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The Park Grass Plots at Rothamsted 1856 -1949

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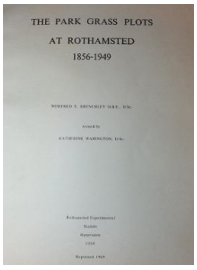

Chapter V. Effect of Manures and Lime on Individual Species

Rothamsted Research

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(f) All three groups of plants are well represented, the LEGUMINOSAE showing the greatest variation with season (1.8 - 20.0 per cent).

Main Constituents of the Herbage on Plot 19

GRAMINEAE

Agrostis vulgaris Alopecurus pratensis Anthoxanthum odoratum Festuca rubra	Chief species
Arrhenatherum avenaceum Avena flavescens Avena pubescens Dactylis glomerata Holcus lanatus	Usually fairly well represented, but relative abundance varies with season
Poa trivialis	Quantity small

LEGUMINOSAE

Lathyrus pratensis	Chief species

MISCELLANEOUS

Achillea millefolium Centaurea nigra Plantago lanceolata Ranunculus spp. Rumex acetosa	Relative abundance varies with season

OTHER SPECIES:- Briza, Lolium, Poa pratensis; Lotus, Trifolium pratense, T.repens; Agrimonia, Ajuga, Anthriscus, Centaurea, Cerastium, Heracleum, Hypochaeris, Leontodon, Luzula, Plantago, Prunella, Stellaria, Taraxacum, Tragopogon, Veronica (See Tables).

Outline of Principal Changes during the period 1877-1948

Yield. Constant, with seasonal fluctuations, until manuring changed in 1905 when it fell and has since remained at much the same level.

Number of Species. Reduced since the change in manuring.

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Number of Species

	1862	1877	1908	1914	1919	1930	1940	1948
G	16	16	?	13	13	10	12	12
L	4	5	?	4	2	4	2	4
M	21	18	?	14	15	12	13	13
Total	41	39	39	31	30	26	27	29

Composition of the Herbage.

Percentage of Gramineae, Leguminosae and Miscellaneous Species

	1872	1877	1905	1914	1917	1919	1936	1948
G	89.4	81.0	64.0	78.8	68.7	75.2	84.1	50.3
L	2.5	8.7	17.8	10.0	21.4	6.1	5.2	17.4
M	8.1	10.3	18.2	11.2	9.9	18.6	10.7	32.3

GRAMINEAE Proportion little changed or slightly reduced till 1944 when reduction marked

Alopecurus pratensis	Increased till 1919, later reduced to former level
Arrhenatherum avenaceum	Increased
Holcus lanatus	Decreased by 1914
Dactylis glomerata	Decreased since 1919
Lolium perenne, Bromus mollis, Cynosurus cristatus	Disappeared

LEGUMINOSAE Variable, increased in many seasons

Lathyrus pratensis	Chiefly responsible for increase

MISCELLANEOUS Little change till 1944 when considerably increased

Achillea millefolium, Plantago lanceolata	Responsible for most of increase since 1944
Ranunculus spp.	Much increased
Rumex acetosa	Variable

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Changes in the Percentage of Certain Species

	1872	1877	1914	1919	1946	1948
Alopecurus pratensis	0.2	5.4	13.4	22.3	13.1	6.2
Arrhenatherum avenaceum	<	-	3.7	7.9	9.8	5.7
Cynosurus cristatus	1.2	2.5	-	-	-	-
Dactylis glomerata	0.7	2.4	12.0	15.8	3.6	3.3
Holcus lanatus	14.0	21.2	3.5	2.1	2.7	1.3
Achillea millefolium	0.7	0.7	1.7	1.4	6.3	10.2
Plantago lanceolata	0.2	0.3	0.2	0.2	15.8	11.8
Ranunculus spp.	2.0	0.2	1.0	4.8	5.9	5.7
Rumex acetosa	0.7	2.7	2.1	8.4	1.8	1.3

Effect of Lime

The quantities of lime applied on this plot to satisfy the lime requirement as determined by the two methods were:- light dressing (LL) 571 lb., and heavy dressing (HL) 3,151 lb. per acre.

pH. Not determined in 1945 (LL = 6.5; HL = 7.6 in 1957).

Yield. Usually decreased, especially with the heavy dressing.

Number of Species. Practically no effect.

Composition of the Herbage.

GRAMINEAE	Usually increased, especially by the heavy dressing. Some species reduced.
LEGUMINOSAE	Variable; no constant difference between the unlimed and either level of lime.
MISCELLANEOUS	Generally decreased, especially by the heavy dressing.

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Effect of Lime on the Percentage of Different Species

	1921			1928			1946			1948		
	U	LL	HL	U	LL	HL	U	LL	HL	U	LL	HL
Agrostis vulgaris	21.8	17.8	13.9	5.8	5.1	2.4	8.0	2.8	0.1	11.8	4.3	0.5
Alopecurus pratensis	13.2	20.3	16.4	33.2	42.6	21.2	13.1	18.3	19.7	6.2	25.2	16.7
Anthoxanthum odoratum	10.3	8.3	2.9	11.6	7.9	0.7	9.1	2.7	0.1	7.3	1.5	-
Arrhenatherum avenaceum	8.2	0.3	13.8	7.9	3.5	15.9	9.8	6.4	13.9	5.7	5.5	14.3
Avena flavescens	5.0	7.7	10.5	3.5	3.2	6.1	1.4	0.5	2.4	1.7	3.0	3.1
Avena pubescens	4.0	1.9	4.6	3.0	2.8	11.9	0.5	1.7	2.7	0.9	1.9	5.4
Festuca rubra	12.5	9.8	15.5	8.1	3.7	13.9	4.6	2.5	3.3	9.8	5.0	4.5
Lathyrus pratensis	4.8	2.1	3.4	1.6	1.5	1.0	9.5	10.5	13.2	13.5	7.4	7.5
Ranunculus spp.	0.4	1.3	0.7	1.8	2.5	1.4	5.9	10.4	2.3	5.7	7.9	4.0
Plantago lanceolata	0.4	0.2	0.1	0.6	-	0.6	15.8	14.2	16.3	11.8	10.4	9.7
Achillea millefolium	0.1	0.2	0.2	0.2	0.1	0.4	6.3	5.4	1.9	10.2	5.2	2.3

U = Unlimed LL = Light lime HL = Heavy lime

FARMYARD MANURE EVERY FOURTH YEAR WITH NITRATE OF SODA AND MINERALS IN INTERVENING YEARS, AFTER NITRATE OF POTASH AND SUPERPHOSPHATE 1872-1904 (Plot 20)

Condition of Plot in 1949 (Unlimed)

(a) pH not determined in 1945. (5.7 in 1957).

(b) Herbage mixed and well grown, but rather irregular.

(c) Growth starts early, especially in the years that farmyard manure is applied.

(d) Yield fairly heavy, higher than on Plots 18 and 19.

(e) Fourteen to twenty-nine species, with occasional traces of several others.

(f) All three groups well represented. The range as shown by the partial separations from 1910-1948 was:-

	Per cent
G	63.5 - 93.2
L	1.0 - 25.0
M	4.2 - 29.8

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Main Constituents of the Herbage on Plot 20

GRAMINEAE

Alopecurus pratensis	Chief species
Arrhenatherum avenaceum Dactylis glomerata	Well represented, but relative abundance varies with season
Agrostis vulgaris Anthoxanthum odoratum Avena pubescens Avena flavescens Festuca rubra Holcus lanatus	Usually well represented
Bromus mollis Poa trivialis	Very variable in quantity

LEGUMINOSAE

Lathyrus pratensis	Chief species

MISCELLANEOUS

Achillea millefolium Rumex acetosa	One or other usually dominant
Ranunculus spp. Plantago lanceolata Tragopogon pratensis Taraxacum vulgare Veronica chameodrys	Small quantity, variable

OTHER SPECIES :- Festuca pratensis, Lolium, Poa pratensis; Lotus, Trifolium pratense, T.repens; Ajuga, Cerastium, Centaurea, Conopodium, Heracleum, Luzula (See Tables).

Outline of Principal Changes during the Period 1877-1948

Yield. Constant except for seasonal fluctuations till the manuring changed in 1905. Reduced for some years after, but has tended to improve since 1930.

Number of species. Reduced.

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Number of Species

	1872	1877	1908	1914	1919	1928	1939	1946	1948
G	15	16	?	14	14	14	12	13	12
L	5	4	?	3	1	2	2	2	3
M	22	18	?	11	14	11	10	10	9
Total	42	38	39	28	29	27	24	25	24

Composition of the Herbage.

Percentage of Gramineae, Leguminosae and Miscellaneous Species

	1872	1877	1905	1914	1917	1919	1928	1939	1946	1948
G	87.1	86.1	62.8	84.2	66.1	81.8	93.0	84.3	72.1	86.3
L	2.0	3.7	23.4	6.5	25.0	4.7	2.8	9.0	5.7	5.0
M	10.9	10.2	13.8	9.3	8.9	13.5	4.2	6.7	22.2	8.7

GRAMINEAE Proportion relatively constant; exceptionally low (65 per cent) in 1945.

Alopecurus pratensis Arrhenatherum avenaceum	Much increased
Dactylis glomerata	Increased since 1904
Avena pubescens	Increased from 1904-1919 but now reduced to former level
Holcus lanatus	Much reduced

LEGUMINOSAE Very variable: exceptionally high in 1945 (18 per cent).

MISCELLANEOUS Very variable: exceptionally high (over 20 per cent) in 1942, 1946 and 1947.

Ranunculus spp. Rumex acetosa	Variable
Anthriscus sylvestris	Introduced since 1877 and of some importance till 1919, now almost disappeared

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Changes in the Percentage of Certain Species

	1872	1877	1914	1919	1928	1946	1948
Agrostis vulgaris	31.4	10.4	4.5	6.5	4.1	3.0	4.1
Alopecurus pratensis	1.2	6.8	11.2	30.3	46.2	33.9	39.2
Anthoxanthum odoratum	7.2	3.5	0.6	1.2	1.9	1.3	1.1
Arrhenatherum avenaceum	<	<	4.2	4.6	11.3	9.9	15.1
Avena pubescens	1.0	2.4	6.3	10.2	6.6	2.6	0.7
Dactylis glomerata	0.3	1.2	10.0	12.5	7.0	10.3	14.7
Holcus lanatus	12.4	29.5	10.4	6.8	4.1	3.0	1.0
Lolium perenne	2.0	3.6	0.3	0.3	0.4	0.1	-
Lathyrus pratensis	0.1	2.7	6.4	4.7	2.6	5.5	4.3
Ranunculus spp.	3.9	4.0	0.5	2.1	0.8	5.0	1.2
Anthriscus sylvestris	-	-	2.8	2.5	0.4	0.7	0.6
Rumex acetosa	1.3	1.5	0.3	3.3	1.4	5.1	1.5

< indicates below 0.05

Effect of Lime

The quantities of lime applied are:- light dressing (LL) 571 lb. and heavy dressing (HL) 2,775 lb. per acre.

pH. Not determined in 1945. (LL = 6.5; HL = 7.6 in 1957).

Yield. No consistent effect.

Number of Species. Little changed, except for occasional increase with heavy lime.

Composition of the Herbage.

GRAMINEAE Proportion unaffected by the light but reduced by the heavy dressing

Anthoxanthum odoratum	Usually increased by light lime
Arrhenatherum avenaceum	Response varies with season
Avena pubescens	Increased by heavy lime

LEGUMINOSAE Variable, but usually increased by heavy lime

MISCELLANEOUS Increased, especially by the heavy dressing

Plantago lanceolata	Increased
Ranunculus spp. } Rumex acetosa }	Response varies with season

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Effect of Lime on the Percentage of Certain Species

	1921			1928			1946			1948		
	U	LL	HL	U	LL	HL	U	LL	HL	U	LL	HL
Agrostis vulgaris	13.3	10.5	5.0	4.1	4.2	1.2	3.0	1.5	0.1	4.1	2.5	0.1
Anthoxanthum odoratum	1.1	6.4	1.8	1.9	6.4	0.7	1.3	3.2	0.7	1.1	1.9	0.2
Arrhenatherum avenaceum	10.0	9.5	4.1	11.3	8.7	3.8	9.9	26.9	15.5	15.1	21.7	17.4
Avena pubescens	12.3	8.0	19.2	6.6	9.3	28.9	2.6	4.0	9.1	0.7	3.0	6.8
Holcus lanatus	10.0	10.3	8.0	4.1	7.9	5.0	3.0	2.9	1.4	1.0	5.7	1.6
Poa trivialis	1.2	1.8	1.0	1.2	3.5	3.0	0.9	4.0	3.6	1.3	3.9	4.3
Plantago lanceolata	0.5	0.4	-	<	0.4	0.4	3.2	6.7	6.3	0.9	6.2	4.1
Ranunculus spp.	0.9	0.8	1.2	0.8	1.3	1.2	5.0	1.2	1.9	1.2	1.9	1.3
Rumex acetosa	1.5	1.3	1.1	1.4	1.6	0.3	5.1	1.6	1.7	1.5	1.4	0.5

U = Unlimed LL - Light Lime HL = Heavy Lime

< indicates below 0.05

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CHAPTER V.

EFFECT OF MANURES AND LIME ON INDIVIDUAL SPECIES

Every species of importance is considered individually in this chapter. Some indication is given of the extent to which it has occurred on the various plots, both unlimed and limed, and the manurial treatments which favour or discourage it are briefly summarised. Where applicable, a list follows of the chief plant associations of which it is a member. Changes in nomenclature (1952) are given in brackets. Details of the manurial treatments on the different plots will be found in Table 1.

A. GRAMINEAE

AGROSTIS VULGARIS (A. tenuis) Fig. 12.

Occurs in samples from every plot, limed and unlimed. It is usually present in fair quantity, except on the plots receiving super only or nitrate of soda and minerals. It is very much discouraged by lime.

UNLIMED

QUANTITY

Very large (usually over 40 percent)

Plots	1	Ammonium salts
	4^2	Super and ammonium salts
	10	Minerals without potash and ammonium salts (under 10 percent till 1939)
	11^2	Minerals with silicate and heavy ammonium salts (under 1 percent till 1915)
	18	Minerals without super, and ammonium salts

Large (9-20 percent)

Plots	$3,5^1$	Unmanured
	5^2	Minerals after ammonium salts till 1897
	15	Minerals

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Medium (1-9 percent)

Plots	6, 7, 8	Minerals
	11[1]	Minerals and heavy ammonium salts (under 1 percent till 1915)
	13, 19	F.Y.M. * with and without fish guano
	17	Nitrate of soda
	20	F.Y.M., minerals and nitrate of soda

Very variable (0-12 percent)

Plot	9	Minerals and ammonium salts

Usually very low

Plots	4[1]	Super
	14, 16	Minerals and nitrate of soda

Agrostis vulgaris encouraged by:-

(a) Starved soils

(b) Minerals and sulphate of ammonia, alone or in combination

(c) Organic manures

Agrostis vulgaris not encouraged by:-

(a) Superphosphate

(b) Nitrate of soda with minerals

LIMED **

QUANTITY

Considerably decreased

Plots	1, 4[2], 10	Ammonium salts with incomplete minerals
	3	Unmanured
	7, 15	Minerals
	11[2]	Minerals with silicate and heavy ammonium salts
	13	F.Y.M. and fish guano alternately
	17	Nitrate of soda

* F.Y.M. = Farmyard manure.

** For Plots 18, 19 and 20 throughout, both levels of lime are included unless otherwise stated viz. LL = light lime; HL = heavy lime.

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Slightly decreased

Plots	8	Minerals without potash
	11^1	Minerals and heavy ammonium salts
	19, 20	F.Y.M., with and without minerals and nitrate of soda

Plots with Agrostis vulgaris among the three chief grasses.

	Unlimed			Limed		
	First	Second	Third	First	Second	Third
1914	-	$1,2,3,4^2,5^1,5^2,6,9$	7,8,12,17,18	-	1	-
1919	-	1,3,6,9,15,18	$2,4^2,5^2,7,11^1,13$	-	-	-
1948 or 1949	$1,4^2,10,11^2,18$	$2,3,5^1,9,13$	$5^2,19$	-	-	18 LL

Agrostis vulgaris in Plant Communities

UNLIMED

A marked feature of all associations except the specialized ones occuring with heavy nitrogenous manuring or super alone. The absence of Agrostis from the Dactylis-Holcus-Festuca-Avena pubescens community in the latter case (Plot 4^1) is noteworthy, as the herbage is not of the coarse rank nature which would kill out Agrostis simply by competition.

LIMED

Agrostis vulgaris is a less conspicuous element of the various associations on the limed areas.

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AIRA CAESPITOSA (Deschampsia caespitosa)

Present on fewer plots in 1919 than in 1877, traces occurring only on Plot 5^1, 8, 10, 18 and 19. It was recorded on Plots 5^1 and 18 (heavy lime) in 1946, but has since apparently disappeared.

ALOPECURUS PRATENSIS Fig. 13.

Usually occurs in samples from every plot, limed and unlimed. It responds readily to a plentiful supply of nutrients provided sufficient lime is applied. It requires abundant nitrogen and thrives on the unlimed areas of plots receiving sodium nitrate but requires lime before it can take advantage of nitrogen supplied as ammonium sulphate.

UNLIMED

QUANTITY

Large (usually well over 10 percent)

Plots	5^2	Minerals after ammonium salts till 1897
	13	F.Y.M. and fish guano alternately
	14, 15	Minerals with and without nitrate of soda (high N)
	17	Nitrate of soda
	19, 20	F.Y.M. with and without minerals and nitrate of soda

Medium (1 to 9 percent)

Plots	3	Unmanured
	7	Minerals
	18	Ammonium salts and minerals without super

Small (usually under 1 percent)

Plots	1, 4^2, 9, 10	Ammonium salts with and without minerals
	5^1	Unmanured
	8	Minerals without potash
	11^1, 11^2	Minerals and heavy ammonium salts

Alopecurus pratensis encouraged by:-

(a) Nitrate of soda, whether alone or with minerals

(b) Minerals alone or after ammonium salts

(c) Organic manures

Alopecurus pratensis not encouraged by:-

(a) Starved soils

(b) Most incomplete manures

(c) Heavy dressings of ammonium salts

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LIMED

QUANTITY

Greatly increased

Plots	4^2	Super and ammonium salts
	9, 10, 11^1, 11^2	Minerals with and without potash, and ammonium salts

Increased

Plot	1	Ammonium salts

Decreased

Plots	13	F.Y.M. and fish guano alternately
	14	Minerals and nitrate of soda (high N)
	17	Nitrate of soda
	20	F.Y.M., minerals and nitrate of soda

On plots with highly acid soil and a good supply of plant nutrients, liming has caused a very great increase in Alopecurus pratensis e.g. 0.8 to 31.8; 1.1 to 78.9; and 0.2 to 32.5 percent on Plots 9, 11^1 and 4^2 respectively in 1947.

On plots with slightly acid soil, liming has usually had little or no effect on the relative quantity, irrespective of the level of nutrient supply.

Plots with Alopecurus pratensis among the three chief grasses

Unlimed

	First	Second	Third
1914	15,16,17	13,14,19,20	10,11^2,11^1
1919	13,14,15,16,17,19,20	5^2, 11^2	10, 18
1948 or 1949	11^1,11^2,13,15,16,20	5^2,6,7,14,17	2, 3, 12

Limed

	First	Second	Third
1914	4^2, 10, 11^2	9,11^1,13,16	-
1919	4^2,10,11^1,11^2,13,16	7, 8	-
1948 or 1949	9,11^1,11^2,19,20	3, 4^2, 10	13, 15

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Alopecurus pratensis in Plant Communities

UNLIMED

(a) Heavy nitrogenous and mineral manures (Plot 14), not too acid. Alopecurus - Arrhenatherum with Dactylis. Comparatively few Leguminous or Miscellaneous plants.

(b) Less but fairly heavy manuring (Plots 15, 16, 17, 19, 20). Alopecurus with Dactylis - Festuca rubra - Arrhenatherum and less generally Agrostis and Anthoxanthum. Lathyrus and Plantago usually well represented.

(c) Organic manures (Plot 13). Alopecurus with Agrostis - Dactylis - Anthoxanthum - Festuca rubra - Holous - Plantago - Rumex and Achillea. Leguminosae unimportant.

LIMED

(a) Minerals only (Plot 7). Alopecurus - Arrhenatherum - Dactylis with Bromus in some years.

(b) Superphosphate and ammonium salts (Plot 4^2). Alopecurus - Festuca rubra - Poa pratensis, but the two latter may take a subordinate place in some seasons.

(c) Heavy nitrogenous and mineral manures:-(Plot 9) Alopecurus - Anthoxanthum - Arrhenatherum - Dactylis; (Plot 10) Alopecurus - Festuca rubra Arrhenatherum - Rumex; (Plot 11^1) Alopecurus with occasional other grasses; (Plot 11^2) Alopecurus - Arrhenatherum with occasional Dactylis and Poa pratensis.

(d) Organic manures (Plot 13). Arrhenatherum - Dactylis - Alopecurus with much Lathyrus and Plantago in some years.

N.B. The Alopecurus associations are more varies on the limed than on the unlimed plots, and Agrostis vulgaris is no longer a chief component.

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ANTHOXANTHUM ODORATUM Fig. 14.

Occurs to some extent in samples from every plot. It flourishes best on well manured and acid soil, and is usually reduced by lime.

UNLIMED

QUANTITY

Large and very variable (10 to 52 per cent)

Plot	10	Minerals without potash and ammonium salts

Fairly large and very variable (usually over 10 percent)

Plots	4^2	Super
	5^1	Unmanured after ammonium salts till 1897

Small (usually under 8 percent)

Plots	2, 3, 12	Unmanured
	5^2	Minerals after ammonium salts till 1897
	7, 8, 9	Minerals with and without ammonium salts
	13	F.Y.M. and fish guano alternately
	17	Nitrate of soda
	18	Minerals without super and ammonium salts
	19, 20	F.Y.M. with and without nitrate of soda and minerals

Very small (usually under 1 percent)

Plots	1	Ammonium salts
	11^1, 11^2, 14	Minerals and heavy nitrogenous manuring

Anthoxanthum odoratum encouraged by:-

Ammonium salts with minerals, except when nitrogen very high.

Anthoxanthum odoratum not encouraged by:-

(a) Ammonium salts alone

(b) Heavy nitrogenous manures and minerals

Other manurial treatments have little effect.

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LIMED

QUANTITY

Considerably decreased

Plots 4^2	Super and ammonium salts
10	Minerals without potash and ammonium salts
13, 19	F.Y.M. with and without fish guano alternately
15	Minerals
17	Nitrate of soda

Plots with Anthoxanthum odoratum among the three chief grasses.

	Unlimed			Limed		
	First	Second	Third	First	Second	Third
1914	9, 10	-	1, 4^2, 5^2	-	10	9
1919	-	5^1, 10	2, 12	-	-	-
1948 or 1949	-	-	10, 19	-	-	10

Anthoxanthum odoratum in Plant Communities

UNLIMED

(a) Unmanured (Plots 2, 3, 12) and nitrate of soda (Plot 17). Associations very mixed, with Anthoxanthum in variable proportion.

(b) Unmanured after ammonium salts (Plot 5^1); Festuca rubra - Agrostis - Anthoxanthum - Dactylis - Rumex - Centaurea - Conopodium.

(c) Ammonium salts with superphosphate (Plot 4^2); Agrostis - Festuca rubra - Holcus - Anthoxanthum - Rumex.

(d) Ammonium salts and minerals without potash (Plot 10); Anthoxanthum - Agrostis - Holcus with some Arrhenatherum.

(e) F.Y.M. and fish guano; (Plot 13) Alopecurus - Agrostis - Anthoxanthum with Dactylis - Festuca - Plantago - Rumex and Achillea.

LIMED

(a) Ammonium salts (Plot 1); Avena pubescens - Dactylis with Anthoxanthum - Festuca rubra.

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Contd.

(a) Ammonium salts with super (Plot 4^2); Alopecurus - Festuca rubra with Poa pratensis and Anthoxanthum.

(b) Ammonium salts and minerals with and without potash (Plots 9 and 10); Alopecurus - Anthoxanthum with Arrhenatherum and Dactylis on Plot 9 and Alopecurus - Festuca rubra - Arrhenatherum with Anthoxanthum on Plot 10.

ARRHENATHERUM AVENACEUM (A. elatius) Fig. 15.

Generally occurs in samples from every plot, limed and unlimed. It thrives best on plots receiving heavy complete manures, whether as organic or artificial fertilizers. Elsewhere comparatively little is present. The effect of lime is very variable and large increases or decreases may occur on the same plot in different seasons.

UNLIMED

QUANTITY

Large (up to 40 percent)

Plots 14	Minerals and nitrate of soda
11^1*, 11^2*	Minerals and ammonium salts with and without silicate of soda

Medium (usually over 8 percent)

Plots 8	Minerals without potash
16	Minerals and nitrate of soda
19, 20	F.Y.M. with and without minerals and nitrate of soda

Usually small (1 to 9 percent)

Plots 12	Unmanured
4^1	Super
5^1, 5^2	Unmanured or minerals after ammonium salts to 1897
6, 7, 15	Minerals
10	Minerals and ammonium salts without potash
13	F.Y.M. and fish guano alternately

* Till 1919 only. No further complete botanical analyses were made till 1949 when 1.0 percent was present. According to field observations the reduction occurred about 1922.

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Very small (under 1 percent)

Plots 2, 3	Unmanured
1	Ammonium salts
9, 11^1, 11^2, 18	Ammonium salts and minerals with and without super
17	Nitrate of soda

Probably absent

Plot 4^2	Super and ammonium salts

Arrhenatherum avenaceum encouraged by:-

(a) Nitrogenous dressings with minerals; if N as ammonium salts till 1919 only

(b) Minerals with and without potash

(c) Organic manures

Arrhenatherum avenaceum not encouraged by:-

(a) Nitrogenous manures alone, or since 1919, heavy ammonium salts with minerals

(b) Starved soils

(c) Most incomplete manures

LIMED

QUANTITY

Usually increased

Plots 1, 9	Ammonium salts with and without minerals
7	Minerals
11^1, 18	Ammonium salts and minerals with and without super
13, 19 HL	F.Y.M. with and without fish guano
14, 20	Minerals and nitrate of soda with and without F.Y.M.

Effect varies with season

Plots 8, 15	Minerals
10	Ammonium salts and minerals without potash
11^2	Heavy ammonium salts with minerals and silicate of soda

Little affected

Plots 3	Unmanured
4^2	Super and ammonium salts
17	Nitrate of soda

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Seasonal effect of lime on the percentage of Arrhenatherum avenaceum on heavily manured plots

Plot	1914	1919	1948 or 1949
9	Increase (8 - 39)	No effect	Increase (0.6 - 14)
10	Increase (5 - 9)	Decrease (26 - 8)	Little change (5 - 4)
11^1	Increase (7 - 21)	Decrease (31 - 16)	Increase (0.0 - 2)
11^2	Increase (21 - 26)	Decrease (46 - 16)	Increase (0.8 - 17)

Plots with Arrhenatherum avenaceum among the three chief grasses

Unlimed

	First	Second	Third
1914	13, 14	11^1, 11^2	-
1919	9, 10, 11^2	8, 11^1, 13, 14	19
1948 or 1949	8, 14	4^1, 16, 20	9, 11^2 (1 percent)

Limed

	First	Second	Third
1914	9, 13	11^1, 11^2	
1919	8, 9	10, 11^1, 11^2. 13	-
1948 or	8, 13, 14*, 15, 16, 20	10, 18, 19	7

* Both Sun and Shade

Arrhenatherum avenaceum in Plant Communities

UNLIMED

(a) Minerals without potash (Plot 8); Festuca rubra - Arrhenatherum - Holcus - Trifolium pratense - Plantago.

(b) Heavy nitrogenous manures and minerals.

Ammonium salts with and without silicate of soda (Plots 11^1 and 11^2); formerly an important constituent of the association on both plots but now inconspicuous.

Nitrate of soda (Plot 14); Arrhenatherum - Alopecurus - Dactylis.

(c) Organic manures.

F.Y.M. alone (Plot 19); Alopecurus - Arrhenatherum - Anthoxanthum - Agrostis - Lathyrus - Plantago.

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F.Y.M. and minerals (Plot 20); Alopecurus - Arrhenatherum - Dactylis - Lathyrus - Rumex.

LIMED

(a) Minerals with and without potash.

With potash (Plot 7); Alopecurus - Arrhenatherum - Dactylis - Lathyrus - Heracleum.

Without potash (Plot 8); Arrhenatherum - Avena pubescens - Lotus - Plantago.

(b) Nitrogenous manures and minerals.

Ammonium salts (Plots 9 and 11[2]) Alopecurus - Arrhenatherum - with or without much Dactylis.

Nitrate of soda (Plot 14); Arrhenatherum - Festuca rubra - with Alopecurus, Lathyrus and Dactylis (Sun), Avena pubescens (Shade).

(c) Nitrogenous manures and minerals without super (Plot 18); Arrhenatherum - Dactylis - Festuca rubra - Taraxacum; with light lime Centaurea and Plantago also.

(d) Organic manures.

F.Y.M. and fish guano (Plot 13); Dactylis - Arrhenatherum - Alopecurus - Lathyrus - Plantago.

F.Y.M. with and without minerals and nitrate of soda (Plots 19 and 20); Arrhenatherum - Alopecurus with Dactylis - Lathyrus - Plantago, and Ranunculus on Plot 19.

AVENA FLAVESCENS (Trisetum flavescens)

UNLIMED

QUANTITY

Small	(1.5 - 4 percent)	
Plots	17	Nitrate of soda
	19, 20	F.Y.M. with and without minerals
Very small	(under 1 percent)	
Plots	2, 3, 12	Unmanured
	6, 7, 8, 15, 16	Minerals alone or with nitrate of soda (low N)

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Absent

Plots 1, 4^2, 9, 10, 11^1	Ammonium salts with and without minerals
11^2, 18	
5^1, 5^2	Unmanured or minerals after ammonium salts till 1897
13	F.Y.M. and fish guano alternately
14	Minerals and nitrate of soda (high N)

LIMED

Slightly increased in some seasons on Plots 1, 3, 7, 8, 14(shade), 17 and 19, otherwise little effect.

Avena flavescens in Plant Communities

A very insignificant member of all the associations in which it occurs, except occasionally on the limed sections of plots receiving F.Y.M.

AVENA PUBESCENS (*Helictotrichon pubescens*) Fig. 16.

Generally distributed over the whole area, but is very intolerant of ammonium salts and is entirely absent from a few plots, and present in such small quantities on others that it does not appear in the hay samples. It is much less plentiful on the unlimed areas than it was before 1919 and may be considerably increased by lime, even to the extent of becoming one of the three chief grass species. On the limed section of Plot 14 it is particularly abundant in the part shaded by a tree, little occurring in the sun.

UNLIMED

QUANTITY

Medium (usually 1 to 6 percent)

Plots 2, 3, 12	Unmanured
4^1,	Super
5^2,	Minerals after ammonium salts till 1897
6, 7, 8, 15	Minerals with and without potash
16, 17	Nitrate of soda with and without minerals
20	F.Y.M. with minerals and nitrate of soda

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Very small (not usually over 1 percent)

Plots	14	Minerals and nitrate of soda (high N)
	19	F.Y.M. after minerals and nitrate of soda

Almost or entirely absent

Plots	1	Ammonium salts
	4^2	Super and ammonium salts
	9, 10, 11^1, 11^2	Minerals and ammonium salts
	13	F.Y.M. and fish guano alternately
	18	Minerals without super, and ammonium salts

Avena pubescens encouraged by:-

(a) Minerals, especially superphosphate

(b) Nitrate of soda, alone or with minerals

Avena pubescens not encouraged by:-

(a) Ammonium salts, alone or with minerals

(b) Frequent dressings of organic manures

LIMED

QUANTITY

Greatly increased

Plots	1*	Ammonium salts
	2, 3	Unmanured
	4^1	Super
	15	Minerals
	16, 17	Nitrate of soda with and without minerals

Increased

Plots	7, 8	Minerals with and without potash
	14, 20	Minerals and nitrate of soda with and without F.Y.M.
	19 (HL)	F.Y.M. after minerals and nitrate of soda

Little or unaffected

Plots 4^2, 9, 10, 11^1, 11^2, 13, 18, 19 (LL)

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* Avena pubescens is negligible on the unlimed part of this plot.

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Avena pubescens in Plant Communities

UNLIMED

A rather insignificant member of various mixed associations.

LIMED

(a) Ammonium salts (Plot 1); Avena pubescens - Dactylis - Festuca rubra - sometimes with Plantago.

(b) Unmanured (Plots 2, 3); Avena pubescens - Lotus with Festuca rubra - Dactylis - Trifolium pratense - Plantago - Leontodon and on Plot 3 also Alopecurus - Briza - Poterium.

(c) Superphosphate (Plot 4^1); Avena pubescens - Trifolium pratense - Lotus - Lathyrus with Leontodon - Plantago - and sometimes Ranunculus spp.

(d) Minerals and nitrate of soda (Plot 16); Arrhenatherum - Alopecurus - Avena pubescens - Dactylis - Lotus - Lathyrus - Trifolium pratense: sometimes with Bromus - Anthriscus - Ranunculus spp.

(e) Minerals alone (Plot 15); Arrhenatherum - Avena pubescens - Trifolium pratense - T.repens - Lathyrus with Plantago.

(f) Nitrate of soda (Plot 17); Avena pubescens - Dactylis - Festuca rubra - Plantago - Ranunculus and sometimes Leontodon autumnalis.

Plots with Avena pubescens among the three chief grasses

	Unlimed			Limed		
	First	Second	Third	First	Second	Third
1914	-	4^1	-	4^1	2,3,4^1,8	16
1919	4^1	-	-	2,3	8	7,16
1948 or 1949	-	-	-	2,3,4^1	8,15,16	1,17,14 (shade)

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BRIZA MEDIA

Present on a few plots only. It is generally an indicator of poverty or exhaustion of soil, and disappears when conditions are improved. It is usually increased by lime.

UNLIMED

QUANTITY

Small (1.0 - 6 percent)

Plots	2, 3, 12	Unmanured
	4^1	Super
	8	Minerals without potash
	17	Nitrate of soda

Absent

Plots 1, 4^2, 5^1, 5^2, 6, 7, 9, 10, 11^1, 11^2, 13, 14, 15, 16, 18, 19, 20.

Briza media encouraged by:-

(a) Starved or exhausted soils
(b) Nitrate of soda alone

Briza media not encouraged by:-

(a) Fair or good manuring of every kind
(b) Ammonium salts alone
(c) Complete minerals alone

LIMED

QUANTITY

Increased

Plots	2, 3	Unmanured
	4^1	Super
	8	Minerals without potash

Briza media in Plant Communities

A constituent of the very varied association characteristic of the poorer soils, but is only conspicuous at flowering time. It does not appear to be specially associated with any particular species or group of species, except Plantago and Leontodon.

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BROMUS MOLLIS

Occurs on a few plots only. Quantity extremely variable with season, but has on the whole become less plentiful.

UNLIMED

QUANTITY

Small (usually under 1 percent)

Plots 6, 7, 15	Minerals with potash
14, 16	Nitrate of soda with minerals
20	F.Y.M. with minerals and nitrate of soda (plentiful in 1943 and 1944).

Traces only

Plots 4^1	Super
8	Minerals without potash
13, 19	F.Y.M. with and without fish guano
17	Nitrate of soda

Absent

Plots 1, 2, 3, 4^2, 5^1, 5^2, 9, 10, 11^1, 11^2, 12, 18. Traces on Plot 12 in 1940.

Bromus mollis encouraged by:-

(a) Nitrate of soda and minerals with and without F.Y.M.

Bromus mollis not encouraged by:-

(a) Starved soils

(b) Ammonium salts with and without minerals

LIMED

QUANTITY

Increased

Plots 7, 14, 16	Minerals with and without nitrate of soda
19	F.Y.M. after minerals and nitrate of soda

Bromus mollis in Plant Communities

Bromus shows a specially close connection with certain Leguminosae and Miscellaneous species, notably *Lathyrus*.

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(a) Minerals, limed or unlimed (Plots 7, 15); Bromus - Lathyrus - Trifolium pratense - T.repens - Centaurea - Achillea - Plantago.

(b) Minerals and nitrate of soda, limed or unlimed (Plots 14, 16); Bromus - Lathyrus - Anthriscus - Ranunculus spp., Plantago - Taraxacum - Rumex.

CYNOSURUS CRISTATUS

Traces occur on a few plots. Both distribution and quantity remained comparatively unchanged till 1919, since when a gradual decrease has taken place.

DACTYLIS GLOMERATA

Occurs in samples on practically every plot, limed and unlimed. It is plentiful with most types of manuring except those inducing very acid or starved conditions. It is not greatly affected by liming except where soil acidity is high.

UNLIMED

QUANTITY

Fairly large (8-25 percent)

Plots 6, 7, 8, 15	Minerals with and without potash
13	F.Y.M. and fish guano alternately
14, 16	Minerals and nitrate of soda
17	Nitrate of soda
20	F.Y.M., minerals and nitrate of soda

Small, but variable (usually under 5 percent)

Plots 1	Ammonium salts
2, 3, 12	Unmanured
4^1	Super
5^2, 5^2	Unmanured or minerals after ammonium salts till 1897
19	F.Y.M. after minerals and nitrate of soda

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Very small (usually under 1 percent)

Plots	4^2	Ammonium salts and super
	9, 10	Ammonium salts and minerals with and without potash
	11^1, 11^2	Heavy ammonium salts and minerals with and without silicate
	18*	Ammonium salts and minerals without super

Dactylis glomerata encouraged by:-

(a) Minerals with and without potash

(b) Nitrate of soda with and without minerals

(c) F.Y.M. with and without minerals and nitrate of soda

Dactylis glomerata discouraged by:-

(a) Starved soils

(b) Ammonium salts with or without minerals (complete or partial)

LIMED

QUANTITY

Considerably increased

Plots	1, 9	Ammonium salts with and without minerals
	13	F.Y.M. and fish guano alternately
	18	Ammonium salts and minerals without super
	11^1, 11^2	Heavy ammonium salts and minerals with and without silicate

Little changed

Plots	3	Unmanured
	7, 8	Minerals with and without potash

Slightly decreased

Plots	14	Minerals and nitrate of soda (high N, shaded area)
	15	Minerals
	17	Nitrate of soda

Plots with Dactylis glomerata among the three chief grasses

	Unlimed		
	First	Second	Third
1914	6	7, 16, 18	5^1, 14, 19
1919	2,6,7,12,18	3,16,19,20	5^1, 17
1948 or 1949	6, 7, 17	8, 12, 15	1, 41, 5^1, 13, 14, 16, 18, 20

* Large amounts of Dactylis glomerata occurred on this plot till 1919 but in 1948 only traces were left.

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	LIMED				
	First		Second		Third
1914	-		-		7
1914	7 -	2, 16	-		-
1948 or 1949	1, 7, 18	2, 4[1], 13, 14 sun, 17, 19 LL			9, 11[1], 19 HL, 20

Dactylis glomerata in Plant Communities

UNLIMED

(a) Festuca rubra - Agrostis - Dactylis is a common community associated with other species according to the manuring:-

No manure or nitrate of soda alone (Plots 2, 3, 12, 17); with Alopecurus - Anthoxanthum - Avena pubescens - Briza - Leontodon hispidus - Plantago or Rumex.

Minerals only (Plots 6, 7, 15) and Organic manure (Plot 19) with Lathyrus and Alopecurus, Achillea and Plantago.

Organic manure with and without minerals and nitrate of soda (Plots 13, 20) with Alopecurus and often Plantago and Rumex.

(b) Minerals and nitrate of soda (Plots 14, 16); Alopecurus - Arrhenatherum - Dactylis with Taraxacum, and Lathyrus on Plot 16.

(c) Minerals without potash (Plot 8); Arrhenatherum - Festuca rubra - Dactylis - Trofilium pratense - Achillea - Plantago.

LIMED

(a) Unmanured (Plot 3); Avena pubescens - Festuca rubra - Alopecurus - Dactylis - Lotus.

(b) Ammonium salts alone (Plot 1); Avena pubescens - Festuca rubra - Dactylis with Plantago.

(c) Minerals (Plot 7); Alopecurus - Arrhenatherum - Avena pubescens - Dactylis - Lathyrus - Trifolium repens - Heracleum.

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FESTUCA RUBRA * Fig. 17.

Occurs in samples from every plot, limed and unlimed. It is generally plentiful except where the manuring is very heavy and it is much affected by season. The response to lime varies considerably.

UNLIMED

QUANTITY

Large (often over 40 percent)

Plot 5^1	Unmanured after ammonium salts till 1897

Very variable with season (mostly up to 20 percent)

Plots 1	Ammonium salts
2, 3, 12	Unmanured
4^1, 4^2	Super with and without ammonium salts
5^2	Minerals after ammonium salts till 1897
7, 8	Minerals with and without potash

Small (up to 11 percent)

Plots 6, 15	Minerals
10	Ammonium salts and minerals without potash
13	F.Y.M. and fish guano alternately
16, 17	Nitrate of soda with and without minerals
18	Ammonium salts and minerals without super
19, 20	F.Y.M. with or without minerals and nitrate of soda

Very small (under 1 percent)

Plots 9	Ammonium salts and minerals
11^1, 11^2	Heavy ammonium salts and minerals with and without silicate
14	Heavy nitrate of soda and minerals

Festuca rubra encouraged by:-

(a) Starved soils

(b) Minerals and light dressings of ammonium salts singly or in combination

(c) Organic manures

* The Festuca ovina of the early records of J.B. Lawes and J.H. Gilbert and later of W.E. Brenchley, now identified by Mr. C.E. Hubbard of the Herbarium, Kew as F.rubra.

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Festuca rubra not encouraged by:-

(a) Minerals and heavy dressings of nitrate of soda or ammonium salts

LIMED

QUANTITY

Considerably increased

Plots	4^2	Super and ammonium salts
	9, 10	Ammonium salts and minerals with or without potash
	14, 16 (particularly shade)	Minerals and nitrate of soda
	17	Nitrate of soda
	18 (HL)	Ammonium salts and minerals without super

Decreased

Plots	1	Ammonium salts
	3	Unmanured
	7, 8, 15	Minerals with and without potash
	13	F.Y.M. and fish guano alternately

Little affected

Plots	11^1, 11^2	Ammonium salts and minerals with and without silicate
	18 (LL)	Ammonium salts and minerals without super
	19, 20	F.Y.M. with and without minerals and nitrate of soda

Plots with Festuca rubra as the chief grass

	Unlimed	Limed	Plots with no limed area
1914	1,2,3,4^1,4^2,7,8,18,19,20	1,2,3,4^1,8,16	5^1,5^2,12
1919	4^2	-	5^1,5^2
1949	2,3,4^1	4^2,10,17	5^1,5^2,12

Festuca rubra in Plant Communities

UNLIMED

A prominent feature of many plant associations. Festuca - Agrostis - Anthoxanthum is characteristic of Plots 4^2 (Ammonium salts and super) and 5^1 (Unmanured after Ammonium salts).

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Its occurrence appears to bear little relation to the general balance of the three main groups of herbage, as it may be dominant where Gramineae, Leguminosae and Miscellaneous plants are well represented, and also where one or both of the latter groups are nearly or entirely suppressed.

LIMED

Association very varied as on the unlimed and dominance is affected by season. Ammonium salts and super (Plot 4^2) Festuca - Alopecurus - Poa pratensis.

FESTUCA PRATENSIS

Rarely seen on any plot and has decreased considerably both in distribution and quantity. At one time it was more plentiful on the limed sections, especially of Plots 7, 8 and also Plot 19 (HL).

HOLCUS LANATUS Fig. 18.

Occurs in samples from every plot, limed and unlimed. It is usually kept in check by its associates, but it tends to dominate the situation when conditions are less favourable to the other species. High nutrition, associated with soil acidity, gives it great encouragement.

UNLIMED

QUANTITY

Very large (up to 100 percent)

Plots 9, 11^1	Ammonium salts and minerals

Variable (mostly 20-74 percent)

Plots 10	Ammonium salts and minerals without potash
11^2	Ammonium salts and minerals with silicate

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Small (mostly under 10 percent)

Plots 2, 3, 12	Unmanured
4^1, 4^2	Super with and without ammonium salts
5^1, 5^2	Unmanured or minerals after ammonium salts till 1897
6, 16	Minerals with and without nitrate of soda (low N)
7, 8, 15	Minerals with and without potash
13	F.Y.M. and fish guano alternately
17	Nitrate of soda
18	Minerals without super and ammonium salts
19, 20	F.Y.M. with and without minerals and nitrate of soda

Almost or enitrely absent

Plots 1	Ammonium salts
14	Minerals and nitrate of soda (high N)

Holcus lanatus encouraged by:-

(a) Heavy dressings of ammonium salts and minerals

(b) Nitrate of soda alone

(c) Omission of potash

Holcus lanatus not encouraged by:-

(a) Starved soils

(b) Mineral manures, alone or in combination with nitrogenous fertilizer other than heavy dressings of ammonium salts

Suppressed by:-

(a) Ammonium salts alone

(b) Heavy nitrate of soda and aminerals

LIMED

QUANTITY

Increased

Plot 1	Ammonium salts

Decreased

Plots 7, 8	Minerals with and without potash
19 (HL)	F.Y.M. after minerals and nitrate of soda

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Considerably decreased

Plots 9, 10	Minerals and ammonium salts
11^1, 11^2	Minerals and heavy ammonium salts with and without silicate
17	Nitrate of soda

Little or variably affected

Plots 2, 3, 4^1, 4^2, 13, 14, 15, 16, 18, 19LL, 20.

Plots with Holcus lanatus among the three chief grasses

	Unlimed			Limed		
	First	Second	Third	First	Second	Third
1914	11^1,11^2	8	4^1,13,20	11^1	-	2, 4^1, 13
1919	1,2,3,8,11^1	9,17	4^1, 11^2,	-	4^1	1, 2, 3, 11^1
1948 or 1949	9, 11^1, 11^2	10	4^2, 8	-	-	4^1, 11^1

On plots with highly acid soils and a good supply of plant nutrients, liming has caused a very great decrease in Holcus lanatus viz. 90.6-2.5 percent (Plot 9, 1948) and 81.7-7.6 and 40.8-2.4 percent (Plots 11^1 and 11^2 respectively, 1947). The effect of lime on plots of medium or low acidity is much smaller.

Holcus lanatus in Plant Communities

UNLIMED

(a) Ammonium salts and minerals (Plots 9, 10); Holcus - Anthoxanthum - Agrostis with the latter two usually almost absent on Plot 9.

(b) Heavy ammonium salts and minerals (Plots 11^1, 11^2); Holcus - Agrostis with Arrhenatherum also on Pplot 11^2

The other associations in which Holcus occurs are both very varied in composition, and also influenced by season.

LIMED

Most of the associations are varied and variable, even on Plots 11^1 and 11^2 where Holcus, usually plentiful, may be greatly reduced in some seasons.

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LOLIUM PERENNE

Very small amounts often occur on Plots 8, 17 and 20 although formerly this species was found on most plots in fair quantity.

POA PRATENSIS Fig. 19.

Present on most plots and is tenacious of its position in spite of the very small amounts that usually occur. It is not much affected by manuring, but is considerably increased by lime.

UNLIMED

QUANTITY

Small (up to 6 percent)

Plots	5^2	Minerals after ammonium salts till 1897
	7, 14, 15	Minerals with and without heavy nitrate of soda

Very small (usually under 1 per cent)

All other plots, but usually absent on Plots 9 and 10.

LIMED

QUANTITY

Much increased

Plots	4^2	Super and ammonium salts
	9, 10	Ammonium salts and minerals with and without potash
	11^1, 11^2	Heavy ammonium salts and minerals with and without silicate

Increased

Plots	1	Ammonium salts
	2, 3	Unmanured
	13	F.Y.M. and fish guano alternately

Little affected

Plots 4^1, 7, 8, 14, 15, 16, 17, 18, 19, 20.

Poa pratensis in Plant Communities

UNLIMED

An insignificant member of all associations except occasionally on Plot 14 where it may be quite prominent.

LIMED

Insignificant except on the following plots:-

(a) Super and ammonium salts (Plot 4^2); Alopecurus - Festuca rubra - Poa pratensis - Anthoxanthum.

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(b) Minerals and ammonium salts (Plots 9, 10); Alopecurus - Arrhenatherum - Poa pratensis with Anthoxanthum and Dactylis (Plot 9) or Festuca rubra (Plot 10).

(c) Minerals and heavy ammonium salts (Plots 11^1, 11^2); Alopecurus - Poa pratensis - with Arrhenatherum, Dactylis and Holcus.

POA TRIVIALIS

UNLIMED

Present in very small amounts.

QUANTITY

Small (usually under 1 percent)

Plots 14, 16	Minerals and nitrate of soda (9.8 percent on Plot 14 in 1940)

Very small (under 0.9 percent)

Plots 4^1	Super
6, 7, 8, 15	Minerals with and without potash
13	F.Y.M. and fish guano alternately
17	Nitrate of soda
19, 20	F.Y.M. with and without nitrate of soda and minerals

Almost or entirely absent

Plots 1, 2, 3, 4^2, 5^1, 5^2, 9, 10, 11^1, 11^2, 18.

LIMED

QUANTITY

Increased (sometimes considerably)

Plot 7	Minerals

Increased

Plot 1	Ammonium salts
2, 3	Unmanured
8, 15	Minerals without and with potash
13, 19, 20	F.Y.M. with and without minerals and nitrate of soda
14(sun), 16	Nitrate of soda and minerals
17	Nitrate of soda

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Little or unaffected

Plots 4^1, 4^2, 9, 10, 11^1, 11^2, 18.

Even where liming causes a considerable increase, the amount may remain very small.

Poa trivialis in Plant Communities

Formerly an insignificant member of all associations in which it occurred, but now of some importance on the limed sections.

B. LEGUMINOSAE

LATHYRUS PRATENSIS

Abundant on certain plots, particularly those receiving mineral manures. On most other plots very little is present. The effect of lime varies with the manuring.

UNLIMED

QUANTITY

Sometimes large (up to 34 percent)

Plots 6, 7, 15	Minerals
5^2	Minerals after ammonium salts till 1897
16	Minerals and nitrate of soda (low N)

Medium (up to 13 percent)

Plots 14	Minerals and nitrate of soda (high N)
19, 20	F.Y.M. with and without minerals and nitrate of soda

Very small

Plots 2, 3, 12	Unmanured
4^1	Super
8	Minerals without potash
13	F.Y.M. and fish guano alternately

Almost or entirely absent

Plots 1, 4^2, 5^1, 9, 10, 11^1, 11^2, 17, 18.

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Lathyrus pratensis encouraged by:-

(a) Minerals, alone or with nitrate of soda
(b) Occasional dressings of organic manures

Lathyrus pratensis not encouraged by:-

(a) Starved soils
(b) Ammonium salts alone or with minerals
(c) Nitrate of soda alone

LIMED

QUANTITY

Considerably increased

Plots 1, 9	Ammonium salts with and without minerals
13	F.Y.M. and fish guano alternately
14	Minerals and nitrate of soda (high N)

Slightly increased

Plots 2, 3	Unmanured
4^1	Super

Decreased

Plots 7	Minerals
16	Minerals and nitrate of soda (low N)

Little affected

Plots 4^2, 8, 10, 11^1, 11^2, 15, 17, 18, 19, 20.

Plots with Lathyrus pratensis among the three chief species of the whole herbage.

	Unlimed			Limed		
	First	Second	Third	First	Second	Third
1914	15	6, 7, 16	-	7	-	4^1
1919	-	-	6, 7	7	-	-
1948 or	5^2, 6, 15, 19	-	16, 7	7	15	-

Lathyrus pratensis in Plant Communities

UNLIMED

(a) Complete minerals or occasional dressings of organic manure.
(Plots 5^2, 6, 7, 15, 19, 20); Festuca rubra - Lathyrus - Dactylis - Agrostis, often with Anthoxanthum - Arrhenatherum - Holcus - Alopecurus.

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(b) Minerals and nitrate of soda (Plots 14, 16); Lathyrus - Alopecurus Arrhenatherum - Dactylis with Taraxacum - Plantago and occasionally Anthriscus.

LIMED

(a) Minerals with and without ammonium salts (Plots 7, 9); Dactylis - Alopecurus - Arrhenatherum - Lathyrus, with Trifolium repens on Plot 7 and Anthoxanthum on Plot 9.

(b) F.Y.M. and fish guano (Plot 13); Alopecurus- Arrhenatherum - Dactylis - Lathyrus - Plantago.

(c) Minerals and heavy nitrate of soda (Plot 14); Arrhenatherum - Alopecurus - Dactylis - Lathyrus.

(d) Minerals alone (Plot 15); Arrhenatherum - Avena pubescens - Festuca rubra - Lathyrus with Trifolium repens - Plantago.

LOTUS CORNICULATUS

Low growing and usually late flowering, so is probably more abundant than appears from the hay analyses. It was particularly noticeable in August 1921 after the prolonged drought, and in June 1929, 1930, 1934, 1939 and 1945.

UNLIMED

QUANTITY

Large	(up to 9 percent)	
Plots	2, 3, 12	Unmanured
Medium	(up to 5 percent)	
Plots	4^1	Super
	5^1, 5^2	Unmanured or minerals after ammonium salts till 1897
	6, 7, 8	Minerals with and without potash
	19.	F.Y.M. after minerals and nitrate of soda

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Almost or entirely absent

Plots 1, 4^2, 9, 10, 11^1, 11^2, 13, 14, 15, 16, 17, 18, 20.

Lotus corniculatus encouraged by:-

(a) Starved soils

(b) Minerals

Lotus corniculatus usually suppressed by:-

(a) Nitrogenous manures with minerals

(b) Frequent organic manuring

LIMED

QUANTITY

Considerably increased

Plots	3	Unmanured
	4^1	Super
	8	Minerals without potash
	17	Nitrate of soda

Increased

Plots	1	Ammonium salts
	19 (HL)	F.Y.M. after minerals and nitrate of soda

Decreased

Plot	7	Minerals

Lotus corniculatus in Plant Communities

Not usually a significant species, except in the very mixed associations on the plots receiving no manure or incomplete minerals.

ONONIS ARVENSIS (O. repens).

Occurs in small quantity on Plot 4^1 Unlimed (Super).

TRIFOLIUM PRATENSE

Owing to its low growth, it does not always appear in representative quantity in the hay samples, especially when the season is unfavourable.

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UNLIMED

QUANTITY

Often large (up to 18 percent)

Plots	6, 7, 8	Minerals with and without potash

Medium

Plots	2, 3, 12	Unmanured

Small

Plots	4^1	Super
	5^2	Minerals after ammonium salts till 1897
	15, 16	Minerals with and without nitrate of soda

Trace or absent

Plots 1, 4^2, 5^1, 9, 10, 11^2, 13, 14, 17, 18, 19, 20.

Trifolium pratense encouraged by:-

(a) Minerals
(b) Starved soils

Trifolium pratense almost or entirely suppressed by:-

(a) Ammonium salts
(b) Heavy organic manures
(c) Heavy dressings of sodium nitrate

LIMED

Effect variable; quantity usually increased, but little changed on Plot 8 (Minerals without Potash) where it is already plentiful.

Trifolium pratense in Plant Communities

Not a significant member of any association, except on plots receiving minerals only without lime.

UNLIMED

(a) Complete minerals (Plots 6 and 7); Dactylis - Lathyrus - Trifolium pratense - Plantago - Rumex with Anthoxanthum and Achillea; Lotus and Conopodium in addition on Plot 6.

(b) Minerals without potash (Plot 8); Dactylis - Arrhenatherum - Festuca rubra - Holcus - Trifolium pratense - Plantago - Rumex.

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TRIFOLIUM REPENS

Owing to its low growth and late development it does not appear in representative quantity in the hay samples.

UNLIMED

QUANTITY

Relatively large (up to 3.9 percent)

Plots	7, 8, 15	Minerals with and without potash
	19	F.Y.M. after minerals and nitrate of soda

Absent

Plots 4^2, 5^1, 9, 10, 11^1, 11^2, 13, 14, 18.

Traces on all other plots.

LIMED

QUANTITY

Increased

Plots	7, 15	Minerals
	20 (LL)	F.Y.M. with minerals and nitrate of soda

Little affected

All other plots.

VICIA SEPIUM

Occurs in small quantity on the unlimed sections of Plots 6 and 7 and occasionally on the limed area of Plot 7.

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C. MISCELLANEOUS SPECIES

ACHILLEA MILLEFOLIUM

UNLIMED

QUANTITY

Fairly large (up to 14 percent)

Plots	6, 7, 8, 15	Minerals with and without potash
	19	F.Y.M. after minerals and nitrate of soda

Small (up to 4 percent)

All other plots except:- 4^2, 9, 10, 11^1, 11^2 where absent.

Achillea millefolium encouraged by:-

(a) Minerals
(b) F.Y.M.

Achillea millefolium discouraged by:-

(a) Ammonium salts

LIMED

Achillea is decreased by liming, except on Plots 1 and 17 where there is a slight increase, and Plots 11^1, 19 and 20 where no change occurs.

AGRIMONIA EUPATORIA

Has become more plentiful since 1919, particularly on the limed half of Plot 8 (minerals without potash). Owing to its late development little appears in the hay samples and the following data are based on field observations in September for the ten years 1940-1949.

UNLIMED

Recorded in flower

Almost every year

Plots	2, 3, 12	Unmanured

In 3 seasons

Plots	4^1	Super
	8	Minerals without potash

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In 1 or 2 seasons

Plots	1	Ammonium salts
	4^2	Super and ammonium salts
	5^1	Unmanured after ammonium salts till 1897
	18	Ammonium salts and minerals without super
	19	F.Y.M. after minerals and nitrate of soda

LIMED

Recorded in flower

Almost every year

Plots	1	Ammonium salts
	2, 3	Unmanured
	4^1	Super
	8	Minerals without potash (usually rated plentiful)
	18	Ammonium salts and minerals without super
	19	F.Y.M. after minerals and nitrate of soda

In 3 or 4 seasons

Plots	7	Minerals
	16	Minerals and nitrate of soda

In 1 or 2 seasons

Plots	13	F.Y.M. and fish guano alternately
	17	Nitrate of soda
	15	Minerals

AJUGA REPTANS

Little appears in the hay samples, but it is a regular feature on the plots receiving no manure (2, 3, 5^1, 12), nitrate of soda (17) and F.Y.M. with and without minerals (13, 19, 20) and to a less extent super (4^1) and minerals without potash (8). The addition of lime has no marked influence on its distribution or quantity, except on Plot 1 (ammonium salts alone) where a small amount of Ajuga is introduced.

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ANTHRISCUS SYLVESTRIS

UNLIMED

QUANTITY

Small (up to 5 percent)

Plots 14, 16	Nitrate of soda and minerals

Trace

Plot 20	F.Y.M., minerals and nitrate of soda

Absent

All other plots

LIMED

QUANTITY

Increased

Plots 16	Nitrate of soda and minerals
13	F.Y.M. and fish guano alternately

Introduced

Plots 7, 9	Minerals with and without ammonium salts

Absent

All other plots

CAREX PRAECOX (C.caryophyllea)

UNLIMED

QUANTITY

Appreciable (up to 1.7 percent)

Plots 3	Unmanured
17	Nitrate of soda

Trace

Plot 8	Minerals without potash

Absent

All other plots

LIMED

Up to 0.3 percent on Plot 3 and a trace on Plot 8 otherwise absent.

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CENTAUREA NIGRA

Centaurea nigra is encouraged by one-sided manuring whether nitrogenous or mineral but suppressed when both are applied together. Its response to lime varies.

UNLIMED

QUANTITY

Medium (up to 8 percent)

Plots	3, 5[1]	Unmanured
	4[1]	Super
	6, 7, 8	Minerals with and without potash
	17	Nitrate of soda

Small (under 1 percent)

Plots	1	Ammonium salts
	13, 19	F.Y.M.
	15	Minerals

Absent

All other plots, except for traces on Plot 10.

Centaurea nigra encouraged by:-

(a) Starved soils

(b) Nitrogenous manures or mineral manures alone

Centaurea nigra almost or entirely suppressed by:-

(a) Nitrogenous and mineral manures applied together

(b) Organic manures

LIMED

QUANTITY

Increased

Plots	1	Ammonium salts
	13, 19, 20	F.Y.M. with and without nitrate of soda and minerals
	18	Ammonium salts and minerals without super

Decreased

Plots	7, 15	Minerals
	17	Nitrate of soda

Little or unaffected

Plots 3, 4[1], 8, 14.

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Centaurea nigra in Plant Communities

Occurs in the very mixed association of plots receiving no manure or incomplete fertilizers. It is seldom found on well manured soils.

CERASTIUM VULGATUM

UNLIMED

Present in small quantity on most plots, except those receiving ammonium salts or nitrate of soda, with or without minerals.

LIMED

Quantity usually slightly increased.

CONOPODIUM DENUDATUM (C.majus)

Very variable with season and has ranged from 1-10 percent. As it flowers and dies down early it is probably more abundant than is indicated by the hay analyses.

UNLIMED

QUANTITY

Medium (usually over 5 percent)

Plots	2, 3, 12	Unmanured
	6, 7	Minerals

Small (usually under 2 percent)

Plots	1, 4^1	Ammonium salts with and without super
	5^1, 5^2	Unmanured or minerals after ammonium salts till 1897
	8, 15	Minerals with and without potash
	13	F.Y.M. and fish guano alternately
	16	Minerals and nitrate of soda (low N)
	17	Nitrate of soda
	19, 20	F.Y.M. with and without minerals and nitrate of soda

Almost or entirely absent

Plots	4^2, 9, 10, 11^1, 11^2, 18	Ammonium salts and minerals with and without super
	14	Minerals and nitrate of soda (high N)

Conopodium denudatum encouraged by:-

(a) Starved soils
(b) Minerals

Conopodium denudatum discouraged by:-

(a) Ammonium salts
(b) Heavy nitrate of soda and minerals

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LIMED

QUANTITY

Decreased

Plots	2, 3	Unmanured
	7, 8	Minerals with and without potash
	13	F.Y.M. and fish guano alternately

Little affected

All other plots

Conopodium denudatum in Plant Communities

Occasionally conspicuous in the varied associations on the unmanured and mineral plots.

EPILOBIUM ANGUSTIFOLIUM (Chamaenerion angustifolium)

Appears occasionally on the unlimed sections only*. In 1947 it was unusually plentiful on the following plots, all of which receive ammonium salts.

Plot 1	Ammonium salts alone	Trace
4^2	" " " and super	0.8 percent
9	" " and minerals	1.7 " "
11^1	" " (heavy) and minerals	11.9 " "

GALIUM VERUM

Occurs in some seasons in very small quantities on most plots, except those receiving ammonium salts and minerals.

---

* The source of invasion is adjacent to the unlimed sections which increases the chance of colonization on these areas. The inhibiting effect of lime on establishment, however, appears to be real and compares with that of sodium silicate (See p.12).

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HERACLEUM SPHONDYLIUM

Has greatly increased on certain plots since 1924.

UNLIMED

QUANTITY

Fairly plentiful

Plots 6, 7	Minerals (up to 4 percent on Plot 7)

Small, often absent

Plots 9,	Minerals and ammonium salts; (0.4 percent)
13, 19	F.Y.M. (1.3 percent; Plot 13)
14	Minerals and heavy nitrate of soda; (up to 1.0 percent)

Traces

Plots 5^2, 8, 10, 16, 17, 20.

Absent

All other plots.

LIMED

QUANTITY

Greatly increased

Plots 7, 9	Minerals with and without ammonium salts

Increased

Plot 19	F.Y.M. after minerals and nitrate of soda

Introduced

Plot 11^2	Ammonium salts, minerals and silicate of soda
15, 16	Minerals with and without nitrate of soda
18	Ammonium salts and minerals without super

HIERACIUM PILOSELLA

Has become more plentiful and may be important on Plot 5^1 (unmanured after ammonium salts till 1897). It occurs to some extent also on the following plots including any limed areas:-

Plots 2, 3, 12	Unmanured
4^1	Super
5^2	Minerals after ammonium salts till 1897
8	Minerals without potash

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HYPOCHAERIS RADICATA

Has increased in distribution, and now occurs to some extent on all plots except:-

Plots	1	Ammonium salts
	4^1	Super
	10, 11^1, 11^2	Ammonium salts and minerals with and without silicate
	16	Minerals and nitrate of soda
	18	Ammonium salts and minerals without super
	19, 20	F.Y.M. with and without minerals and nitrate of soda

LEONTODON AUTUMNALIS

Late flowering, so no figures from hay analyses are available. The following data are from observations made in September, 1946-1949.

UNLIMED

QUANTITY

Abundant

Plots	4^1	Super
	8, 15	Minerals with and without potash
	17	Nitrate of soda

Plentiful

Plots	3	Unmanured
	16	Minerals and nitrate of soda (low N)

Small

Plots	2, 12	Unmanured
	5^2	Minerals afer ammonium salts till 1897
	6, 7	Minerals
	13	F.Y.M. and fish guano alternately
	14	Minerals and nitrate of soda (high N)
	20	F.Y.M. minerals and nitrate of soda

Absent

All other plots.

LIMED

In general the quantity is reduced by lime.

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QUANTITY

Plentiful

Plot 17	Nitrate of soda

Small

Plots 1	Ammonium salts
2	Unmanured
7, 8, 15	Minerals with and without potash
10	Ammonium salts and minerals without potash
13, 19	F.Y.M. with and without fish guano
18	Ammonium salts and minerals without super

LEONTODON HISPIDUS Fig. 20.

Abundant on a few plots, but traces may occur on most others.

UNLIMED

QUANTITY

Fairly large (up to 18 percent)

Plots 2, 3, 12	Unmanured
4^1	Super
8	Minerals without potash
17	Nitrate of soda

Small (0.1-1.9 percent)

Plots 5^1	Unmanured after ammonium salts till 1897
6, 7	Minerals
13	F.Y.M. and fish guano alternately
19	F.Y.M. after minerals and nitrate of soda

Occasional traces

Plots 1, 5^2, 9, 10, 11^1, 14, 18, 20.

Absent

All other plots.

Leontodon hispidus encouraged by:-

(a) Starved soils

(b) Super

Leontodon hispidus discouraged by:-

(a) Most forms of good or medium manuring

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LIMED

QUANTITY

Slightly increased or little changed

Plots	1	Ammonium salts
	4^1	Super
	13	F.Y.M. and fish guano alternately

Decreased

Plots	2, 3	Unmanured
	17	Nitrate of soda

Plots with Leontodin hispidus among the three chief species of the whole herbage.

	Unlimed			Limed		
	First	Second	Third	First	Second	Third
1914	-	2, 3, 4^1	-	-	-	2
1948 or 1949	2, 4^1, 3	12	-	-	3	-

Leontodon hispidus in plant communities

UNLIMED

A characteristic of the association on the plots with no manure, super and minerals without potash (2, 3, 12, 4^1, 8). Festuca rubra - Agrostis - Dactylis - Holcus - Anthoxanthum - Briza, Trifolium pratense - Leontodon - Plantago - Rumex - (Little or no Agrostis on Plot 4^1 and little Briza on Plot 8).

LIMED

Characteristic of the same plots as the unlimed areas, but in somewhat different association. viz. Dactylis - Avena pubescens - Holcus - Briza - Trifolium pratense - Leontodon - Plantago - Centaurea. (Often much Poterium on Plot 3 and Scabiosa on Plot 8).

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LINUM CATHARTICUM

Rarely if ever appears in the hay samples. On the unlimed areas it occurs only on Plots 2 and 3 (unmanured), but it is a regular feature on the limed halves of both these plots and also of Plot 4^1 (super) and to a less extent of Plot 1 (ammonium salts).

LUZULA CAMPESTRIS

Has increased since 1914.

UNLIMED

QUANTITY

Variable (mostly below 1 percent)

Plots	1	Ammonium salts
	2, 3, 12	Unmanured
	5^1, 5^2	Unmanured or minerals after ammonium salts till 1897
	6, 7, 8, 15	Minerals with and without potash
	17	Nitrate of soda

Traces

Plots 4^1, 9, 11^1, 11^2, 13, 18, 19.

Absent

Plots 4^2, 10, 14, 16, 20.

LIMED

Little general change in quantity, but decreased on Plots 7, 8 and 15.

PIMPINELLA SAXIFRAGA

Owing to its late development, very little appears in the hay samples and it is more plentiful, especially on the plots receiving no manure or minerals, than the analytical figures indicate. Probably increased by lime.

PLANTAGO LANCEOLATA Fig. 21.

Plantago lanceolata is chiefly associated with poor exhausted soils and may be very plentiful in some seasons. The effect of lime varies with the manuring.

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UNLIMED

QUANTITY

Large (may reach 33 percent)

Plots	2, 3, 12	Unmanured
	4^1	Super
	8	Minerals without potash
	13	F.Y.M. and fish guano alternately
	17	Nitrate of soda
	19	F.Y.M. after minerals and nitrate of soda

Variable (up to 6.5 percent)

Plots	6, 7, 15	Minerals
	20	F.Y.M.,minerals and nitrate of soda

Absent or occasional traces

Plots $1, 4^2, 5^1, 5^2, 9, 10, 11^1, 11^2, 14, 16, 18.$

Plantago lanceolata encouraged by:-

(a) Starved or exhausted soils
(b) Nitrate of soda alone
(c) F.Y.M., with and without fish guano

Plantago lanceolata almost or entirely suppressed by:-

(a) Ammonium salts with minerals
(b) Nitrate of soda with minerals
(c) Unmanured or minerals after ammonium salts

LIMED

QUANTITY

Increased

Plots	1	Ammonium salts
	13	F.Y.M. and fish guano alternately
	15	Minerals
	18	Minerals without super and ammonium salts
	20	F.Y.M., minerals and nitrate of soda

Decreased

Plots	7, 8	Minerals with and without potash
	14, 16	Nitrate of soda and minerals

Effect variable

Plots	2, 3	Unmanured
	4^1	Super

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Unaffected

Plots	17	Nitrate of soda
	19	F.Y.M. after minerals and nitrate of soda

Plantago lanceolata in plant communities

Generally characteristic of the various associations on the poorer soils, although it is also conspicuous on the plot receiving F.Y.M. and fish guano. It may show a connection with Briza and Leotodon hispidus.

Plots with Plantago lanceolata among the three chief species of the whole herbage.

	Unlimed			Limed		
	First	Second	Third	First	Second	Third
1914	-	-	8, 17	-	-	-
1919	2, 3, 4^1, 8, 17	-	-	-	2, 3, 4^1	8
1948 or 1949	8, 13	-	4^1	1	3, 4^1, 8	13

POTENTILLA REPTANS

Occurs occasionally. A characteristic feature of Plot 1 (ammonium salts alone).

UNLIMED

QUANTITY

Small

Plots	1	Ammonium salts (1.9 percent in 1948)
	3	Unmanured (0.3 percent in 1948)

Trace

Plot	13	F.Y.M. and fish guano alternately

LIMED

Almost absent. [0.1 percent on Plot 1 (ammonium salts) and a trace on Plot 3 (unmanured) in 1948].

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POTERIUM SANGUISORBA

Poterium sanguisorba is usually regarded as a calcareous plant and the quantity occurring on the unlimed plots is unexpected.

UNLIMED

QUANTITY

Large clumps

Plots 2, 3, 4^1 — Unmanured (18 percent, 1938) Super

Traces

Plots 5^1, 8, 10, 14.

LIMED

QUANTITY

Large clumps

Plots 2, 3, 4^1 — Unmanured (13 percent, 1947) Super

Traces

Plots 8, 10.

PRIMULA VERIS

Seldom represented in the hay samples.

UNLIMED

QUANTITY

Present

Plots 2, 3, 12 — Unmanured (especially Plot 12)

Occasional

Plot 4^1 — Super

LIMED

Seldom recorded. Originally present on Plots 7, 8, 13, 15 and 19 but has now disappeared.

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Fig.4.

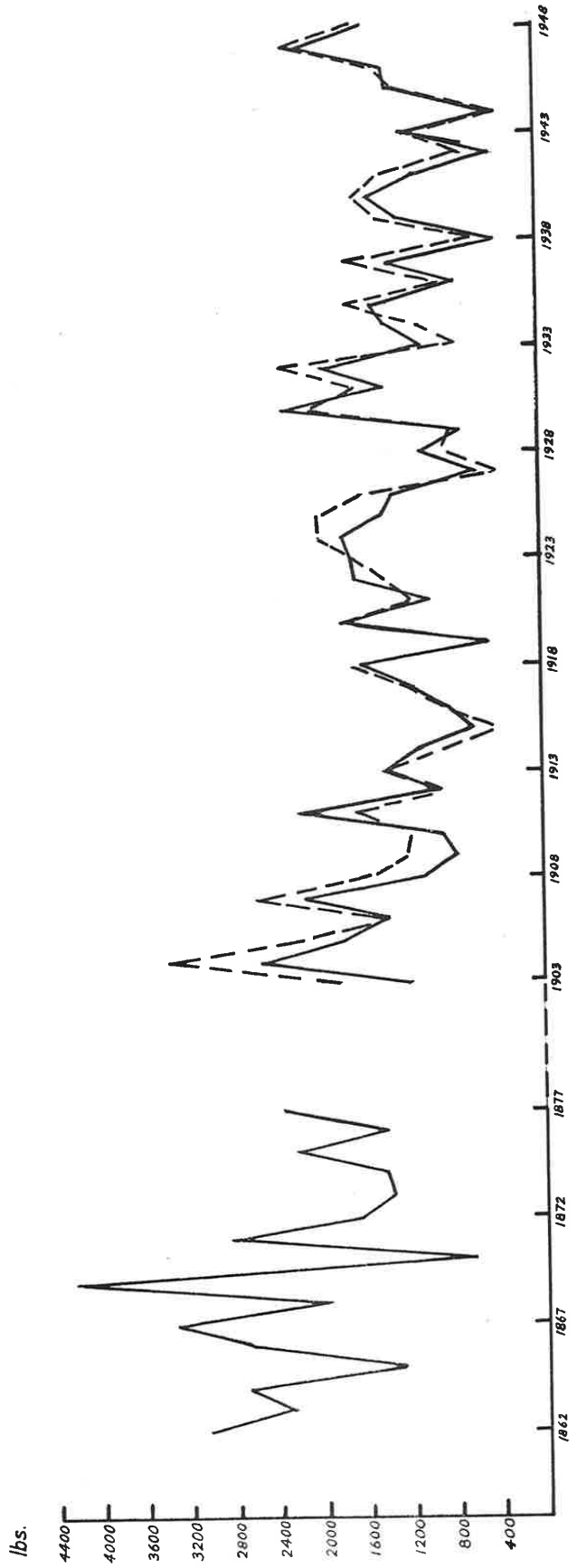

Fig. 4. YIELD (lb. per acre 1st crop) PLOT 3.——Unlimed-----Limed

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Fig. 5.

Fig. 5. YIELD (lb. per acre 1st crop) PLOT 5. showing effect of change in manuring in 1897

..... 1862 – 1897 Ammonium salts _____ 1898 – 1947

Unmanured (PLOT 5¹). - - - - - - - 1898 – 1947 Minerals (PLOT 5²).

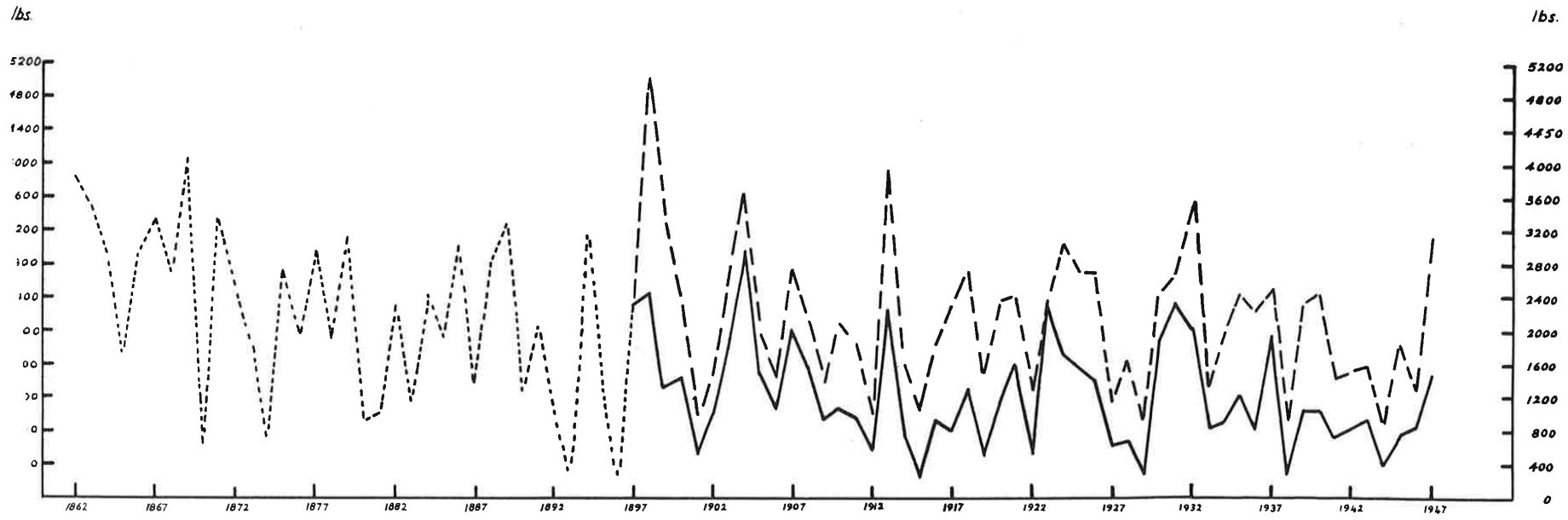

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Fig.6.

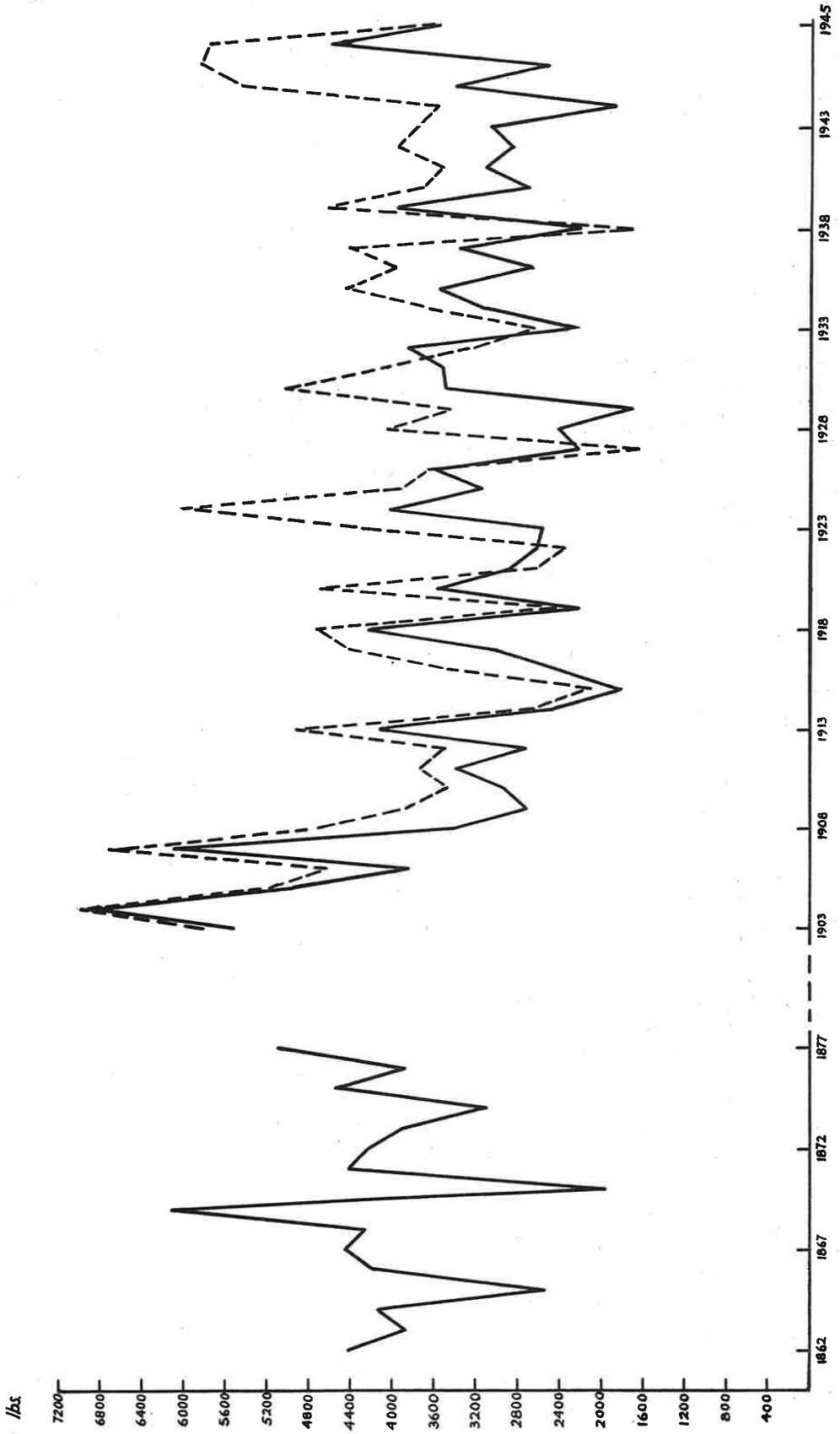

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Fig.7.

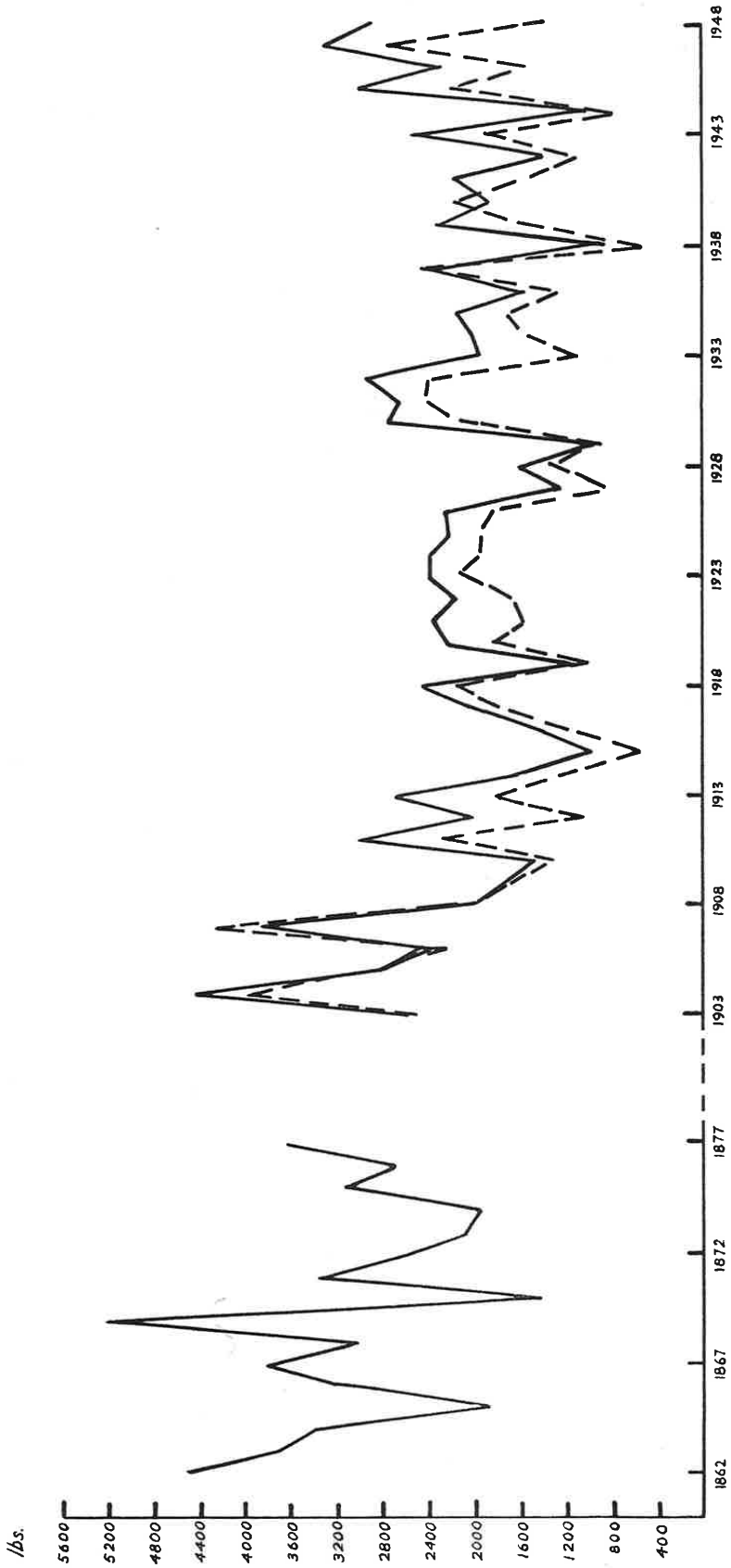

Fig. 7. YIELD (lb. per acre 1st crop) Plot 8. ———Unlimed - - - - Limed

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Fig.8.

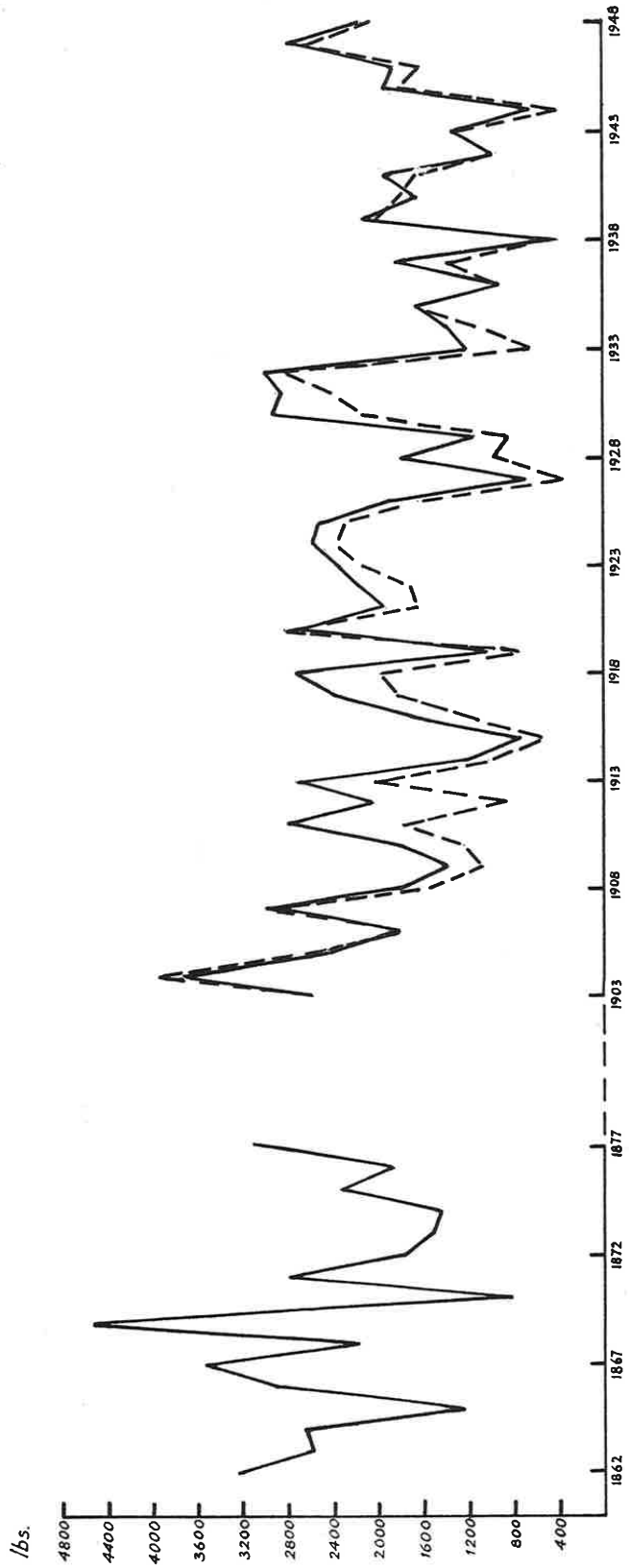

Fig. 8. YIELD (lb. per acre 1st crop) PLOT 4¹ ——— Unlimed - - - - Limed

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Fig.9.

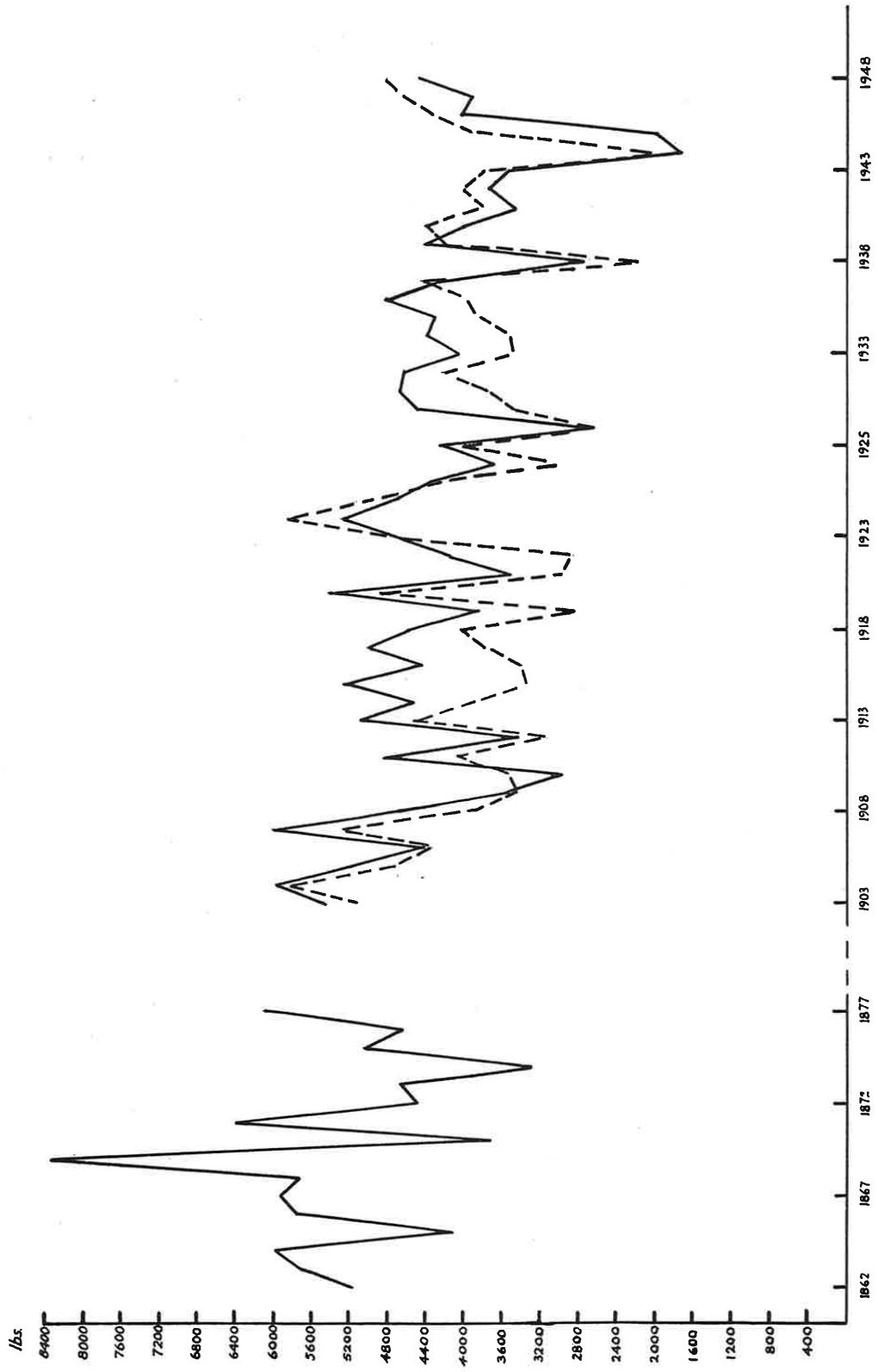

Fig. 9. YIELD (lb. per acre 1st crop) PLOT 16 ——— Unlimed - - - - Limed

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Fig. 10.

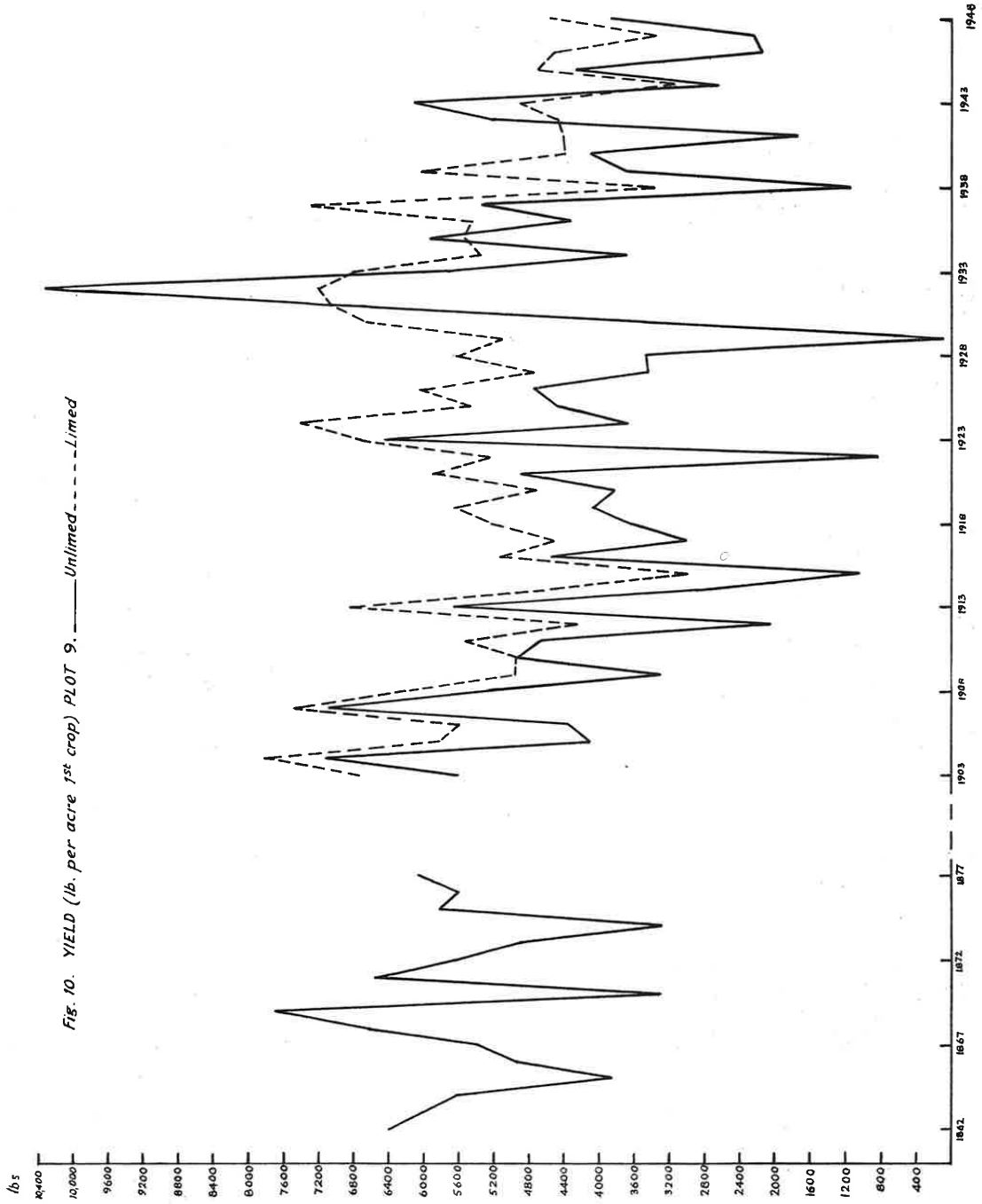

Fig. 10. YIELD (lb. per acre 1st crop) PLOT 9. ——— Unlimed - - - - Limed

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Fig. 11.

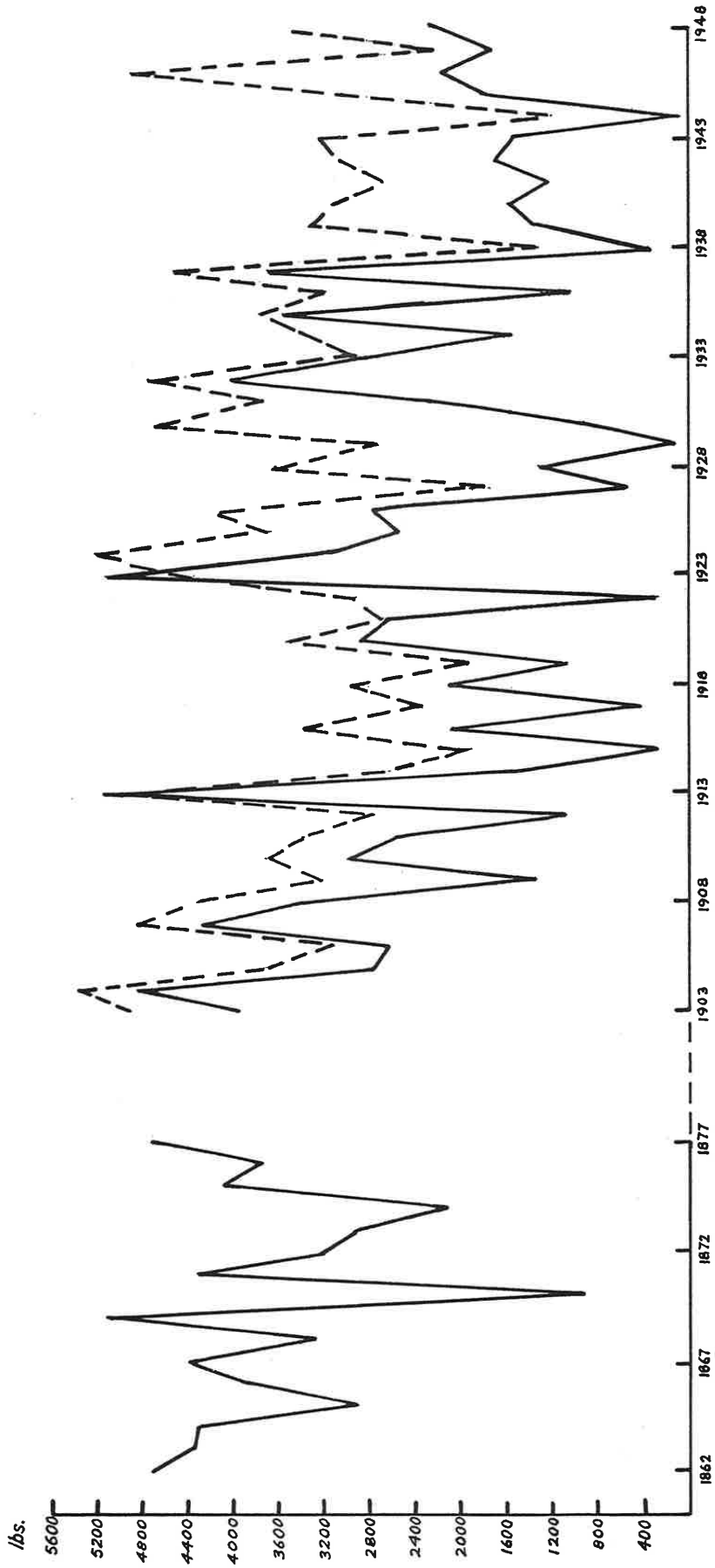

Fig. 11. YIELD (lb. per acre 1st crop) PLOT 4². _____ Unlimed - - - - - - Limed

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Fig. 12.

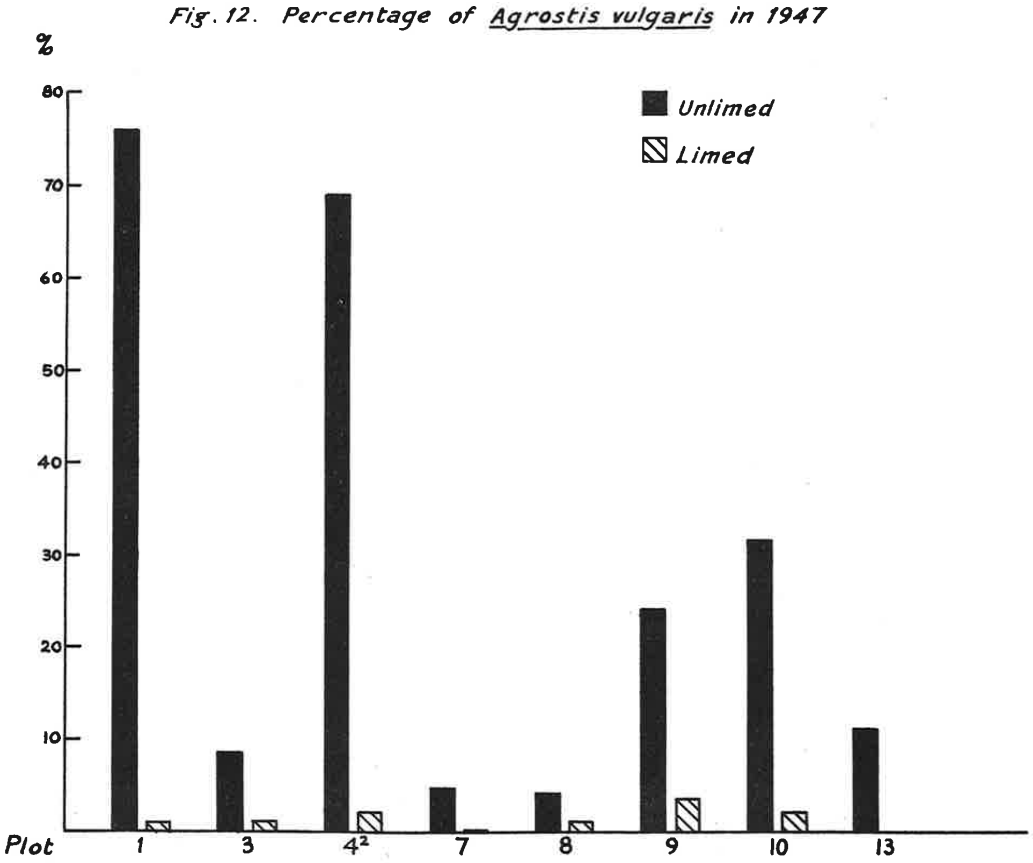

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Fig. 13.

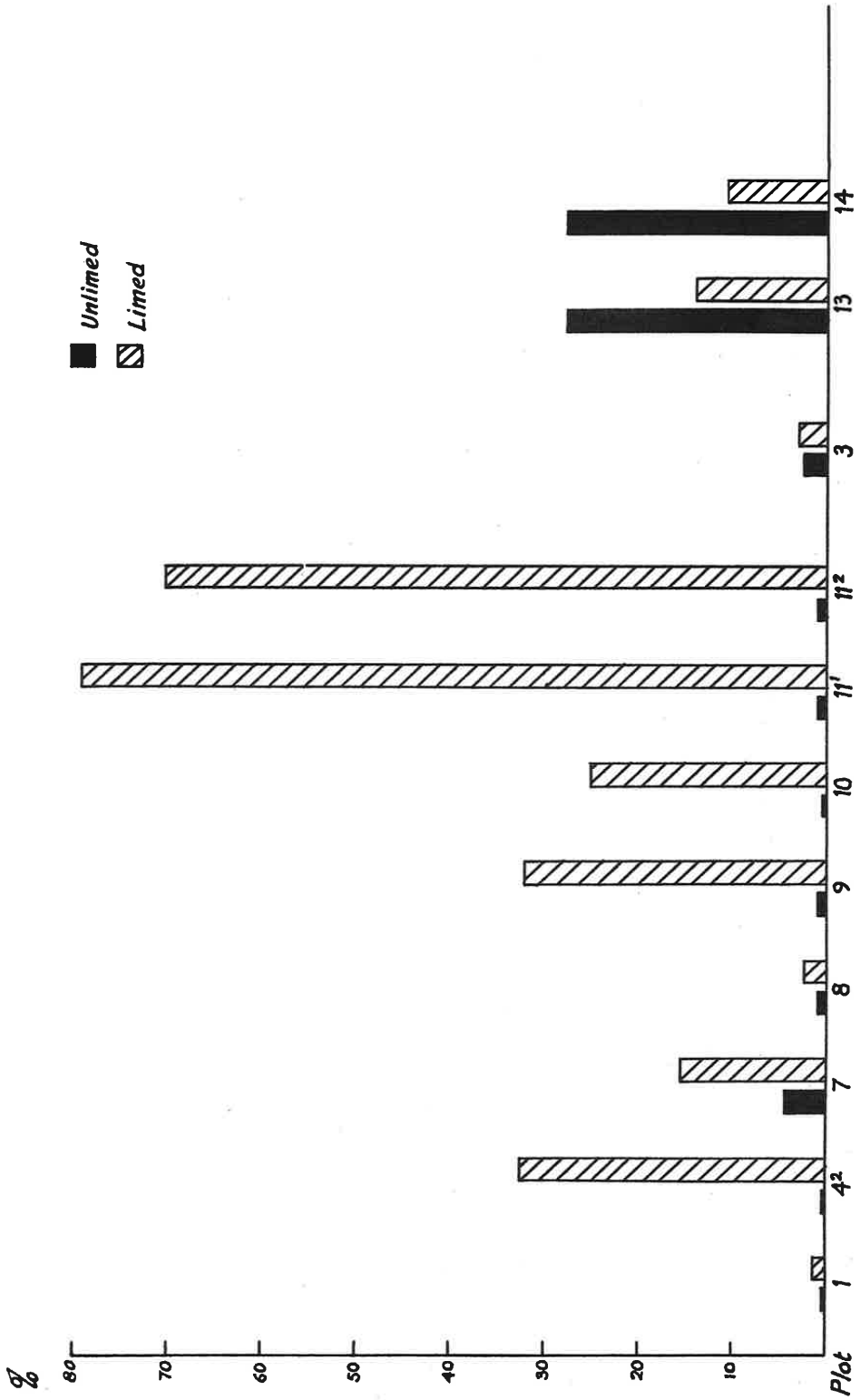

Fig. 13. Percentage of Alopecurus pratensis in 1947

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Fig. 14.

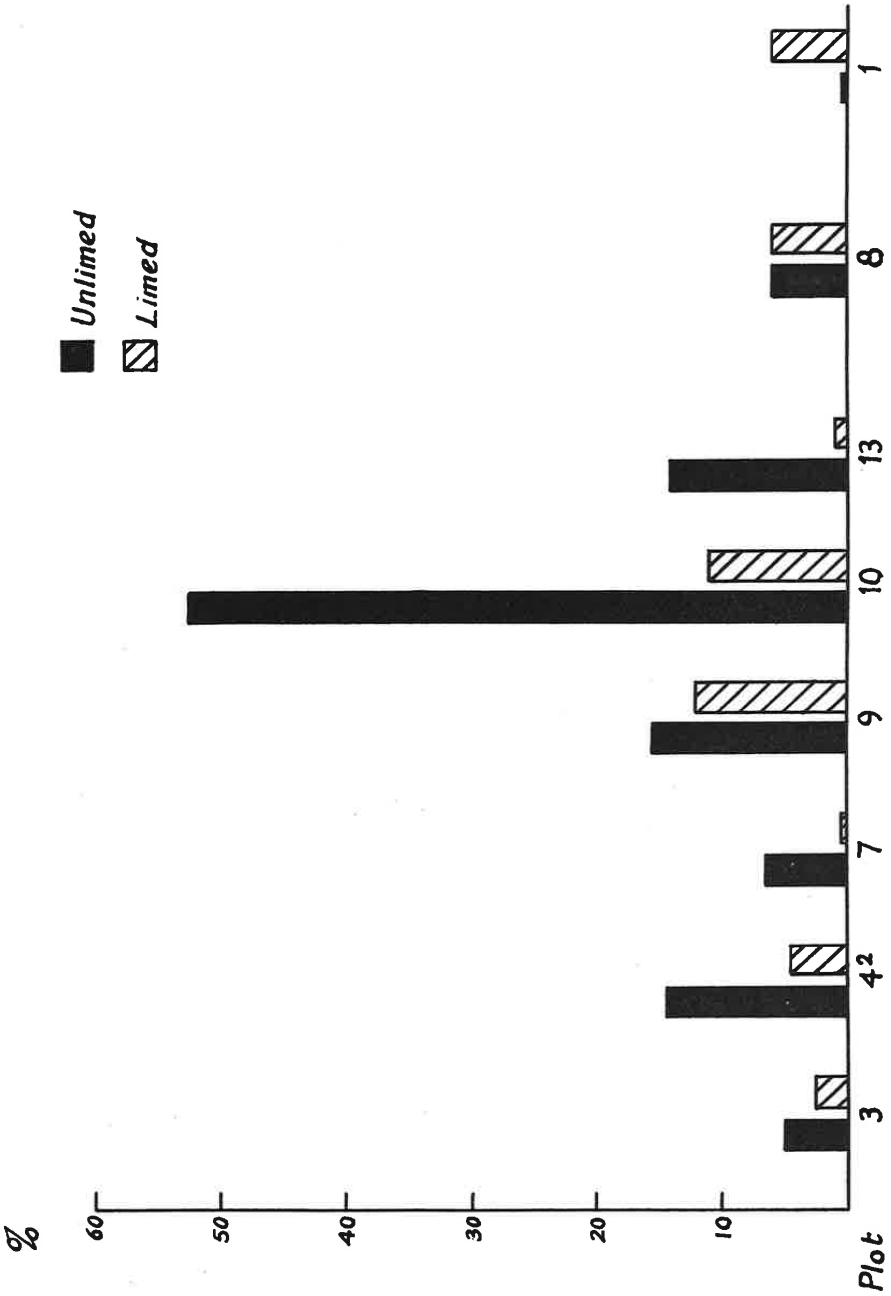

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Fig. 7. Yield (lb. per acre 1st crop) Plot 8, unlimed and limed
8. Yield (lb. per acre 1st crop) Plot 4^1, unlimed and limed
9. Yield (lb. per acre 1st crop) Plot 16, unlimed and limed
10. Yield (lb. per acre 1st crop) Plot 9, unlimed and limed
11. Yield (lb. per acre 1st crop) Plot 4^2, unlimed and limed
12. Percentage of Agrostis vulgaris in 1947
13. Percentage of Alopecurus pratensis in 1947
14. Percentage of Anthoxanthum odoratum in 1947
15. Percentage of Arrhenatherum avenaceum in 1947
16. Percentage of Avena pubescens in 1947
17. Percentage of Festuca rubra in 1947
18. Percentage of Holcus lanatus in 1947
19. Percentage of Poa pratensis in 1947
20. Percentage of Leontodon hispidus in 1947
21. Percentage of Plantago lanceolata in 1947
22. Percentage of Rumex acetosa in 1947

TABLES

Number

1 a Manures - all plots
Yield of hay - all unlimed plots

1 b Regular liming of half-plots - dates and amounts.
Soil pH on unlimed and limed half-plots
Yield of hay - all limed plots

2 Botanical analyses, plots 3, 12, 2, 5^1 unmanured

3 Botanical analyses, plots 6, 7, 8, 15. Minerals only, no N

4 Botanical analyses, plots 5^2, 4^1, Minerals and plots 14, 16, 17, nitrate of soda and Minerals

5 Botanical analyses, plots 9, 10, 11^1, 11^2, Ammonium Salts with and without Minerals

6 a Botanical analyses, plots 1, 4^2, 18, Ammonium Salts with and without Minerals

6 b Botanical analyses, plots 13, 19, 20, Farmyard Manure