EFFECT OF ANNUAL APPLICATIONS OF SULPHATE OF AMMONIA AND SULPHATE OF POTASH ON YIELD OF A PHOSPHATED PASTURE.

H. O. ASKEW and D. J. STANTON, Cawthron Institute, Nelson.

IN a. paper presented last year to the Grassland. Association Conference attention was directed to an apparent effect of sulphate of potash in overcoming the depression in. yield that follows the repeated use of sulphate of ammonia and superphosphate on the pastures at the Marsden Research Farm, Stoke, Nelson. It is the purpose of this article to show how this effect has operated during the past four years.

SEASONAL PRODUCTION.

It will be necessary first to examine the distribution of the yield of dry matter over the season. In Table I data are presented showing the distribution of yield of. dry matter for different treatments during the 1935-36 season.

Table I.

Period.	Yield in Pounds of Dry Matter per Acre.		
	3 cwt. Superphosphate.	3 cwt. Superphosphate, 1½ cwt. Sulphate of Ammonia.	3 cwt. Superphosphate, 1½ cwt. Sulphate of Ammonia, ½ cwt. Sulphate of Potash.
24/7/35 to 30/9/35	*686*	872	907
1/10/35 to 23/12/35	**2,628**	*2,467*	2,548
24/12/35 to 20/5/36	2,527	2,453	*2,677*
Total	5,841	5,792	6,132

It is clear from these data that where nitrogen has been used markedly increased yields were obtained in the first, or early-spring, period, but that later in the season where nitrogen and phosphate only were used the yields fall below those for phosphate only, so that over the whole season the total yield in the former ease may fall below that of the latter. On the other hand, when potash was added to the fertilizer-treatment. the depression in yield in the second period was not so great as for nitrogen in conjunction with phosphate, and in the third period the yield from the complete treatment was actually the highest of all the treatments. For the whole season the complete treatment of nitrogen, phosphate, and potash gave the highest yield. The increase in yield for the season of the complete treatment over that of nitrogen and phosphate has amounted to 340 lb. of dry matter per acre. This increase, together with that of 224 lb. for the third period, was statistically significant.

Now compare the yields for the phosphate and the complete treatments. Except for the initial period when the nitrogen was exerting its full effect, the complete, treatment did not show a very marked advantage in yield over the phosphate treatment, the total increase of the second and third periods for the complete treatment being only 70 lb. of dry matter above the yield of the phosphate treatment.

It must, be pointed. out, however, that the use of potash has very largely overcome. the depression in yield shown in the second period under nitrogen. treatment, and in the third period the Complete treatment shows a statistically significant increase over both. the phosphate and the phosphate-plus-nitrogen treatment. It appears therefore that. on this Nelson pasture in the presence of. potash the .depressing effect of annual applications of sulphate of ammonia on yield was not so marked, and that potash acted in the direction of making the distribution of production on the completely fertilized area approach more closely to that on which phosphate only has been used. This is important in Nelson, because any reduction in pasture-productiori during the summer period has a Serious effect in. limiting, the carrying-capacity. of a farm.

Examination of the yield data for the same three fertilizer treatments shown in Table I over the past four seasons yields some interesting results. The requisite data are given in Table II. It is clear from these data- that the complete feitilizer has given the best result in terms of pounds of dry matter per acre in all four seasons. If allowance is made for the exceptionally dry season, of 1933–34, the increases in yield shown in favour of the complete, treatment were appreciable, and almost in proportion to the total yield,. of' the corresponding season. Moreover, except in 1933–34, these increases were statistically significant.

But when a comparison is made of the yields from treatments A and B, it is seen that, except in the first- season,. decreases in yield, not statistically significant, however, have followed the annual use of sulphate of ammonia in conjunction with 3 cwt. superphosphate. The use of sulphate of ammonia usually on this pasture does not 'appear' to be advisable, even though annual phosphate applications are also provided.

Table II.—Yield in Pounds of Dry Matter per Acre.

Season.	Treatment A.	Treatment B.	Difference B–A.	Treatment C.	Difference C–A.
1932–33	3,869	4,006	137	4,077	208
1933–34	3,192	3,119	73*	3,265	73
1934–35	4,830	4,828	2*	5,052	222
1935–36	5,841	5,792	49*	6,132	291

* Decrease in yield.

NOTE.—Treatment A : 3 cwt. superphosphate per 'acre ; Treatment B : As A plus 1½ cwt. sulphate of ammonia ; Treatment C : As B plus ½ cwt. sulphate of potash.

To obtain the direct effect of the potash application, the differences in yield of treatments B and C must be taken. These are given below in Table III :-

Table *III.*

Season.	Pounds of Dry Matter per Acre: Increase following Use of ½ cwt. Sulphate of Potash per Acre.
1932–33	71
1933–34	146
1934-35	224
1935–36	340

SUMMARY OF RESULTS.

These data indicate that pctash when used in conjunction with a manurial programme involving the annual use of superphosphate and sulphate of ammonia was having an increasing beneficial effect on the pasture, as the increments have increased to a much greater extent than would be expected from the annual totals. As these increases have been obtained in seasons of varying moisture conditions, it would appear that potash has maintained the pasture in a better state of productivity than would have been the case if nitrogen and phosphate only were used for top-dressing purposes. Not only has the use of potash enabled the depressing effect of sulphate of ammonia to be overcome, but, as indicated in Table II, the complete treatment has given materially improved yields over the use of superphosphate alone. This does not mean, however, that the use of a complete. fertilizer will be profitable. Indeed, the data indicate that, compared with the cost of 3 cwt. of superphosphate per acre, the complete treatment cannot be payable. But the data show the value of potash applications in promoting an optimum yield of pasture in those cases where sulphate of ammonia is used frequently in addition to a top-dressing of superphosphate.

SUMMARY.

The use of a complete fertilizer gave the highest yield of pasture in mowing-trials at the Marsden Research Farm. Stoke, Nelson.

The use of sulphate of potash at the rate of ½ cwt. per acre overcame the depression in yield following the annual use of sulphate of ammonia on a phosphated pasture.

Where nitrogen is used annually in conjunction with phosphate; application of potash appears to be necessary if optimum yields are to be obtained.

DISCUSSION ON PAPERS BY MESSRS. WOODCOCK, ASKEW, AND STANTON

Mr. *Smith* : The potash response throughout Taranaki is confined generally to high-production farms. A big percentage of potash is being removed and, knowing that originally potash was very deficient in the soil and that there has been a heavy usage, one believes that the type of farming is the reason of the potash response. In Southland there is potash response. Farmers who could not get the lambs away off their mothers before the use of potash had nothing to complain of after the use of potash.

Mr. ***Rodda*** : Has any chemical work been carried out to determine whether potash-treated pasture is sweeter than that not treated ?

Mr. Madden : Does potash actually favour clover-growth, or does it make the pastures more palatable ? In the green-keeping experiments potash has invariably suppressed clover growth.

Mr. Hudson : Often an increase in palatability is attributed directly to the influence of a specific treatment on the chemical composition of the herbage. I am rather inclined to think that while such may be the case, the real, or at least a very important, effect of a treatment on palatability is due to the increased succulence. Anything which increases production increases the rapidity of the growth ; more rapid growth means more succulcncc. More succulent growth almost always is more palatable, It is interesting that the response to potash is, in a number of cases, associated with soils that are derived from materials that are originally low in potash. It is rather surprising that we do not get the same correlation in respect to lime response. So far as our experience goes, and so far as the opinions of people who know the Waikato go, there is not a general lime-deficiency such as might be expected from the nature of the material from which Waikato soils are derived. I disagree with Dr. Askew's conclusions that potash has corrected that undesirable effect of sulphate of ammonia in causing what I have referred to as " slumping."

Mr. Harris : I have been carrying out fairly comprehensive investigations of potash results in Southland, and there are several points that have become quite clear. In the first place the results from potash in Southland come from a heavy clay subsoil, loam on top, and in general are confined to the high-producing farms that have-had supplies of phosphate over a long period. The problem in Southland is becoming greater on the highly top-dressed and highly producing farms. It appears that good results come from heavy land even well limed and well phosphsted, and that the phosphate gives good results. Further, Mr. Woodcock mentioned that in the past the best responses from potash had come from the eastern districts. At the present time we are getting a very great response from a wide area in the western district of Southland.

Mr. *Taylor* : In the sandy soils in North Auckland the potash response is not showing when the soil is at a young stage, but adolescent and mature soils are definitely showing potash response, The clays showed no potash response at any stage except on extremely mature soils : then potash response appeared and increased with the maturity of the soil. On the red-brown soils derived from basalt, potash response appeared evident whether they were young or mature, and 1 am inclined to believe that is due to the original poorness in potash of the raw material. With regard to Taranaki, all the soils on which there were plots are on soil types that belong in that red-brown group or are related to it. They are light in texture, and just from an examination of the soil it would not be surprising if potash response occurred in the whole of Taranaki.

Dr. Askew : I would like to join with Mr. Woodcock in some of his remarks in regard to soil analyses, If he looks in the last soil-survey report he will find that conclusions arrived at there as a result of the chemical analyses are identical with his. An analysis of a soil refers to that area alone and not to any other even on the same farm. He points out that some of the apparently high-potash soils still give a potash response. By courtesy of the Soil Survey people I have been able to get figures which illustrate differences which may occur on the one farm. The best paddock showed 0·58 per cent. of available potash. Two people previously analysed that area and got 0·33 per cent. and 0·014 per cent. respectively. Another farm which had been in the same hands since it was broken in showed practically the same figures for samples from three different places. So far the chemist's interpretation of the soil analyses in those Taranaki areas is that. the chemical figures fit in very well with the response, and therefore I think that Mr. Woodcock's statements that the estimated available phosphate does not suggest any correlation must be incorrect and liable to. be misleading. Another thing I would point out is that the results of a field trial referred to that area and to no other. The previous history of these soil types that have been used may be an explanation of apparent discrepancy.