Phosphorus supplements for dairy cows

L. C. Snook

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To ensure continued high milk production and good health it is essential that dairy cows should receive adequate supplies of phosphorus in their food. For many months of the year, typical Western Australian pastures do not contain sufficient of this essential element. If the farmer fails to provide the correct form of mineral supplement the cows cannot produce milk to full capacity, or they deplete their bodily reserves with resultant ill-health. In either case the farmer suffers financial loss.

Recent studies have shown very clearly that many cows in our South-Western dairying districts are suffering from a real or incipient phosphorus deficiency. This must certainly affect milk production, and may also reduce resistance to disease and be one explanation of seasonal infertility. Even on the best of winter pastures it seems that productive cows cannot make good the losses in phosphate suffered during the summer, when dry feed relatively deficient in phosphorus forms the bulk of the diet.

It is well known, of course, that, as pasture plants mature, the phosphorus content falls, but very few realise just how serious this fall can be to the milking cow. Even good quality meadow hay cut from excellent South-West mixed pastures does not contain enough phosphorus. The present indications are that not only should dairy stock of all types receive phosphatic supplements during the summer months but that supplements should be fed to milking cows during the winter as well, as it is during this time that lactation imposes the maximum drain on the mineral reserves.

There is no justification for the assumption that phosphatic supplements are unnecessary when the pastures have been heavily topdressed with superphosphate. High producing dairy cows cannot eat enough pasture to satisfy their phosphorus requirements.

POSSIBLE PHOSPHATIC SUPPLEMENTS

Bonemeal.

Sterilised bonemeal has for many years been the standard source of phosphorus for use in stock foods and mineral licks. Bonemeal is an excellent supplement in that it supplies not only phosphorus but presumably all the other essential minerals which have been used to build sound healthy bone.

Bonemeal is commonly made available to stock mixed with an equal weight of common salt. The mixture can be placed in boxes set up in convenient places in
the paddocks. Some sort of shelter to keep out the rain is necessary. This method of supply has a number of disadvantages, however. Consumption of the lick is variable and uncertain; some cows eat a lot, others none at all. In practice these salt boxes are often neglected by both the stock and the owner.

Mixing the bonemeal with a palatable foodstuff is much to be preferred, as the farmer can then be sure that all animals consume their quota. This is relatively easy where the cows are bail-fed, that is if the cows will eat food containing bonemeal. It is unfortunate that bonemeal can make rations so unpalatable to some cows that there are many dairymen who refuse to use it. Because of this, and because only limited supplies of bonemeal are available, other sources of phosphorus are recommended.

Average milking cows should receive about two ounces of bonemeal per head daily. The requirements will vary according to milk production and the quality of the grazing. Good cows should receive up to four ounces of bonemeal daily. Heifers on dry feed will grow better and conceive more readily if bonemeal is made available.

Boneflour.

This consists of the mineral residue from bones which have been extracted in the preparation of products such as gelatine. It is sold as a fine whitish powder which has very little odour and can easily be mixed with other foodstuffs. It is a popular and useful supplement but has the disadvantage that regular supplies cannot be guaranteed. Boneflour is used in the same quantities as bonemeal.

Di-calcic Phosphate.

This is prepared from phosphatic rock and in pre-war years was used in considerable quantity. It is an expensive source of phosphorus, however, because of the difficulties of manufacture. The further use of di-calcic phosphate is not recommended.

Superphosphate.

Following the field trials described in a previous publication (Snook, 1949) superphosphate has become quite a popular source of phosphorus for livestock. Previously, superphosphate had received little consideration for direct use as a mineral supplement although it was cheap and readily available. This neglect was chiefly due to the assumption that the fluorine present would prove toxic. I have considered this factor carefully and field trials to date have supported my contention that superphosphate is a safe source of phosphate for livestock if used as recommended in this article—

Untreated Superphosphate.—The mixing of dry superphosphate with other foodstuffs, or in mineral licks is NOT recommended. Half the bulk of commercial superphosphate consists of calcium sulphate or gypsum, an inert, unpalatable substance of no food value to animals. A certain amount of calcium fluoride is also present (about 0.7 per cent. F.). The gypsum and some of the fluoride can, however, readily be separated from the valuable water soluble calcium phosphate by mixing the superphosphate with water. The useless materials quickly sink to the bottom of the container leaving the phosphate in the clear solution above. There is no point in using “straight super” when a purified product can be prepared so simply.

Superphosphate in the Drinking Water.

During the summer of 1948-49 tests were carried out to determine if the phosphorus requirements of dairy cows could be supplied by adding superphosphate to the drinking water. This method has become quite popular and is now widely practised where stock have to drink water which can be treated. Up to 5 lb. of superphosphate can be added to every 100 gallons of water without reducing the palatability. On most farms the use of 3 lb. of superphosphate in every 100 gallons of water is adequate, if the treatment is maintained throughout the summer. At this rate of supplementation a cow drinking the usual ten gallons of water daily will obtain as much phosphorus as is present in 3½ oz. bonemeal. A cow on this intake throughout the summer will calve down in the autumn with an abundant reserve of phosphorus, in contrast to the depleted condition so commonly seen. This should encourage maximum milk production and reproductive efficiency.
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Methods of Using Superphosphate in the Drinking Water.—The methods used to supply water treated with superphosphate will vary according to conditions. On the properties, where the tests were made stock are watered from concrete containers holding about 600 gallons, which are kept filled by the use of ball-cock taps. These large containers are treated by adding daily one pound of superphosphate for every three cows drinking from the trough, on the assumption that each cow will drink about 10 gallons of water daily. It would be more exact and fool-proof, of course, to treat a container full of water by adding 3 lb. superphosphate per 100 gallons, using this, refilling, and again treating with superphosphate.

Some farmers are adding the superphosphate to the large tanks from which drinking water is reticulated. The necessary periodic removal of the gypsum from the bottom of the tank may prove difficult. Perhaps this could be avoided if the required amount of superphosphate is mixed with two or three times its weight of water (5 lb. superphosphate to one or two gallons) and left to settle. The clear supernatant fluid will contain most of the phosphate and this could be decanted into the tank. The sludge should then be washed with another lot of water to extract some of the remaining phosphate. Doubtless many modifications will be used but there seems no obvious obstacle to the wide use of treated drinking water. This would permit all stock to build up their phosphate reserves during the summer months when normally the reserves of this mineral are being depleted. The possibility must even be considered that if the cows freshen in the autumn with adequate reserves there may be no need for further supplements while good quality green feed is available.

One possible disadvantage may be mentioned. The addition of phosphate to the drinking water encourages a prolific growth of green algae and similar water plants. This growth is not necessarily harmful but it may offend those who like to keep the water troughs clear of plant growth.

Concentrated Solutions from Superphosphate.—Treatment of the drinking water is of little use during the winter months or where alternative water is freely available. A concentrated solution of water soluble phosphate can be prepared, however, by thoroughly mixing superphosphate with water at the rate of 5 lb. per gallon, i.e., with double its weight of water. The clear solution obtained when the mix is left to stand is very rich in phosphate, one pint containing as much phosphate as 6 oz. bonemeal. It is of interest to note that very little fluoride remains in solution, all but a trace being precipitated with the gypsum sludge. The concentrated solution is now widely used to damp down food fed in the bails, as half a pint per head daily constitutes a very worthwhile supplement. It can also be used to damp down meadow hay or chaff fed to cows in the field. Farmers report that stock prefer the treated hay. If hay could be sprayed with the concentrated solution as it was being stacked, the phosphorus requirements of the stock eating the fodder could be assured.

The concentrate is particularly useful when only a little food is given in the bails. Some farmers, for example, use only enough bran or pollard to soak up the fluid added and the cows eat this readily. By attaching small feeding boxes to the doors or sides of walk-through bails cows can be given their supplement even though the rate of passage through the shed is rapid.

Fig. 2.—Cow No. 51. This was the second best producer in the control group during the first year under test, producing 278 lb. butterfat in her first lactation. Production declined to 238 lb. and 190 lb. in the succeeding two lactations. This cow has received a phosphatic supplement since 18/3/54 and promises to be one of the highest producers in the herd. In the first three months of the current lactation she produced 198 lb. butterfat (an average of 2.2 lb. a day).

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Preparation.—Superphosphate should be added to water at the rate of 5 lb. per gallon. Mix thoroughly with a stick and then pour from bucket to bucket about six times. Where the containers are too large to do this, stir thoroughly from top to bottom using a mixer made like a cream stirrer.

When all the water-soluble phosphate has been dissolved further stirring is unnecessary. In practice, however, it may be an advantage to have two or three containers which can be used in rotation. If these are placed in a handy position it is not much bother to give them all a thorough stir once a day.

On being left to stand, the undissolved material quickly settles to the bottom leaving a clear fluid which can be dipped off as required. The sludge on the bottom should be thrown on the manure heap before the next batch is prepared. Some phosphate will remain in the sludge so this should not be wasted.

Testing Strength of Solutions.—Obviously a certain amount of mixing is essential to make sure all the soluble phosphate has gone into the solution, but no one wants to waste time stirring unnecessarily. By using an hydrometer to measure the specific gravity, the strength of the solution can be read in a matter of seconds. Suitable hydrometers with a long, easily-read scale from 1.000 to 1.200 can be purchased for about 14s. A saturated solution gives a reading of 1.100. If the value is much less than this either more stirring or more superphosphate is needed.

Effect on Metal Containers.—Although the saturated solution is strongly acid in reaction, it does not appear to be actively corrosive. Apparently a film of iron phosphate is formed on iron surfaces and this may be protective from, rather than inductive of rusting. Kerosene tins and galvanised buckets have been used at this laboratory without apparent damage. No reports have been received of damage following the use of superphosphate solutions in galvanised iron tanks and water troughs. Comments from farmers regarding this are invited.

FIG. 3.—These twin Jersey heifers, A12 and A13, are believed to be identical twins. They calved in 1954 and are receiving identical treatment during their first lactation. Average production per day has shown a striking similarity as follows:

A12—20.0 lb. milk; 4.94% test; 0.99 lb. butterfat.
A13—20.0 lb. milk; 4.90% test; 0.98 lb. butterfat.

If this evenness in production is maintained, one of the twins will probably be transferred to the control group at its next lactation.

The rock phosphate imported into Western Australia for the manufacture of superphosphate comes from Christmas Island (in the Indian Ocean south of Batavia). It so happens that this rock contains much less fluorine (1-1.7 per cent.
than the phosphatic rocks available in most other countries (these generally contain more than 3 per cent. F.). It seems that advantage should be taken of this fortunate circumstance and tests have therefore been made to see if it is safe to use Christmas Island rock as a direct source of phosphate for animals.

In August 1950 trials were commenced at the Bramley Research Station to test the effect of continuous feeding. Ground rock phosphate from Christmas Island has been given to mature milking cows at the rate of 4 ounces per head daily. A heifer born to one of these cows was likewise placed on the supplement when 15 months of age and is now in its second lactation. A number of heifers have been added to the experiment during the last 12 months. No toxic effects have been observed in these cows or their progeny: in fact they all look particularly healthy and production records are well above average. Full details of this work will be described elsewhere. Of more significance, perhaps, are the results being obtained in a number of commercial herds where ground rock phosphate from Christmas Island has been fed to the cows in milk for over three years, the ration being three ounces per head daily. Milk yields and conception rates have shown a marked and consistent improvement and these responses suggest that tentative recommendations can be made concerning the use of Christmas Island ground rock. The following limitations must be appreciated, however.

(i) The recommendations here being made apply to phosphatic rock from Christmas Island. At present West Australian supplies are obtained exclusively from this source.

(ii) The tests on which these recommendations are based were carried out in the south western corner of the State where the drinking water and the pasture has a low fluorine content.

(iii) Fluorine is a cumulative poison and if ground rock phosphate is fed to excess over an extended period dairy cows may lose their appetite, become unthrifty, and eventually suffer from damage to the teeth and the skeleton.

(iv) Young animals are more susceptible to excessive fluorine than are mature animals, hence rock phosphate should not be fed to calves or yearlings if some other source of phosphate is available.

(v) On properties where supplementary feeding in the bails is continued throughout the year it may be wise to withdraw the ground rock phosphate from the concentrate mixture for three months in each year.

Methods of Feeding Ground Rock Phosphate.

In Concentrate Rations.

(a) Add it to the bulk mixture used in the bails, so that each cow receives 2-3 ounces of ground rock phosphate in the daily ration.

(b) Use a pepper tin or some such measure to add to the appropriate amount of the ground rock phosphate to the food given to each cow.

(c) Use one of the following mixtures:

(i) Ground rock phosphate, 100 lb.; Stock salt, 50 lb.—Maximum per cow per day—4½ oz.

(ii) Ground rock phosphate, 100 lb.; Boneflour or bonemeal, 100 lb.; Stock salt, 50 lb.—Suitable for highly productive cows where it is desired to lessen the risk of feeding excess fluorine. Up to 5 ozs. per head daily should be quite safe.

(iii) In coastal areas add 1 oz. of cobalt chloride or cobalt sulphate to each 100 lb. of lick prepared as under (i) or (ii).

(iv) Ground rock phosphate, 100 lb.; Denmark Lick, 50 lb.—Maximum per cow daily—4½ ozs. This is an easy way of adding cobalt and copper and common salt to a phosphate lick.

In Lick Form.

Any of the mixtures given in (c) above can be fed to stock in the form of licks. Consumption rates may be high when the licks are first made available but after a while it will be found that the amount eaten will not exceed the recommended intake. Palatability can be controlled to a considerable degree by using more or less salt. With cattle the problem is often one
of enticing the stock to eat enough lick. Molasses can sometimes be used with advantage to increase palatability and to produce a crumbly texture which facilitates handling.

It is suggested that licks containing ground rock phosphate should be fed for only six months of the year, e.g. during the summer months. This should eliminate any danger of excess fluorine being accumulated in animals with an excessive fondness for salt licks.

Phosphatic Supplements—Cost Per Unit of Phosphorus


<table>
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<tr>
<th>Material</th>
<th>Purchase Price</th>
<th>Cost per 100 lb.</th>
<th>Phosphorus Content (per cent. P.)</th>
<th>Cost per unit of phosphorus</th>
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<tr>
<td>Superphosphate</td>
<td>£13 2s. 9d. per ton</td>
<td>11 9</td>
<td>8 (water soluble)</td>
<td>17s. 6d.</td>
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<tr>
<td>Bone meal</td>
<td>44/6 per 125 lb. bag</td>
<td>35 6</td>
<td>12 (total)</td>
<td>3s. 0d.</td>
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<tr>
<td>Bone flour</td>
<td>£2 10s. 0d. per 125 lb. bag</td>
<td>40 0</td>
<td>14 (total)</td>
<td>2s. 10d.</td>
</tr>
<tr>
<td>Ground rock phosphate ex Christmas Island</td>
<td>£10 12s. 0d. per ton</td>
<td>9 6</td>
<td>17 (total)</td>
<td>7d.</td>
</tr>
</tbody>
</table>

Reference.

Snook, L. C. (1949), Journal Department Agriculture, Western Australia, 26, 169.

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