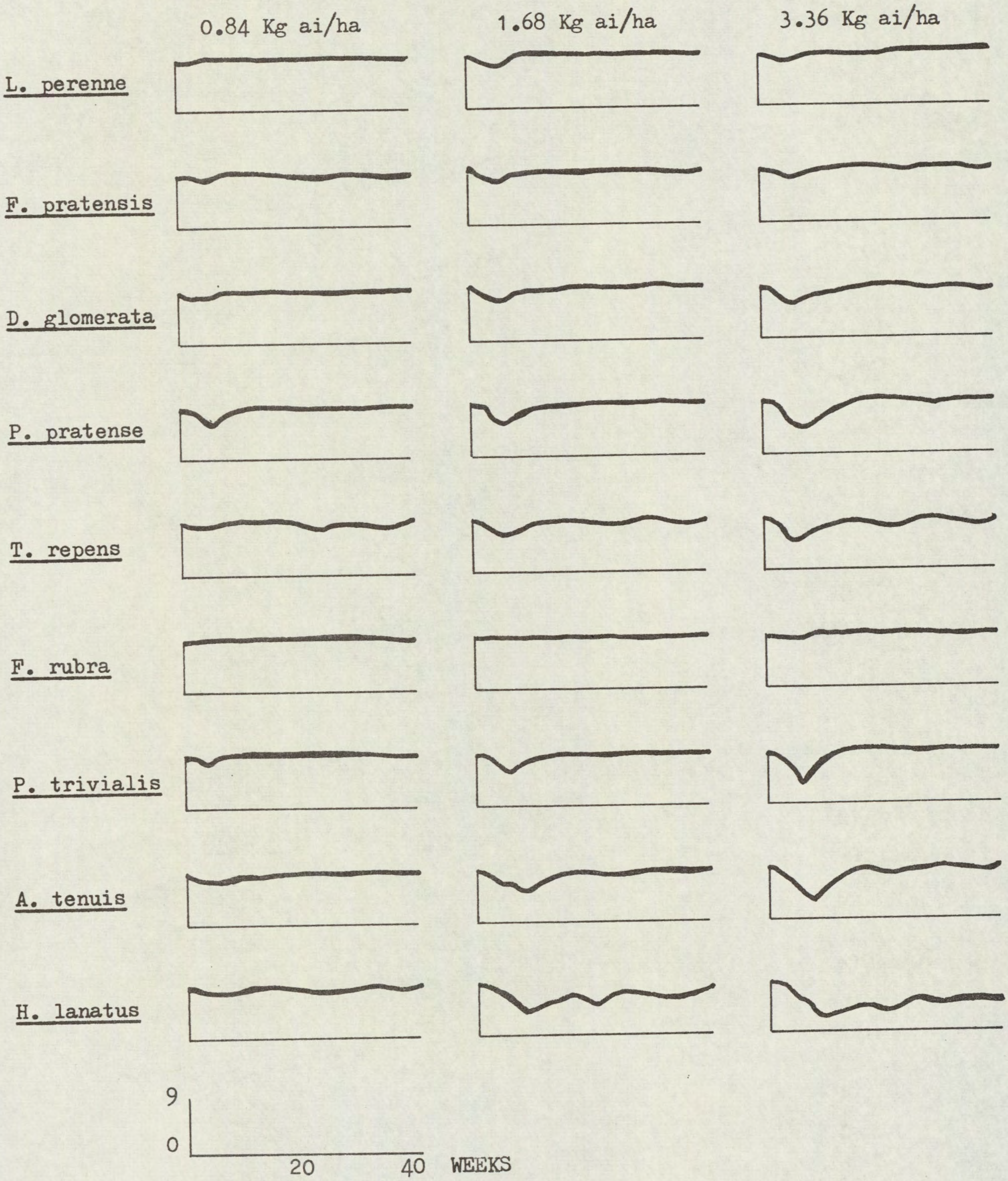


FIG. 8

The effect of the water soluble powder formulation of asulam on grass and clover swards sown on 12.10.64 and treated on 26.7.65 (expt. C)

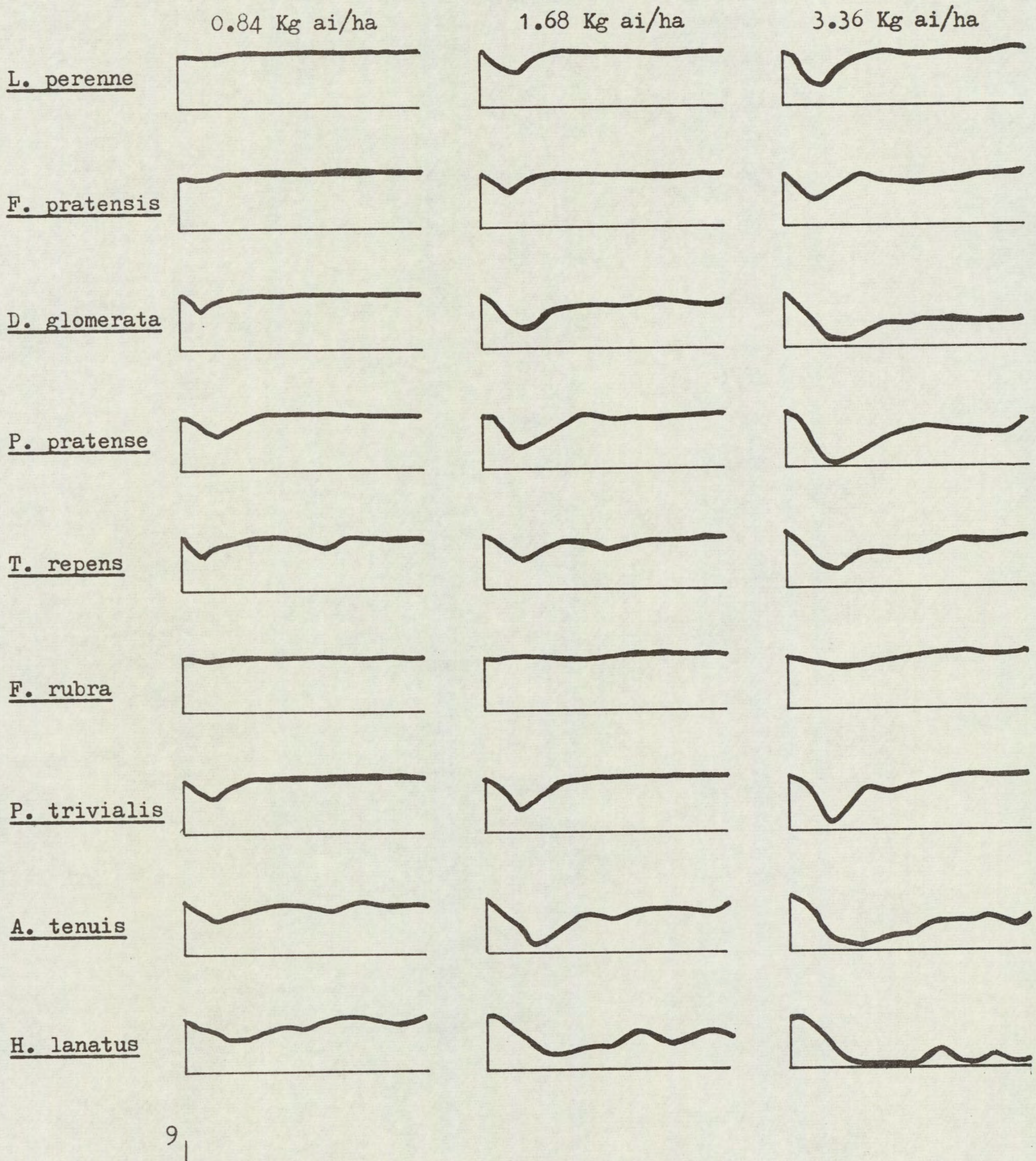


FIG. 9

The effect of M & B 8882 on grass and clover swards sown on 12.10.64 and treated on 26.7.65 (expt. C)

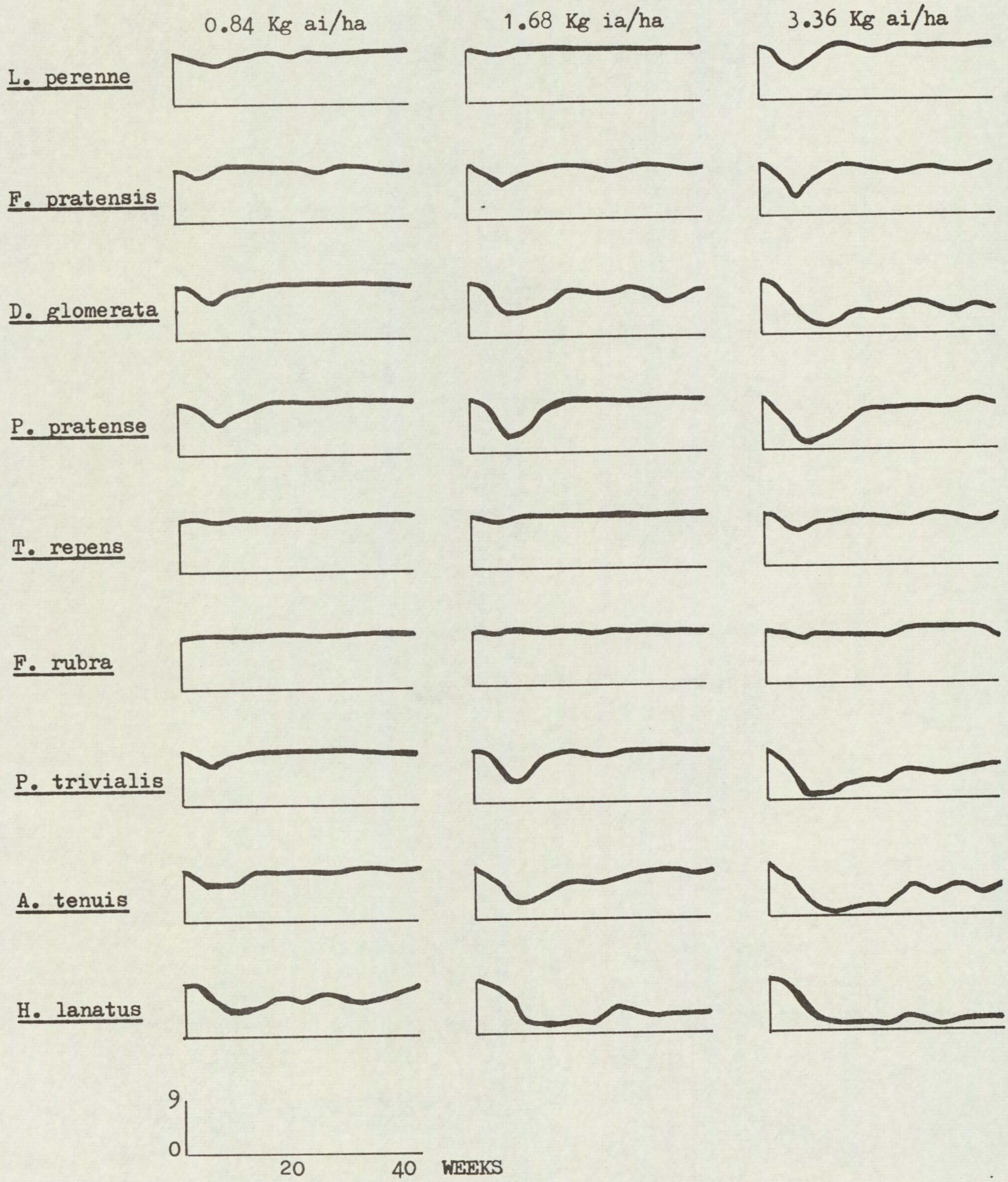


FIG. 10

The effect of the wettable powder formulation of asulam on grass and clover swards sown on 12.10.64 and treated on 21.10.65 (expt. C)

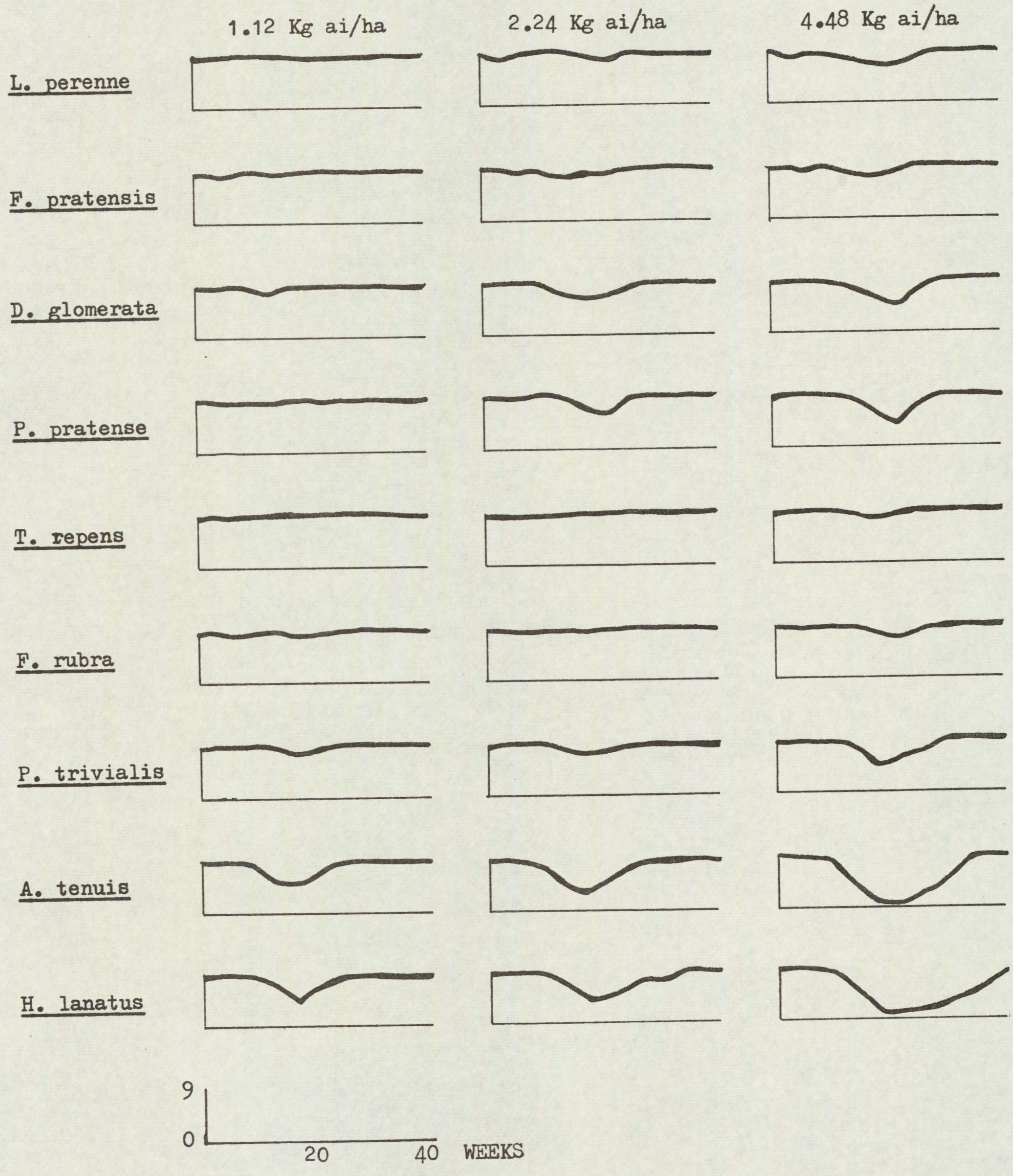


FIG. 11

The effect of the water soluble powder formulation of asulam on grass and clover swards sown on 12.10.64 and treated 21.10.65 (expt. C)

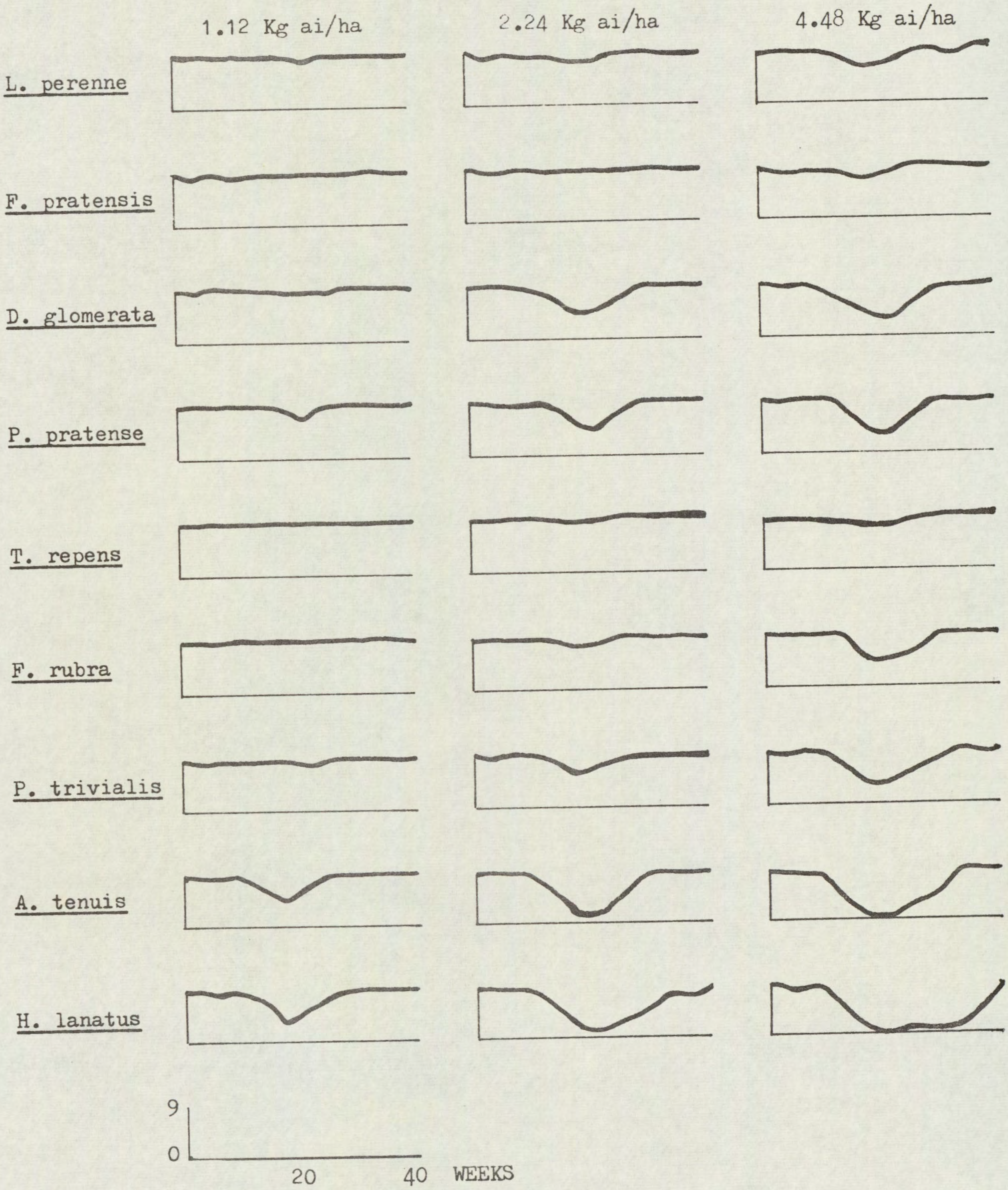


FIG. 12

The effect of M & B 8882 on grass and clover swards sown on 12.10.64 and treated on 21.10.65 (expt. C)

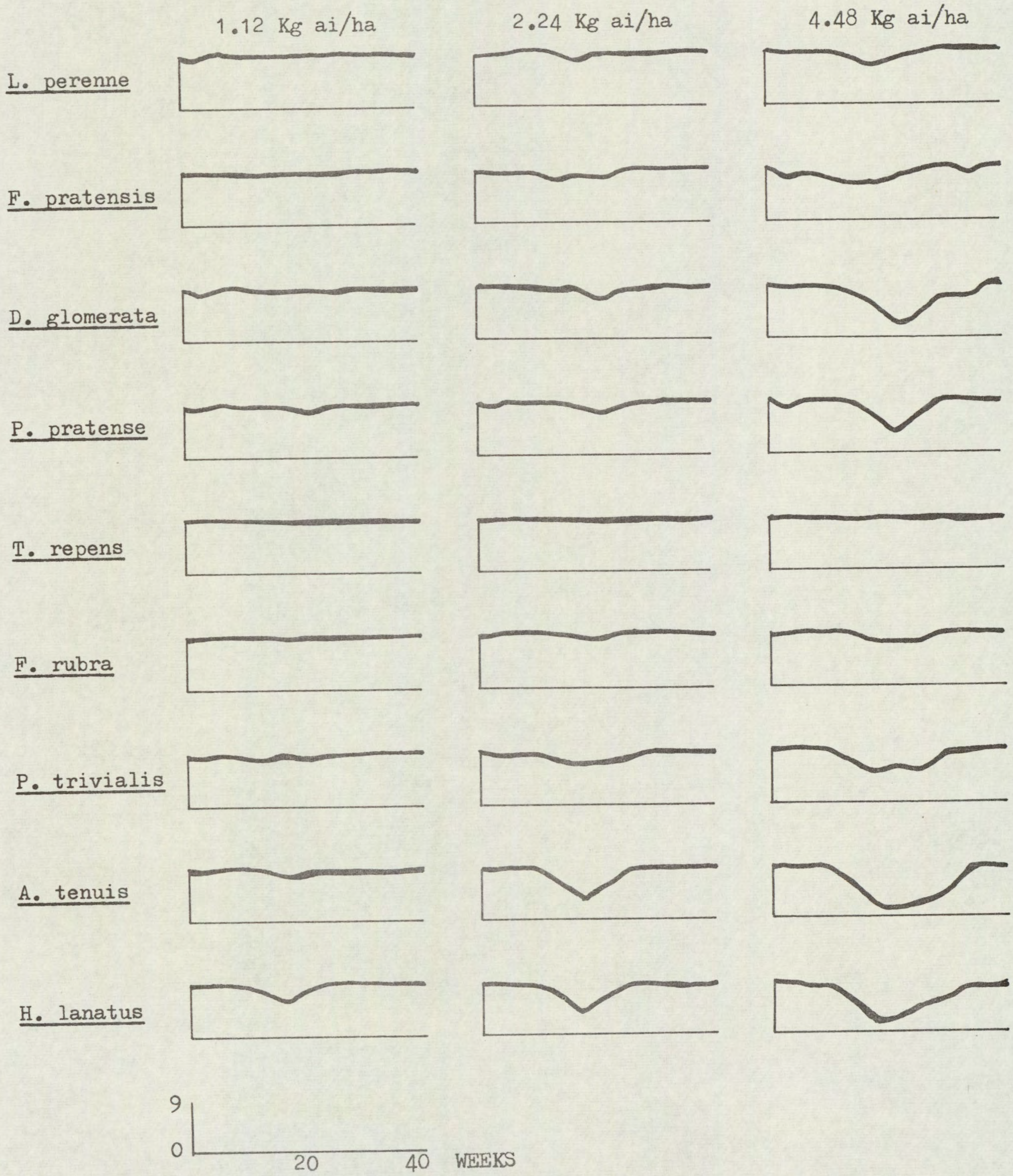


FIG. 13

The effect of M & B 8882 on grass and clover swards sown on 12.10.64 and treated on 22.7.66 (expt. D)

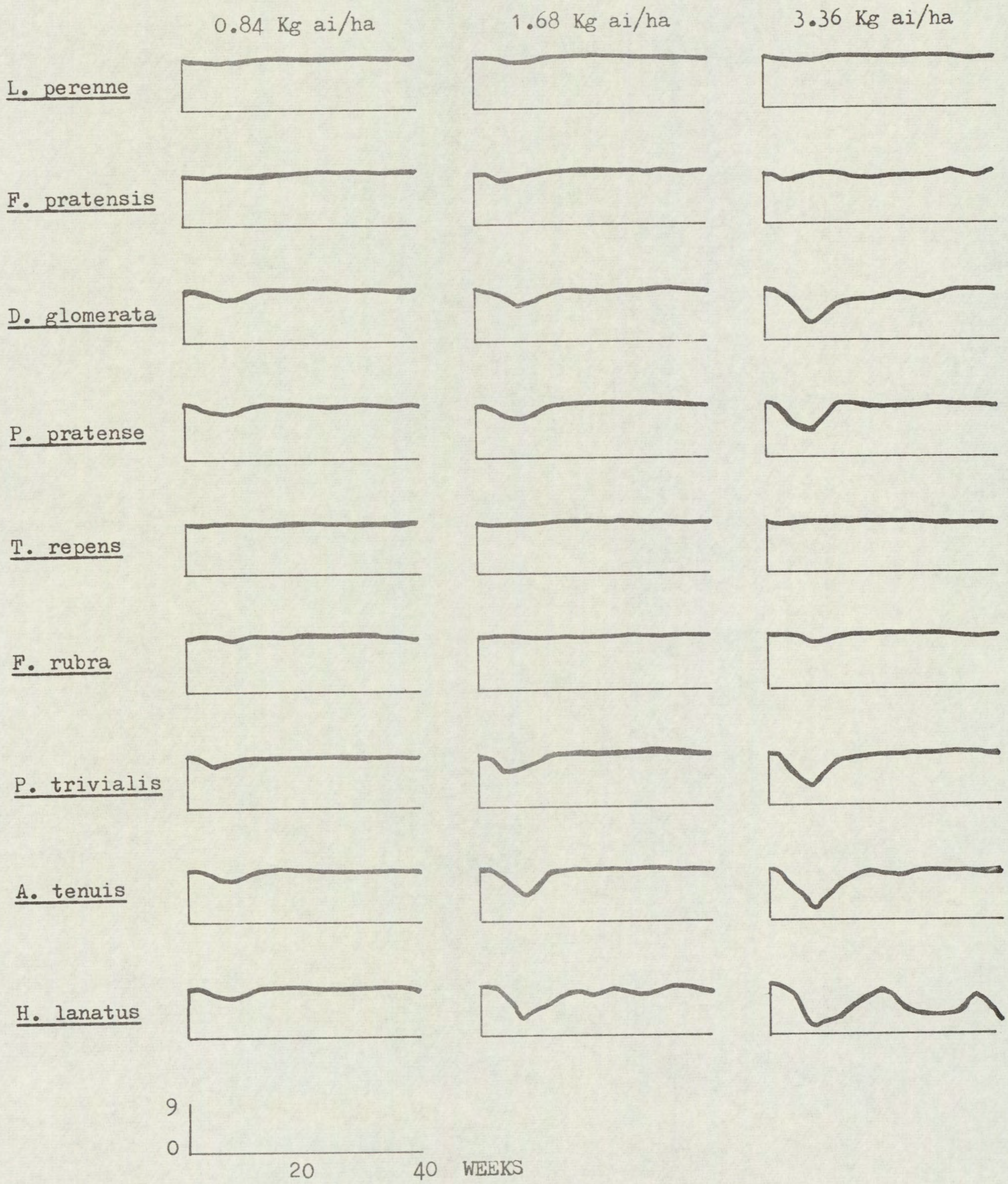


FIG. 14

The effect of M & B 8882 on grass and clover swards sown on 12.10.64 and treated on 7.11.66 (expt. D)

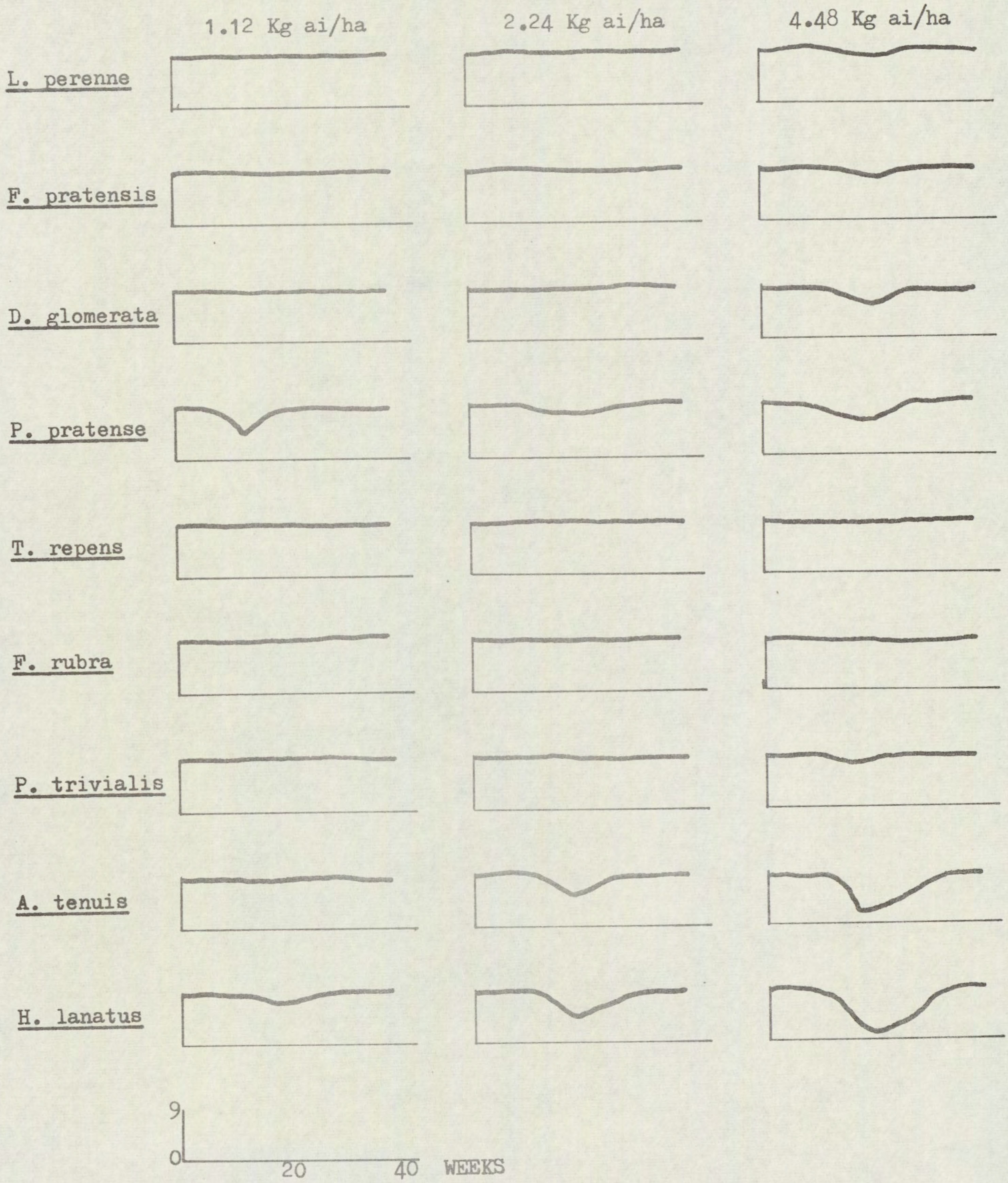


FIG. 15

The effect of asulam on grass and clover swards sown on 14.5.66 and treated on 7.7.67 (expt. E)

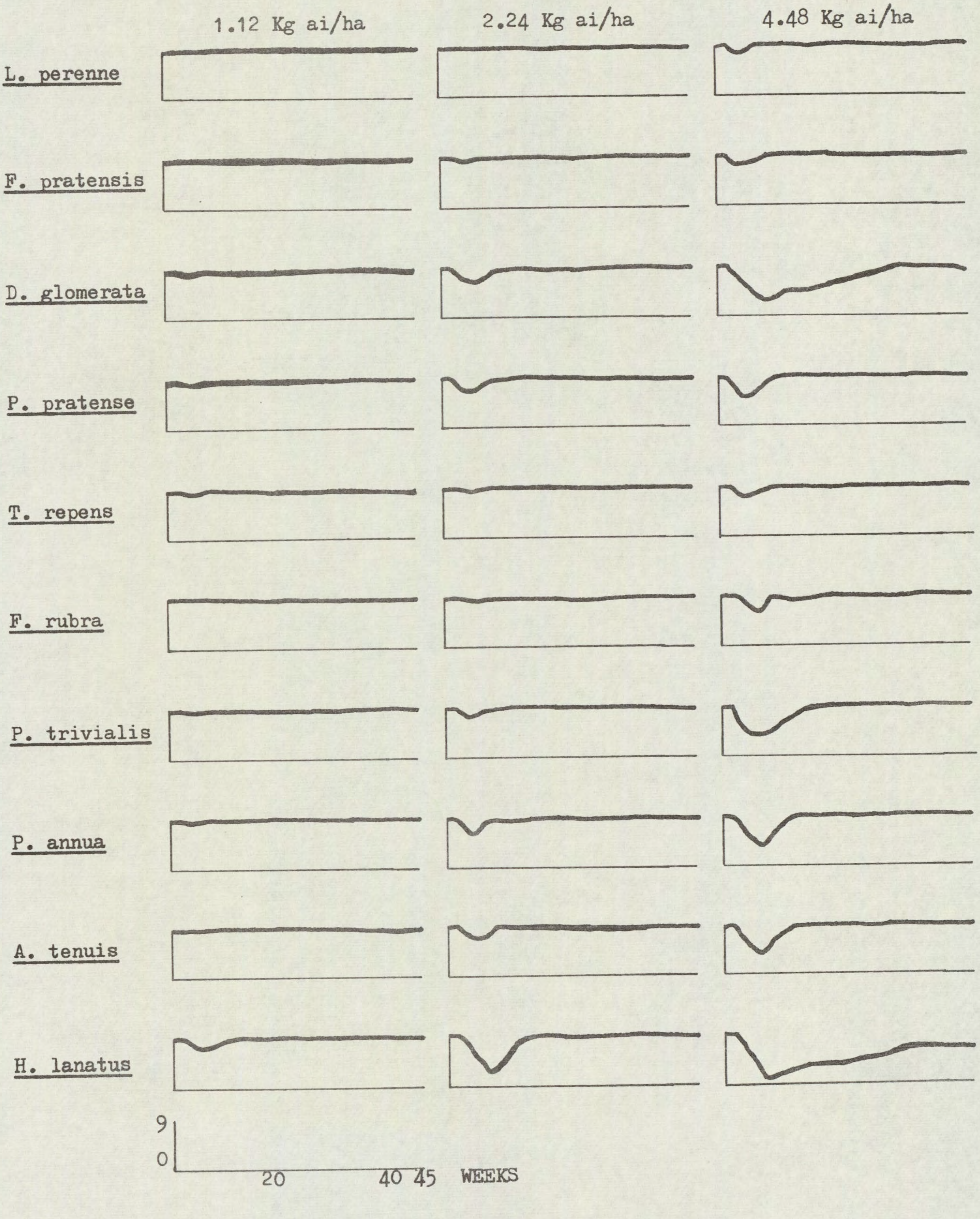
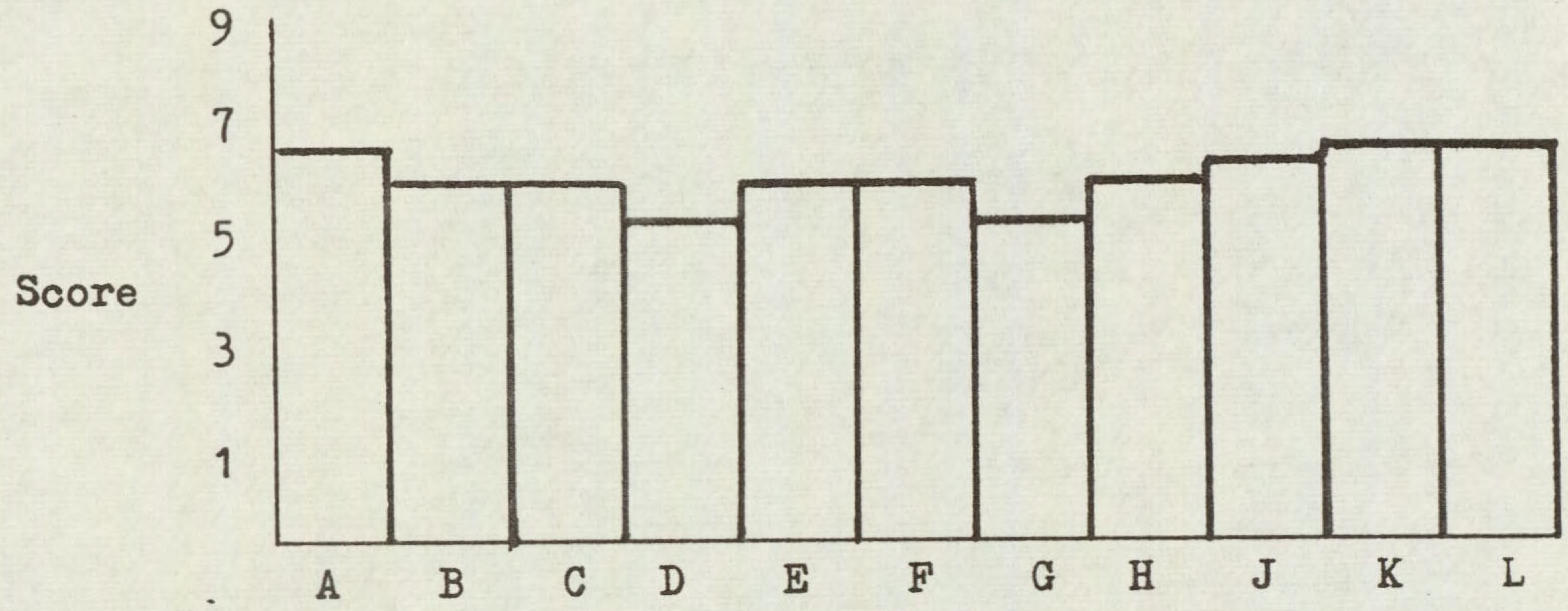


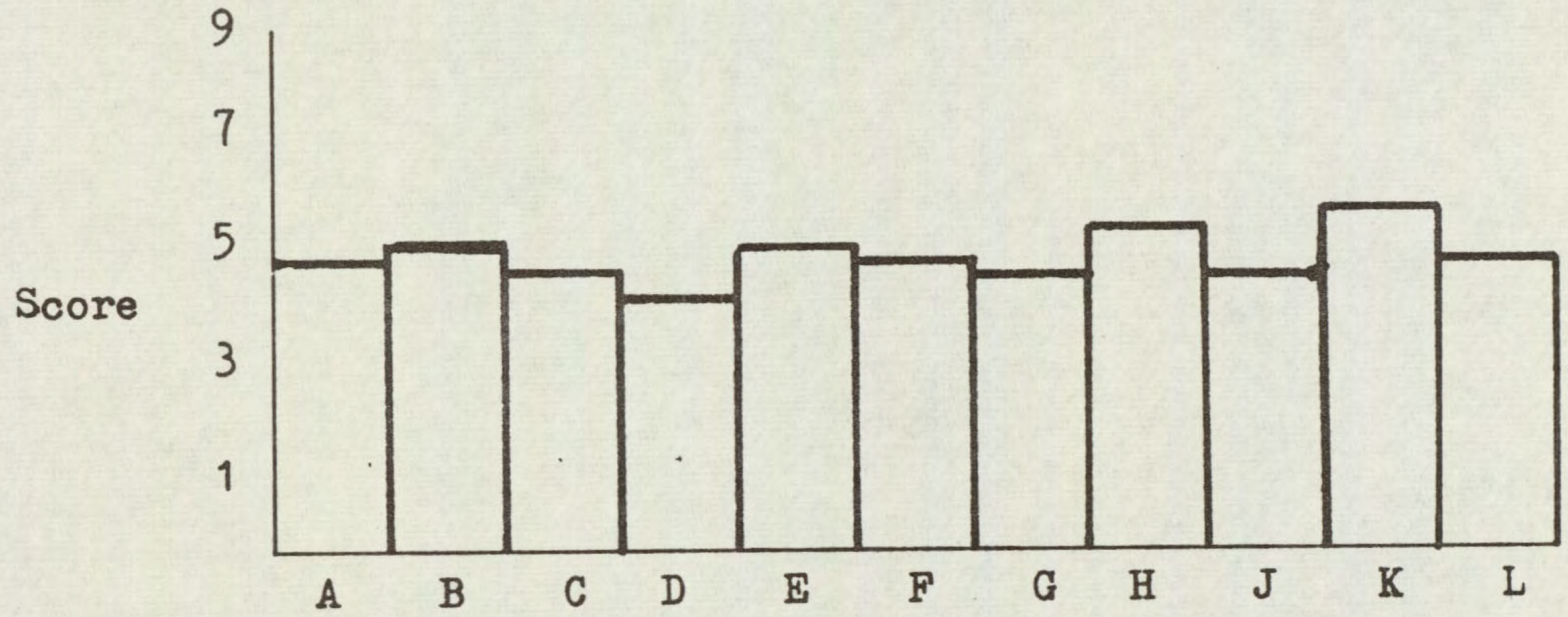
FIG. 16

The effect of asulam on various cultivars of perennial ryegrass sown on 16.8.66 and treated on 1.7.68 (expt. F)

Asulam @ 2.24 Kg/ha



Asulam @ 3.36 Kg/ha



Cultivars of <u>Lolium Perenne</u>

A Tetraploid Pasture Perennial

B Danish Hunsballe

C Dutch Tetraploid Perennial

D Dutch Early Presto III

E New Zealand Certified Grasslands Ruani

F S24

G S23

H Kent Indigenous

J S321

K Barenza Tetraploid "Barpastra" Pasture

L S101

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Technical reports available

5. A survey of the problem of aquatic weed control in England and Wales. October, 1967. T.O. Robson. Price - £0.25.

6. The botany, ecology, agronomy and control of Poa trivialis L. rough-stalked meadow-grass. November 1966. G.P. Allen. Price - £0.25.

7. Flame cultivation experiments 1965. October, 1966. G.W. Ivens. Price - £0.25.

8. The development of selective herbicides for kale in the United Kingdom. 2. The methylthiotriazines. Price - £0.25.

9. The post-emergence selectivity of some newly developed herbicides (NC 6627, NC 4780, NC 4762, BH 584, BH 1455). December, 1967. K. Holly and Mrs. A.K. Wilson. Price - U.K. and overseas surface mail - £0.25; overseas airmail - £0.50.

10. The liverwort, Marchantia polymorpha L. as a weed problem in horticulture; its extent and control. July, 1968. I.E. Henson. Price - £0.25.

11. Raising plants for herbicide evaluation; a comparison of compost types. July, 1968. I.E. Henson. Price - £0.25.

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13. Changes in the germination capacity of three Polygonum species following low temperature moist storage. June, 1969. I.E. Henson. Price - £0.25.

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