Level Of Superphosphate Topdressing And Butterfat Production Per Acre

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ONE of the major problems in the economy of grassland management in New Zealand is undoubtedly the question of efficient fertiliser practice.

A growing number of dairyfarmers are asking for information as to the stage at which the application of an increasing amount of fertiliser ceases to be economic, and how existing rates of topdressing might be related to previous rates.

How then are we to determine the most economic amount of fertiliser that can be applied to dairy pastures having in mind the previous topdressing practice and the needs of the particular soil type.

The problem assumes a major economic importance when we consider the annual national cost of topdressing N.Z. pastures. The present total of phosphatic fertiliser usage approximates around 850,000 tons per annum and of this total well over half is taken up in the topdressing of dairy pastures. This means a total annual cost to the primary producers of this country of between £9 and £10 millions and to the Dairy Industry alone of approximately £5 to £6 millions. This constitutes by far the greatest single item of cost in dairyfarm working and maintenance charges.

What is needed therefore is information of a more precise nature on the question of economy of application of phosphatic fertiliser in place of the nebulous information available at present. The solution to this economic problem probably offers a greater immediate cost benefit than can be secured by any other single piece of applied research.

The question we ask does not involve the issue as to whether phosphatic fertiliser is or is not necessary for our dairy pastures. We are satisfied that phosphatic dressings are necessary for the great majority of our pastures. But we are seeking more precise information from the research field or from the practical farmer as to the phosphate requirements of pastures in terms of resultant butterfat production in order to ensure that maximum production is being secured at the most economic cost.

In the meantime we have endeavoured to assemble some data from dairyfarms which may assist in indicating the range of existing practice in rate of annual topdressing with phosphatic manures, and to study the range of practice by our best grassland farmers. To some extent also the data offer an approach to the question of relationship between level of such topdressing rates and butterfat production per acre.

Source of Data.

From questionaires sent out to testing dairyfarmers in connection with a general survey of dairy husbandry problems, information was obtained on the amount of phosphatic fertiliser used on a number of these farms in the 1949-50 season. About five sixths of this fertiliser was applied in the form of superphosphate and the remainder as basic slag, North African phosphate and other forms of imported phosphate. The topdressing rate was calculated by dividing the total quantity used by the area of the farm in grass. This may differ in some cases from the actual rate applied where the whole area of the farm has not been uniformly topdressed but from data collected in the following

season and which included rate of application it was found that no serious bias was likely to have been introduced by the method adopted.

The farms were selected from two separate areas, South Auckland and Taranaki. It is considered that soil type within these areas (with the exception of the Northern Hauraki Plains) would be reasonably uniform in initial response to phosphate though the phosphate status of soils on the various farms might well differ considerably at the time of the survey.

Before proceeding to deal with the results of the surveys it may be desirable to repeat—and so avoid misunderstanding—that the initial purpose of this survey is to describe existing topdressing practices in relation to butterfat production per acre and to emphasise the extension workers' difficulty in advising the dairyfarmer as to whether he should apply 2, 3, 4, 5 or 6 cwt. of superphosphate per acre on land where the previous topdressing rate has been at least 2 cwt. per acre. The economic aspect of the problem can best be described by pointing out that the cost of each extra cwt. applied would pay interest on an additional £12 capitalisation per acre. It is evident therefore that something more precise than our present information should be available by way of advice to farmers.

Analysis of Results.

Table I shows the distribution of 682 dairyfarms in the South Auckland area ranged according to level of topdressing per acre and butterfat production per acre. All farms included in these surveys were straight dairyfarms, self contained, i.e., with no outside grazing area, purchasing no hay or concentrates, and rearing all replacement stock. The table also shows average butterfat production per acre for each topdressing range, average production per cow and average carrying capacity, i.e., number of cows carried per 100 acres. The scatter diagram does indicate a low correlation (+ 0.2) between rate of phosphatic topdressing per acre and butterfat production per acre but the correlation is difficult to interpret in terms of the direct effect of superphosphate on butterfat production per acre.

Table II shows the survey results of 230 farms in Taranaki and similar trends to those quoted in Table I are in evidence.

In both these Tables there are obvious difficulties of interpretation and it would be impossible with the limited data available to decide the physical significance of the slight positive correlation shown between the level of phosphate application and butterfat production per acre. Obviously fully developed farms with no waste ground and first class pastures throughout are likely to have uniform topdressing rates over all acres and a carrying capacity in excess of farms where a limited amount of semi waste land or land not fully developed forms part of the total. Also the more fully improved farms may on average tend to be better farmed from a dairy cattle husbandry point of view than farms less fully developed. These are debatable issues in a table attempting to indicate a straight forward relationship between phosphate topdressing and butterfat production per acre.

They cannot be overlooked however because they may have a very material bearing even on the small correlation evident between these two variables.

In order to overcome the difficulty of interpretation just mentioned, further tables have been constructed based on farms with a higher butterfat production per acre than 250 lb. This constitutes the top level of farms in the samples shown in Tables I and II, and all are farms in a high state of development with good management. We

were able to secure the amount of phosphatic fertiliser used in 2 successive years on these farms and therefore the results should be much more useful in indicating normal topdressing practice and in showing the range of variation that exists even among our best grassland farmers. We hope to keep annual records up to date for all these farms so that the long term effect of the differences in practice can be ascertained.

As will be seen from the graphs and accompanying tables for Tables III and IV it is difficult to find any strong evidence in favour of topdressing rates higher than approximately 3 cwt. per acre. In fact it is difficult to tell just where the economic level of topdressing does exist on these farms and the answer may not be obtained until long term effects are available.

How then are we to interpret the data now available—or more important still in the light of all existing information how are we to advise the farmer in his topdressing practices? Should we recommend small plot trials or wide strips across a paddock with not more than say two or three cwt. per acre, in comparison with heavier dressings alongside if heavier dressings are the normal practice, and vice versa if not.

Is it possible to ascertain from the phosphate status of the soil the economic amount of annual topdressing to apply? What do our soil and grassland authorities advise?

Extension work has been likened to a two way bridge between the farmer and the research worker. In this case it almost appears as though the centre spans of the bridge are missing—or else the foundation piles at either or both ends of the bridge haven't been put in.

Can the statement of Williams of the Macauley Institute for Soil Research be accepted as indicating an optimum topdressing rate of N.Z. pastures? (Scottish Agriculture—Autumn 1951, Page 68).

"It is clear that the law of diminishing returns applies to phosphatic manuring. Turnips and swedes require more phosphate than other crops and the soils for these experiments were deliberately chosen because they were low in phosphate. The results therefore show clearly that:—

"There can in general be little or no immediate benefit from applying more than about 6 cwt. of superphosphate per acre even on land very poor in phosphate."

"Repeated falls in the effect of the successive 2 cwt. doses emphasise the second important point that the size of dressing should be adjusted according to the shortage of phosphate in the soil. It is neither necessary nor profitable to put large dressings on soils already well supplied with phosphate."

What bearing has the concluding sentence of William's comments on the topdressing practices of New Zealand dairyfarmers? What should be the future plan of attack on this problem? Can research workers or extension workers supply experimental evidence or more representative field data? My own opinion favours an immediate field investigation by a combined team of soil, pasture and extension workers, together with suitably planned field trials by co-operating farmers. Or shall we continue to let farmers topdress their pastures with a large measure of guesswork and accept the possibility that wastage in the use of superphosphate may continue at an unknown level to the national economic disadvantage and at the expense of the primary producer.

DISTRIBUTION OF FARMS ACCORDING TO PHOSPHATE TOPDRESSING RATE AND PRODUCTION PER ACRE.

TABLE I

Auckland 682 Farms.

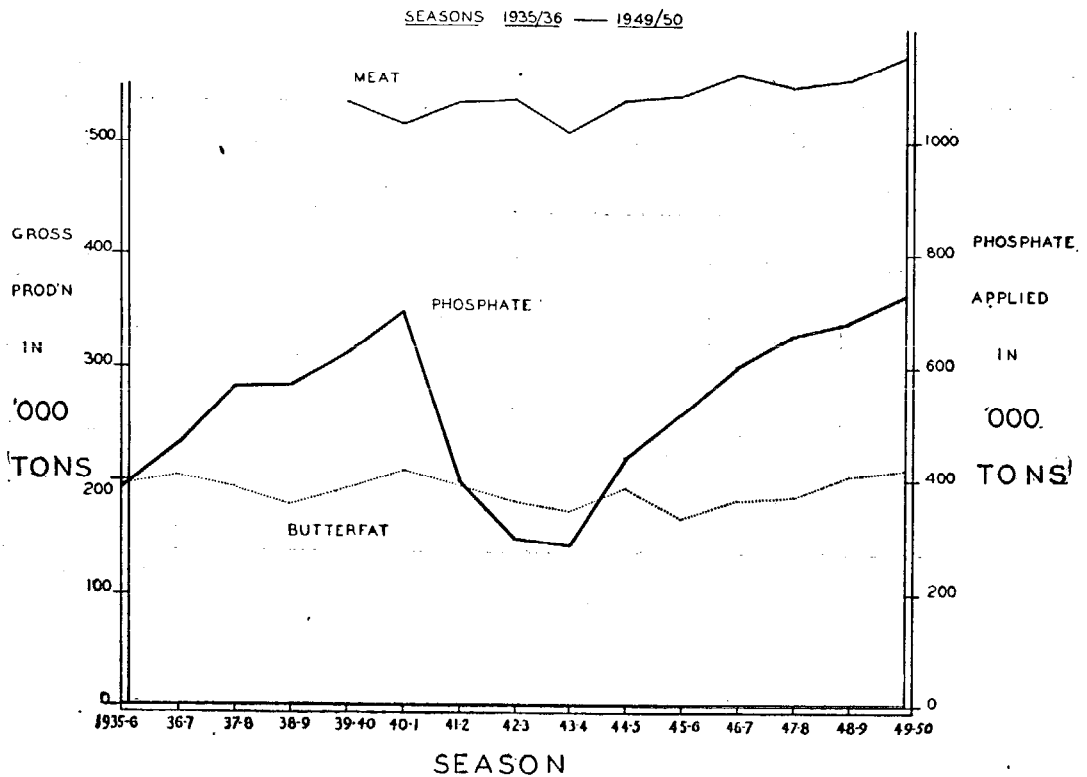
Phosphate Topdressing (Cwt. per Acre)	Distribution of Farms Production per acre (lb. Fat)				Total Farms	Prodn. per Acre (lb. Fat)	Prodn. per Cow (lb. Fat)	Cows Carried per 100 Acres
	0/149	150/199	200/249	250 & Over				
0 — 1.4	26	18	11	2	57	158	265	57
1.5 — 2.4	59	64	26	7	156	162	277	58
2.5 — 3.4	94	128	54	13	289	170	287	59
3.5 — 4.4	28	57	32	9	126	183	288	62
4.5 — 5.4	9	18	12	2	41)			
					)	190	296	65
5.5 and Over	2	2	7	2	13)			
TOTAL No.	218	287	142	35	682	171	284	59
TOTAL %	32%	42%	21 %	5%	100%			

TABLE II

Taranaki—230 Farms.

Phosphate Topdressing (Cwt. per Acre)	Distribution of Farms Production per acre (lb. Fat)				Total Farms	Prodn. per Acre (lb. Fat)	Prodn. per Cow (lb. Fat)	Cows Carried per 100 Acres
	0/149	150/199	200/249	250 & Over				
0 — 1.4	8	3	1	–	12)	164	308	52
1.5 — 2.4	23	24	9	6	62)			
2.5 — 3.4	23	34	31	11	99	187	314	59
3.5 — 4.4	7	16	11	3	37	188	329	56
4.5 — 5.4	2	3	6	2	13)	206	329	61
5.5 and Over	–	3	2	2	7)			
TOTAL No.	63	83	60	24	230	181	316	57
TOTAL %	28%	36%	26 %	10%	100%			

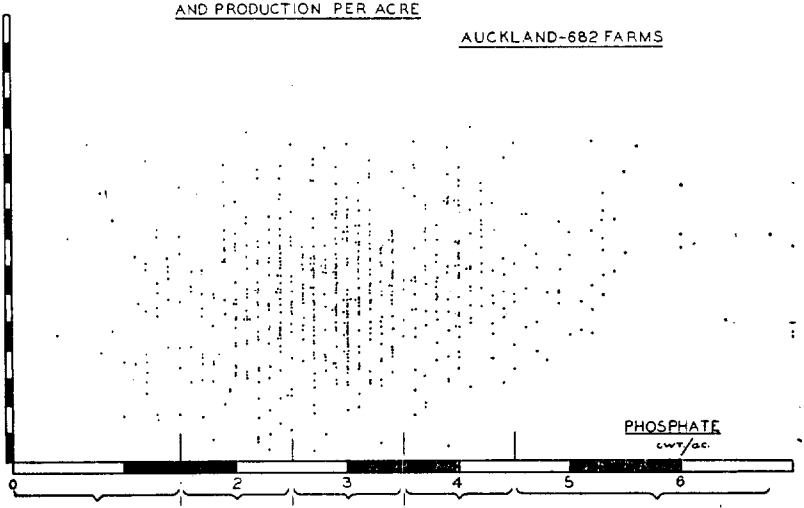
PHOSPHATE APPLICATION AND PRODUCTION TRENDS



FAT

DISTRIBUTION OF FARMS ACCORDING TO PHOSPHATE TOPDRESSING RATE AND PRODUCTION PER ACRE

AUCKLAND-682 FARMS

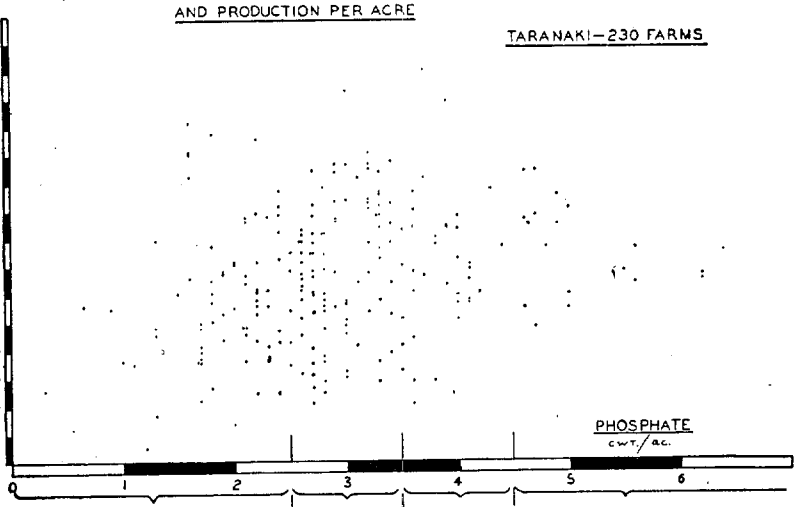


No. of FARMS	57	156	289	126	54
Lb. FAT/ ACRE	158	162	170	183	190
Lb. FAT/ COW	265	277	287	288	296
COWS per 100 ac.	57	58	59	62	65

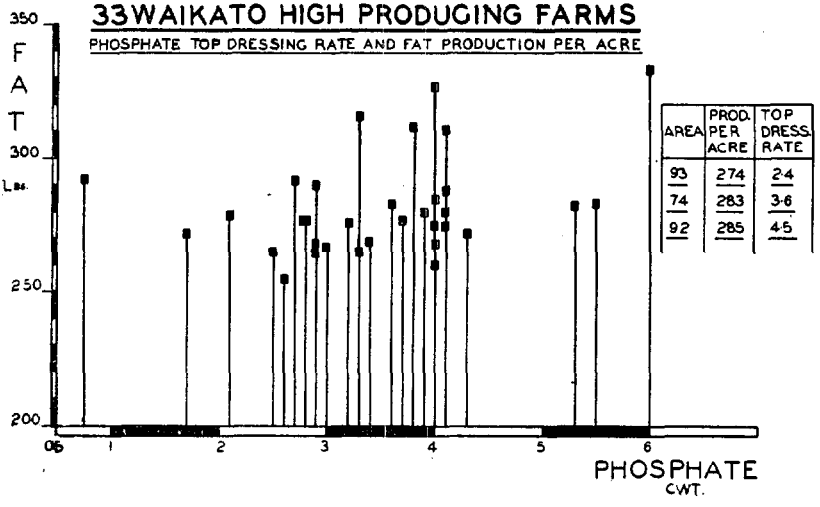
FAT
Lb/ac.

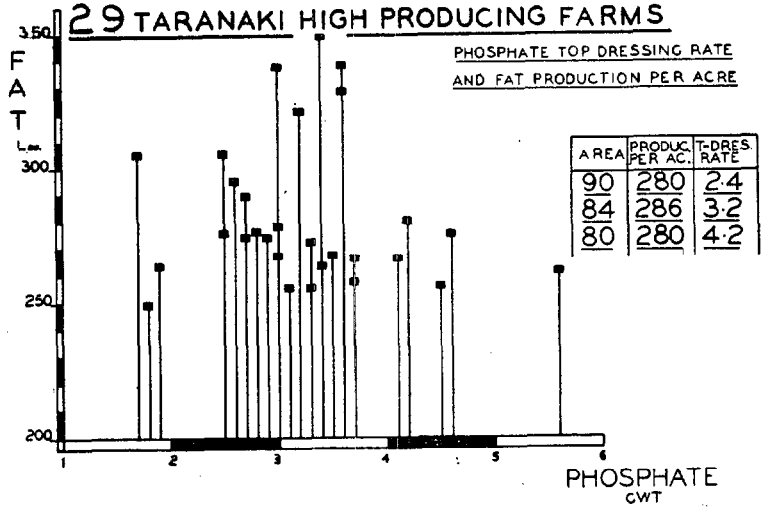
DISTRIBUTION OF FARMS ACCORDING TO PHOSPHATE TOPDRESSING RATE AND PRODUCTION PER ACRE

TARANAKI—230 FARMS



No. of FARMS	74	99	37	20
Lb. FAT/ACRE	164	187	188	206
Lb. FAT/COW	308	314	329	329
COWS/ 100 ac.	52	59	56	61


33 WAIKATO HIGH PRODUCING FARMS
PHOSPHATE TOP DRESSING RATE AND FAT PRODUCTION PER ACRE
FAT
Lbs.
350
300
250
200
0
1
2
3
4
5
6
PHOSPHATE
CWT.
AREA
PROD. PER ACRE
TOP DRESS. RATE
93
274
2·4
74
283
3·6
92
285
4·5


29 TARANAKI HIGH PRODUCING FARMS
PHOSPHATE TOP DRESSING RATE
AND FAT PRODUCTION PER ACRE
FAT
Lbs.
350
300
250
200
1
2
3
4
5
6
PHOSPHATE
CWT
AREA
PRODUC. PER AC.
T-DRES. RATE
90
280
2·4
84
286
3·2
80
280
4·2

Discussion

Mr. SMALLFIELD: One should not generalise for any one soil type, as the requirements of the soil are constantly changing. Over the last 20 years there has been an increasing need for potash, in the soils in the Waikato. I don't think we will ever get to the stage of being able to say that a farm needs 2, 3 or 4 cwts. of phosphate. A soil testing service handling 8000 samples, has been instituted and we hope to build up to 20,000 samples a year.

Mr. WARD: The purpose of my paper was not to show that a standard topdressing rate can be achieved for farms in general but it was to show the wide range of variation in phosphate application even on farms with similar soil type. Also I understand even with the soil testing service and where the phosphate status of the soil is reasonably high, continued applications of 3 or 4 cwt. of phosphates are still being recommended. The purpose of the paper was to pose the question as to whether we really know the relationship between the economic amount of phosphate to apply in comparison with the resultant butterfat production per acre.

Mr. EDMOND: Is there a correlation between soil type, level of available phosphate in the soil and the rate of application of phosphate?

Dr. HAMILTON: There is no correlation between available phosphate and level of production. There is some correlation between soil type and production. The lowest producing farm in the survey was using the highest level of phosphate application.

Mr. BURGESS: North and South Taranaki should have been separated to give us a fair comparison. The response is greater in South Taranaki. With heavy rates of phosphate application the level in the soil does not rise.

Mr. BEVAN: The decline in phosphate dressing that occurred during the war was not accompanied by a drop in production.

Dr. MITCHELL: In any consideration of the best methods of tackling the problems concerning use of phosphatic fertilisers raised by papers such as Mr. Ward's, three facts come to mind.

Firstly, the fate of phosphate in the soil and the manner of its fixation is a chemical problem which has received intensive study all over the world for many years without any clearcut ideas emerging.

Secondly, a survey of the experimental work investigating the desirable rates of applications and responses to phosphatic fertilisers which was carried out in New Zealand in years past indicates that, apart from the comprehensive series of trials to determine the optimum level of phosphate manuring for wheat crops, most of the recommendations made, and particularly those for grasslands, are based on very sketchy evidence. Most are actually based on results of observational plot trials throughout the country.

Thirdly, it was found in the Waipa County after the survey had been carried out, that apparent anomalies for fertiliser response could be clearly resolved. They were generally due to differences in soil type. The soil survey has now been extended to cover almost the whole of the North Island and a large part of the South Island.

From the above facts it can be concluded that the question of how best to use phosphate fertiliser on pastures is not one which calls for an individual programme of intensive research to determine basic issues. It is rather an organisational problem from which answers could probably be got most satisfactorily by a reasonably extensive programme of plot trials interpreted in close relationship with our current knowledge of soil type differences.