OBSERVATIONS RELATIVE TO PASTURE SEED-MIXTURES.

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THE ultimate structure in vegetation is determined by dominance, and dominance is based on the ability of the individual to respond to' its environment. No two plants arc exactly alike in their demands : each plant has its special growing-place. The indigenous forests in general carry a single dominant that largely determines the physiognomic features of the formation-the tawa or rimu, or white pine, or kauri, or totara, or southern beech. In forest development we recognize succession, and dominants appear to mark each phase in the succession : thus we have the manuka dominance, bracken fern,. the indigenous induced hard fern, piripiri dominance, wineberry, mahoe, five-finger dominance, progressing to rewarewa, hinau, or kamahi dominance. In the tussock grasslands we see the same rise to dominance according to growing-place- the fescue tussock, the poa . tussock, the danthonia tussock ; and in the depleted lands of the South Island we see the scabweed dominant under the influence of the rabbit. In the artificial grasslands of New Zealand the trend to dominance is well observed — the rye-grass, cocksfoot, brown-top, ***Danthonia*** *pilosa*, *D. semiannularis*, ratstail, paspalum, tall fescue, prairie-grass, floating sweetgrass, and ***Poa*** *aquatica* dominance respectively.

Dominance within a mixed association presupposes competition and ultimate survival of one plant over another. Survival is based on the ability to persist longer and to grow better than another plant under the conditions of the habitat, and the plant that is gaining ground and canopy in the association is rising to dominance, and, further, the plant rising to dominance is producing more growth than any of its competitors can or will unless there comes about a modification in the habitat. The. real problem of the grassland farmer to-day and of the future is to learn just how to secure dominance of those pasture species that have proved themselves capable of high productivity when subject to conditions appertaining within a utilization plan whereby stock is the main defoliating-agent. He can also employ dominant swards where the mower is, the harvesting-implement, and lucerne stands out pre-eminently in this respect. Lucerne is one of the few permanent agricultural crops where.dominance is recognized as essential for the plant's own well-being.

The trend to simplification of pasture swards is the recognition among grassland workers and ecologists the world over-and it is fitting to mention the name of Yrofessor R. G. Stapledon, of Aberystwyth, in this respect—of the laws governing plant-life- and- plant communities.

Complexity in the pasture sward or in any plant association is in general a sign of non-aggression by any particular plant member, and when no one member of an association is aggressive there is probability of a weak, moribund community. There is ample evidence that the less thrifty and the more open the grassland association the greater the numerical strength of the species, and conversely the more thrifty and

dense the association the fewer species that association contains. Pasture-making is largely a question-of harmonizing plant and environment, and the 'problem is to provide the environment that the high potential producer demands, and the more closely plant-demand and environment harmonize the simpler the association becomes and the simpler can the seed-mixture be that is employed.

Accurate knowledge is essential for' the success of the simple seed-mixture : safety and latitude is afforded in the more complex seed-mixtures, but waste of seed must of necessity result, and care must be taken that an actual reduction in yield does not come about as a result of using the complex seed-mixture.'

The claim for 'complex seed-mixtures is sound, -however, where tie are dealing with a complexity of soil types and a 'complexity 'of ecological conditions such as exist on bush-burn country-the fertile flats and hollows, the steep-'faces and exposed knolls, the shady and the 'sunny aspects. These cannot be uniformly grassed,, and many seed-merchants have been libelled in regard to the seed-mixture pro-- vided for bush-burns or sowers reprimanded for uneven distribution of the seed. The irregular stand secured is but the reflex of one or more species in the seed-mixture becoming dominant according to aspect, and thus, giving -the impression that the sowing or mixing, of the original seed-mixture supplied was at fault. In general also in sowing down to permanent pastures phases in the succession to an ultimate dominant should, be, provided for.

'For the ploughable country where one can govern the habitat and: management at will, the case is strong for the simple seed-mixture composed of one or two grasses and one or two clovers. The intimate mixture of grass and of clover is imperative, and no dffort-should be spared to get the best possible strains and to secure the-best possible conditions for the establishment of these. It is of great practical significance that the grasses and the clovers are ecologically related, and no mixture-maker can afford to ignore this fact.

Control of the environment is'presumed before simplification of seed-mixtures can be carried far.' Soil-fertility and the correct soil-moisture, together with regulation of light and shade by means of pasture-utilization, are three master factors. The perennial rye-grass - white-clover mixture demands control of all three. The cocksfoot - red-clover - white-clover mixture demands 'an intensification of **the** shade factor, which means laxer utilization. ' This also applies in' the case of such pasture-plants as 'timothy, prairie-grass, *Phalaris* ***tuberosa,*** and, to some extent, paspalum. The danthonia-clover dominant sward demands an intensification of the light factor, and utilization by close grazing is a prerequisite. The brown-top - Chewing's-fescue mixture (as for lawns) demands control of the fertility factor if a correct balance is to be secured between these, two species. This-consideration on behalf. of each species calls for niceties in management which can be given to a maximum degree only if the species of similar demands are grouped in simple mixtures by themselves and specially managed so that the correct environment for their maximum development is provided, and this necessitates special-purpose pastures of simple seed-mixtures, separately fenced in order that the correct management may be given to each. Already the claim of lucerne in this respect is recognized.

EXPERIMENTAL EVIDENCE RELATIVE TO SIMPLIFICATION OF SEED-MIXTURES.

Evidence to support the simple seed-mixture and the futility of wasting seed in complicated seed-mixtures where we are able to give reasonable manurial and management conditions to the grasslands laid down is contained in the following trials :-

TRIALS AT MARTON EXPERIMENTAL AREA.

Three years ago six seed-mixtures were laid down at Marton. They were exceedingly well managed under a system of mowing and grazing introduced there by Mr. A. W. Hudson, and were systematically manured. The results are tabulated in Table I.

From Table I it will be noted that under the conditions of the trial which favoured the rye-grass white-clover swat-d it proved detrimental to add certain additional species'to the simple basic seed-mixture, and this is definitely the case in regard to Plot 6, where the addition of *Poa trivialis* has detracted from the total three years' yield by approximately 4 per cent.

At Marton there was laid down at the same time as.the seed-mixture trial given in Table I a series of cocksfoot white-clover - red-clover plots to test out the significance of strain in cocksfoot and red clover. The three years' yields of these plots are comparable to those in Table I, but the management has been more lenient, although probably not quite lenient enough for cocksfoot to produce its best.

Table I.—Showing Tabulated Results of Seed-mixture Trial at Marton after Three Years down

Seed-mixture sown. (Quantities in Pounds per Acre.)	Total Dry Matte of Mixture (in Pounds).	Relative Yields.	Species : Contribution per Cent. at 8th July, 1936.
(1) Perennial rye-grass . . 30 White clover . ,, 3	33,139	100'1	82·9 12·5
(2) Perennial rye-grass . . 30 White clover . . .. 3 Cocksfoot 10	33,103	100'0	72·2 22·5 2·7
(3) Perennial rye-grass . . 30 White clover . . ,, 3 Coclisfoot .. 10 Italian rye-grass . 6	32,738	98·9	80·7 11·1 5·0 ..
(4) Perennial rye-grass 30 White clover . . 3 Cocksfoot .. 10 Crested dogstail ,, 3	32,784	99·0	81.8 11·1 2'3 Trace.
(5) Perennial rye-grass .. 30 White clover . ,, 3 Cocksfoot . . . 10 Timothy . . 4	32,663	98·7	74'7 17·4 3'3 " 4
(6) Perennial rye-grass 30 White clover . 3 Cocksfoot .. 10 *Poa trivialis* . ,, 4	31,804	96·1	67·3 4·9 1·5 25·7

The results are shown in Table II :-

Table II.-Showing Results of Seed-mixture Trials at Marton after Three Years down.

(Trials sown 23rd March, 1933.)

Data from Trial.	Seed-mixtures.		
	Rye-grass-White-clover.	Cocksfoot-White-clover.	Cocksfoot-Red-clover-White-clover.
Total dry matter (in pounds)	33,139	(1) 30,438 (Akaroa) (2) 30,310 (Aberystwyth) (3) 27,841 (Danish) (4) 30,512 (selection)	*(I) 30,463* (Montgomery). (2) 30,225 (Broad).
Percentage botanical composition	Rye. 83 White. 13	Cocksfoot. White. (1) 51 37 (2) 50 39 (3) 40 52 (4) 55 33	Cocksfoot. White. (1) 50 35 5 (2) 53 34 2
Relative total yields	100	(1) 91·8 .. (2) 91·5 .. (3) 84·0 .. (4) 92·1 ..	(1) 91·7 (2) 91·2 .. ..

The utilization in the above trial (Table II) may have been over intense for cocksfoot to develop its maximum production, and it appears that this is certainly true of red clover, the addition of red clover making comparatively little difference in the yield other than to depress it slightly. However, in the case of the cocksfoot it must be said that if the growth were allowed to get much taller the quality of the herbage would probably have deteriorated.

In these trials at Marton it would appear as if the yield can actually be depressed by the addition of species that are in themselves not as productive as the dominants in the mixture. In other words, species for a while at least may occupy ground that would better be occupied by the dominants, no consideration, of course, being given to any value that may be attributed to additional species from a dietetic point of view.

TRIALS AT MASSEY AGRICULTURAL COLLEGE.

In the autumn of 1934 a series of seed-mixture plots was laid down at Massey Agricultural College under—(1) dairy-farm management and (2) under sheep management. Point-analyses to arrive at ground-cover and dissection-analyses to arrive at actual botanical composition of the feed available to stock were made on these plots in May, 1936. The mixtures sown out and 'results to date are contained in Table III.

It will be observed that the addition of species to the general base has made little or no difference to botanical composition, and it would appear to date as though the cocksfoot and Montgomery red clover would not have been greatly missed had these been left out also.

The white clover used in the base mixture was certified permanent-pasture type, and it would appear that strain in the dominant species is likely to alter the botanical composition more than do any additional species. In this respect it is interesting to note the difference in the white-clover strains in respect to ground-cover and actual production as determined in the month of May. The higher actual productivity of the certified "mother" strain and the pedigree strain is determined by the cut and dissected analysis as against the certified perennial pasture strain is noteworthy, and in this respect Kentish wild white clover compares very unfavourably. In this strain in May the ground-cover is high but the yield is low.

Table Ill.-Botanical Composition of Fields derived from Pasture Mixtures sown down Autumn, 1934, and utilized since under Good Dairy-farm Management.

(Botanically analysed May, 1936. A = Ground-cover analysis; B = Cut and dissected analysis.)

Plot.	Base Mixture.										Species added to Base Mixture and their Contribution.			
	Italian Rye-grass (5 lb.).		Perennial Rye-grass (25 lb.).		Cocks-foot (10 lb.).		White Clover (3 lb.).		Montgo-mery Red (3 lb.).					
	A.	B.	A.	B.	A.	B.	A.	B.	A.	B.		Lb.	A.	B
1	..	..	46	64	6	7	45	20	2	1	Base only . .	..	..	.
2	..	..	43	71	9	7	39	18	1	3	No Italian. .	..	..	.
3	..	..	53	71	7	7	35,	17	..	1	Dogstail . .	3	2	..
4	..	..	49	69	5	12	32	10	3	Tr.	Timothy. . .	4	5	7
5	..	..	57	77	3	7	38	14	1	..	Meadow fes-cue	12	..	..
6	..	..	47	54	4	7	..	..	..	1	Mother white, clover	3	43	34
7	..	..	40	86	8	5	..	..	1	..	Kent wild white clover	3	40	9
8	..	..	45	55	2	2	..	.	..	..	Pedigree white clover	3	51	39

In regard to the seed-mixture trials under sheep management, these were sown in the autumn of 1934 on rather wet, stiffish country that if neglected runs back to rushes, brown-top, and sweet vernal. The botanical composition of these mixtures is shown in Table IV, and it will be noted how dominance has been attained by perennial rye-grass • white-clover and how poorly most 'of the subordinate species have contributed to the sward. Here again it will be noted that strains in those species-that are likely to be dominant is important. The white clover sown in the general base is a certified permanent-pasture strain, and it has performed remarkably well. At the time of the analysis (May) it will be noted that, on the whole, production is vii-tually equal to ground-cover excepting where no white clover was sown and a volunteer white clover of an apparently poor type appeared (Plot 11) and where the Kent wild white clover was sown (Plot 13). Here the actual production figure is considerably lower than the ground-cover figure.

Table IV.—Botanical Composition of Plots sown down to various Seed-mixtures, Autumn, 1934, and since utilized under Good Sheep and Cattle Management, Terrace Country, Massey Agricultural College.

Plot.	Base Seed-mixture.										Montgomery Red (3 lb.).		Additional Species.			
	Italian Rye-grass (5 lb.).		Perennial Rye-grass (25 lb.).		Akaroa Cocksfoot (6 lb.).		Dogstail (3 lb.).		White Clover (3 lb.).							
	A.	B.	A.	B.	A.	B.	A.	B.	A.	B.	A.	B.		Lb.	A.	B.
1	Tr.	Tr.	33	53	14	5	0	..	40	28	12	13	Base only	.	.	.
2	,,	,,	37	39	7	6	0	..	37	37	16	13	Italian	15	Tr.	Tr.
3	,,	,,	33	40		6	0	..	41	38	22	13	,,	10	,,	,,
4	,,	,,			4	2	0	..	37	28	24	9	Station perennial	25	33	58
5	,,	,,	38	47	2	2	0	..	43	37	10	12	Timothy	6	3	1
6	,,	,,	42	38	4	2	1	..	31	42	21	17	Brown-top	2		2
7	,,	,,	46	60	3	1	0	..	36	33	13	5	Subterranean clover	4	0	0
8	,,	,,	35	37	4	9	0	..	39	4'	20	12	Subterranean clover (Austral'n)	4	0	Tr.
9	,,	,,	42	50	8	3	0	..	49	46	..		No red alsike	3	0	0
10	,,	,,	39	39	5	7	1	..	42	37	11	12	*Lotus major*	1	0	0
11	,,	,,	44	68	2	3	2	..	16	5	31	21	No white sown			
12	,,	,,	35	36	5	2	0	..	.		17	8	Certified mother white	3	42	52
13	,,	,,	43	53	4	4	1	..			13	22	Kent white	3	36	20
14	,,	,,	34	22	6	3	0	..			12	13	Pedigree white	3	48	62
15	,,	,,	42	56	4	1	1	..	47	39	..		Broad red	3	4	3
16	,,	,,	36	52			1	..	40	36	8	7	Aberystwyth pasture cocksfoot	6	11	3
17	,,	,,	30	50		..	0	..	38	30	19	9	Aberystwyth dual cocksfoot	6	12	10

In the case of the certified "mother" seed and pedigree seed the production figure exceeds ground-cover figure, and this is a vital point when the carrying-capacity of the country comes to be considered. It will be noted that all the subsidiary additional species have fared badly, and even cocksfoot has been hardly worth while. The contribution from Montgomery red clover compared with broad red clover is significant (Plot 15), and the inclusion of Montgomery red clover would appear well worth while.

TRIALS AT WHANGAMOMONA.

Turning now to secondary-growth hill country sowings, the principle of the comparatively simple mixture holds good. In the course of the regrassing experiments in the control of secondary growth at Whangamomona over eighty species of grasses and clovers were sown, and in one mixture over fifty species were used. The outcome of that work was the drawing-up of a seed-mixture the species of which could be counted on one hand.

Some complex seed-mixtures that were sown and the resultant swards produced as a result of the seeding are shown in Table V. It will be noted that of the fifteen species used only three are contributing well after three years down, with volunteer species and weeds ranking higher in importance than the greater number of species sown. The danthonia in the mixture is in its early stages of aggressive development.

Table V.-Showing Composition of Swards sown out in various Mixtures for Secondary-growth., Burns Three Yea& after -sowing down, Whangamomona

Mixtures (Pounds per Acre).	I.	2.	Ground-cover after Three Years. Mixture I,			Mixture 2.
Cdcksfoot	8		2	I	I	4
Crested dogstail	4	6	12	9	10	12
Perennial rye-grass	6	4	2	3	2	3
Italian rye-grass	2	..	.	..	.	..
Poa pratensis	0½	..		0'2	I	I
Brown-top	2		32	55	48	38
Danthonia	I	5	8	I	5	0'2
Paspalum	2	2	I	6	I	4
Chewing's fescue		.	2	I	..	0·5
White clover	I	2	4	2	IO	I
Lotus major	½	I	I4	37	6	34
Lotus hispidus	0½	I	2	0'2	0·4	2
Red clover	I	2		..	I	I
Subterranean clover.	0½	I	.	I	I	4
Yarrow	0⅛	0⅛	I	0·2	I	I
Suckling clover	(Volunteer)		6	3	5	3
Yorkshire fog	,,		6	3	5	3
Catsear	,,		II	4	9	IO
Other weeds	,,		.5	5	16	II

Further evidence of the 'simple seed-mixture and its economy may be seen in the case of seed-mixtures for playing-greens; lawns, &c. In this connection mixtures were laid down in 1932 at the Green-keeping Research Station at Hokowhitu, and these were analysed by the point and dissection methods in May, 1936, four years after sowing. The plots were managed for the whole of the period as a green in play, cutting being close and continuous. Manures and chemicals were applied to control weeds and clover and to maintain soil fertility at a standard that maintained equilibrium between the brown-top Chewing's-fescue combination. The results are **seen** in Table VI.

Here it will be noted little or no improvement to the ultimate sward is secured by the lavish expenditure on seeds additional to that simple brown-top - Chewing's-fescue mixture, although it must be stated that crested dogstail and perennial rye-grass figured in the sward for upwards of two to three years. The main point, however, is that simplicity follows the setting-up and maintenance. of a stable environment. Control of the environment must be the aim of every grassland farmer, and it is for him to learn how best to create a stable environment that will produce the maximum quantity and quality of edible herbage. Land development in New Zealand-by. the State and by the individual farmer each year points clearer and clearer to the fact that **the** goal to grassland attainment is an environment that is conducive to the rise and stabilization of the simple perennial rye-grass - white-clover - dominate sward, aided and abetted may be by special-purpose pastures that are simple in fact and single in purpose.

***Table VI.-Showing Details** of Turf **Analyses at the** Green-keeping Research Area* and *comparing these with* **the** Seed-mixtures *sown.*

(Sown March, 1932 ; analysed May, 1936. A = Point analysis ; B = Percentage composition.)

Plot.	Base Mixture.				Additional Species with their Contribution to the Sward.			
	Brown-top (120 lb. per Acre).		Chewing's Fescue (240 lb. per Acre).					
	A.	B.	A.	B.		Lb.	A.	B.
1	51	40	63	49	Base only	..	..	..
2	55	47	54	47	*Poa pratensis*	240	2	2
3	65	57	43	38	Crested dogstail	240	1	1
4	64	57	41	36	Certified perennial rye-grass	240	..	..
5	71	61	44	38	*Danthonia pilosa*	240	..	..
6	70	50	54	39	Yarrow	40	9	7

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DISCUSSION.

(Follows next paper.)