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TURNIP-MOSAIC.

A VIRUS DISEASE OF CRUCIFERS.

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TURNIP-MOSAIC was first recognized in New Zealand in 1932, when it was observed on rape-plants being grown for seeding purposes at the Plant Research Station Area, Palmerston North. Since then it has become a serious disease of swedes, rape, and turnips at the Station Area, and has been found also in a number of districts throughout the Dominion.

The first accounts of turnip-mosaic are from North America, where it was recorded simultaneously by Gardner and Kendrick (1921) and Schultz (1921). It has also been recorded from Denmark (Gram and Rostrup, 1924), Germany (Pape, 1935), England (Smith, 1935), and Australia (Samuel, 1931).

SYMPTOMS.

On swedes the characteristic symptom of the disease is a mottling and crinkling of the leaves. The mottling is diffuse, the difference between the light and the dark areas being slight (Fig. 1). Less commonly, it occurs as dark-green blistered areas. Symptoms appear only on those leaves which develop after infection has taken place. Infected plants soon become stunted in appearance (Fig. 2), and the "bulbs" (the bulbous portion of the roots), although they continue to grow, are much smaller than those of healthy plants. The leaves of infected plants tend to die prematurely (Fig. 3), and under certain conditions the "bulbs" become susceptible to soft-rot.

In stecklings* during the winter and early spring the symptoms appear as a pronounced mottling of the leaves with little or no crinkling. Infected plants remain stunted and produce a light crop of seed.

In the glasshouse mottling and crinkling are preceded by a clearing of the veins on the developing leaves. This vein clearing, which is a loss of the green colour along the veins, is rarely seen under field conditions.

* Plants of autumn sowing used for seed-production.

On turnips, symptoms, although much the same as for swedes, tend to be more pronounced. Thus leaf-mottling is usually more clearly defined (Fig. 4) and the distortion of leaves and the stunting of plants greater (Fig. 5). Infected plants are also much more susceptible to soft-rot.

On rape the disease produces a definite mottling of the leaves, but leaf distortion and stunting is not as pronounced as with swedes or turnips. There does not appear to be any premature death of leaves, and, after "feeding-off," the plants produce new growth which is, however, still mottled and stunted.

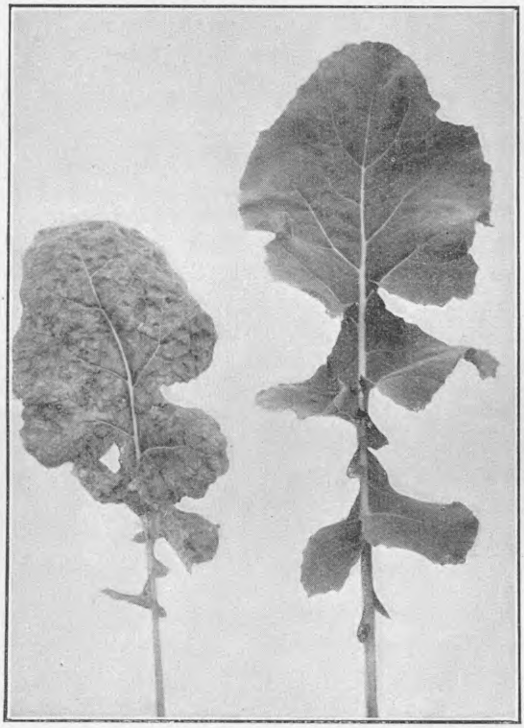

FIG. I. TURNIP-MOSAIC ON SWEDE LEAF.
Healthy leaf on right.

INCIDENCE.

The disease was first observed in 1932 on a few rape plants at the Plant Research Station. In the following year it was found to be common on swedes, rape, and turnips at this area, and was also prevalent on the two former hosts in varietal trial plots at Marton. At the Station Area the amount of infection has increased each year until in the past season practically all swedes and rape were infected.

An inspection of several rape crops in the Marlborough district made during the past season showed a small percentage of mosaic to be present in each. In a recent survey of swede crops a small amount of turnip-mosaic was found in the Otago and Rangitikei districts.

The disease has also occurred during the past three seasons in crops (approximately 2 acres each season) of swede stecklings grown at Colyton, in the Manawatu district. On this area, in the spring of 1935, from 2 per cent. to 3 per cent. of the plants showed infection early in the season.

Economic Importance.

The only country in which turnip-mosaic has been reported to be of economic significance is Germany (Pape, 1935). In that country Pape stated that infection on swedes in Schleswig-Holstein was found to range from 1 per cent. to 90 per cent., and that in two test plots the reduction in yield amounted to 63 per cent. and 57 per cent. respectively.

At the Plant Research Station Area at Palmerston North, where the crops are grown for experimental purposes, turnip-mosaic is a serious disease. It has been particularly severe on turnips, for not only have they become infected with mosaic but the " bulbs " have been subsequently attacked and destroyed by soft-rot. During the past season the effect on swedes was almost as severe, for in several plots the secondary attack by soft-rot destroyed a large percentage of " bulbs." In other plots soft-rot was not responsible for such heavy losses, but the effect of the mosaic was sufficient to render valueless experiments on the control of brown-heart. The effect of the disease on rape was not so pronounced, being limited to stunting of the plants.

Attempts to carry out yield trials with healthy and infected swedes and turnips failed because control plants could not be kept free from mosaic throughout the season. Trials with rape were more successful, since it was found possible to keep the control plants reasonably free from the disease until the time of cutting and weighing.*

During the 1934–35 season trials were carried out in which 100 each of healthy and mosaic-infected rape-plants were grown in ten replications of ten plants per plot. The weights of green leaf showed for healthy plants an average of 0·57 lb. per plant and for mosaic-infected plants 0·42 lb. This represents a reduction in yield of 25·4 per cent., caused by the disease.

In the 1935–36 season further trials were laid down, but despite frequent spraying to control insect vectors† a certain amount of spread of mosaic occurred. All infected plants were, therefore, harvested and weighed separately. Eighty-eight healthy plants gave an average yield per plant of 1·65 lb., while 112 mosaic-infected plants gave an average yield of 1·22 lb. In this case the reduction in yield was 26·1 per cent.

During both seasons the disease spread so rapidly after cutting that the trials were abandoned.

* The crop was harvested and weighed when the plants had reached maturity—*i.e.*, at a stage of growth when they were fit for " feeding-off."

† The term " vector " is applied to any agent, usually an insect, which transmits a virus from one plant to another.

Identity of the Disease.

The disease as it occurs in New Zealand has every appearance of a virus of the mosaic type. A study of its symptoms, methods of transmission, and host range has demonstrated not only its virus nature, but its similarity to turnip-mosaic described by overseas workers.

Methods of Transmission.

Artificial Transmission.—That infection of healthy plants may be brought about by inoculating them with juice expressed from mosaic-infected foliage has already been shown by workers in other countries (Gardner and Kendrick, 1921; Schultz, 1921; Gram, 1925; Clayton, 1930; Pape, 1935).

Early in 1934 experiments were commenced in New Zealand to determine whether the disease could be transmitted in this manner.

Experimental Method.—The inoculum used was juice extracted from leaves of mosaic-infected plants obtained from the field. All healthy plants were raised in steam-disinfected soil in an insect-free glasshouse. Inoculations were carried out usually on plants in the four- to six-leaf stage by rubbing the leaves with muslin moistened with the above juice extract.

Results.—The results of the artificial inoculations are summarized in Table I.

Table I.—Artificial Transmission of Turnip-mosaic.

Date of Inoculation.	Source of Inoculum.	Species inoculated.	Number of Plants inoculated.	Number of Plants infected.
3/1/34 ..	Swede ..	Turnip ..	4	4
3/1/34 ..	Rape ..	,, ..	4	2
3/1/34 ..	Swede ..	Swede ..	4	3
8/10/34 ..	,, ..	Turnip ..	12	8
8/10/34 ..	,, ..	Swede ..	12	5
21/11/35 ..	,, ..	,, ..	8	2

Control plants equal in number to those inoculated all remained healthy.

From these results it is evident that turnip-mosaic is readily transmitted from diseased to healthy plants by juice inoculations.

Insect Transmission.—This was first demonstrated by Schultz (1921), who showed that the aphis *Myzus persicae* was a vector. Clayton (1930) found that the disease was readily transmitted by the aphis *Brevicoryne brassicae.* Working with what was probably the same disease Hoggan and Johnson (1935) showed that both these insects were vectors. Pape (1935) claimed that the disease was also transmitted by the capsid-bug *Lygus pratensis.*

In New Zealand the sucking insects most commonly found on cruciferous crops are the aphides *B. brassicae* and *M. persicae**, so transmission experiments were confined to these.

Experimental Method.—All healthy plants were raised in steam-disinfected soil in an insect-free glasshouse. The infected plants used as a source of inoculum were either transplants from the field or plants

* The identification of these aphides was kindly made by Mr. W. Cottier, Assistant Entomologist at this Bureau.

artificially infected in the glasshouse. The aphides, after being allowed to feed on mosaic-infected plants for at least seven days, were transferred to healthy plants, which were then enclosed in muslin cages in the manner described in a previous article (Chamberlain, 1935). After the aphides had been allowed to feed on the plants for seven to ten days the cages were removed and the plants fumigated. Control plants were treated in a similar manner, except that no aphides were transferred to them.

Results.—The results of the experiments on insect transmission are given in Table II.

Table II.—Insect Transmission of Turnip-mosaic.

Date of Inoculation.	Source of Inoculum.	Species inoculated.	Aphis Species.	Number of Insects transferred.	Number of Plants inoculated.	Number of Plants infected.
13/10/33 ..	Swede ..	Swede ..	*B. brassicae*	36	10	7
10/1/34 ..	,, ..	,, ..	,, ..	20	5	3
17/7/36 ..	,, ..	,, ..	,, ..	20	8	8
10/1/34 ..	,, ..	Turnip..	,, ..	20	5	2
8/3/35 ..	,, ..	Swede ..	*M. persicae*..	10	8	8
12/5/36 ..	,, ..	,, ..	,, ..	15	10	5
12/5/36 ..	Brussel's sprouts	,, ..	,, ..	20	10	7
12/5/36 ..	Cabbage ..	,, ..	,, ..	15	10	4
12/5/36 ..	Broccoli ..	,, ..	,, ..	12	10	2
12/5/36 ..	Cauliflower	,, ..	,, ..	20	10	6

Control plants equal in number to those inoculated all remained healthy.

These results show that turnip-mosaic is readily transmitted by both *B. brassicae* and *M. persicae*.

Seed Transmission.—Field trials carried out by Clayton (1930) with seed from mosaic-infected swede-plants indicated that the disease was not seed-carried.

The following results, although the experiment was not sufficiently large for conclusive proof, support those of Clayton's, for of 432 plants grown from seed of infected plants none developed mosaic.

Experimental Method.—Mosaic-infected swede stecklings were collected from the field and seeded in the glasshouse. Seed from these plants was sown in steam-disinfected soil and the seedlings pricked out into 4 in. pots. These were kept in an insect-free glasshouse until they had developed to the six-to-eight-leaf stage.

HOST RANGE.

The following cruciferous plants have been recorded as hosts of turnip-mosaic: Turnips (*Brassica rapa*), Chinese cabbage [Pe-tsai (*B. cernua*)], Pot-herb mustard (*B. japonica*)—(Schultz, 1921); swedes (*B. napobrassica*), charlock (*Sinapis arvensis*), *Raphanus* sp.—(Gram, 1925); Chinese cabbage [Pak-choi (*B. napus* var. *chinensis*)], white mustard (*S. alba*), black mustard (*B. nigra*), rape (*B. napus* var. *typica*), Brussel's sprouts (*B. oleracea* var. *bullata*), cauliflower (*B. oleracea* var. *botrytis*)—(Clayton, 1930); kale (*B. oleracea* var. *acephala*)—(Smith, 1935).

In New Zealand the disease has been found only on swedes, turnips, and rape. In order to determine whether other cruciferous plants were susceptible, an attempt was made in one experiment to transmit turnip-mosaic, by means of artificial inoculations, to the following vegetables: cabbage (*B. oleracea* var. *capitata*), cauliflower, Brussels' sprouts, broccoli (*B. oleracia* var. *botrytis*), and radish (*Raphanus sativus*). No infection was secured.

In a second experiment transmission to the same five crucifers was attempted by means of the aphis *M. persicae*. The method used was the same as that already described for insect transmission of the disease between swedes and turnips. On 29th January, 1936, approximately twelve *M. persicae* were transferred from a mosaic-infected swede-plant to each of eight plants of the five above-mentioned species.

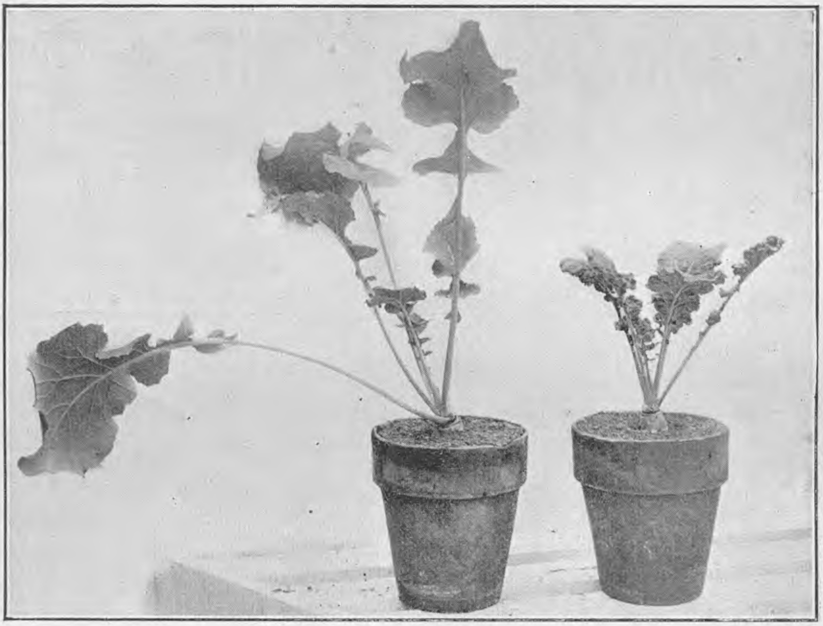

FIG. 2. STUNTING OF SWEDE PLANT CAUSED BY TURNIP-MOSAIC.
Healthy plant on left.

Results.—The numbers of plants which became infected in each species were—cabbage, 1; cauliflower, 2; Brussels' sprouts, 8; broccoli, 7; and radish, 0. The ten control plants remained healthy.

These results show that cabbage, cauliflower, Brussels' sprouts, and broccoli are susceptible to turnip-mosaic. The symptoms which appeared on these plants were caused by turnip-mosaic, since by means of aphides the disease was transmitted back to swedes. (See Table II.)

On cabbage, cauliflower, and Brussels' sprouts turnip-mosaic produced a faint mottling in which the darker-green areas lay adjacent to the veins. On broccoli numerous pale-green areas on the leaves caused a distinct but not pronounced mottling. Under the conditions of the experiments the disease did not adversely affect the growth of any of these four hosts; and as the plants became older the symptoms were difficult to discern.

Hoggan and Johnson (1935) found that a mosaic of crucifers in North America, when transmitted to tobacco (*Nicotiana tabacum*), caused conspicuous brown necrotic lesions confined to the points of infection. Similar results have been secured with turnip-mosaic in New Zealand.

FIG. 3. EFFECT OF TURNIP-MOSAIC ON SWEDE PLANTS IN THE FIELD.

Above—Healthy plants; below—mosaic-infected plants. Both photographs taken in the same crop early in the season, when the disease was prevalent at one end but not at the other.

VARIETAL RESISTANCE.

Working with turnip-mosaic in Germany Pape (1935) recorded some relatively resistant varieties and others which were severely attacked. Amongst the latter was the variety "Yellow Wilhelmsburger."

During the past season a trial of seventy lines of different strains and varieties of swedes, including most of the commonly grown varieties, was undertaken to ascertain their varietal resistance to the fungous disease dry-rot (*Phoma lingam*). All plants were grown in one block, each line of seed being sown in a row 1 chain long. Plants throughout the block became infected with mosaic, thereby enabling observations on varietal resistance to be made. Counts of infected and healthy plants taken in mid-March, 1936, showed that some ten lines exhibited a degree of resistance (Table III).

Table III.—Varietal Resistance to Turnip-mosaic.

Row No.	Variety.	Strain.	Number of Plants.	Percentage of Mosaic.
9	Wilhelmsburger Otofte..	Plant Research Station, Selection No. 1	74	44·6
10	,,	Plant Research Station, Selection No. 2	87	58·6
11	,,	Canadian Strain ..	76	68·4
12	,,	Johnson's Benefactor Strain	77	57·1
13	,,	Plant Research Station, Selection No. 3	78	73·1
26	Imperial	Webb's No. 2 Strain..	57	63·2
30	White-fleshed Purple Top	Sutton's Sensation Strain*	76	0·0
41	Wilhelmsburger Otofte..	Danish Strain ..	64	78·1
52	,, ..	English Strain (Sharpe's)	63	73·0
69	Sharpe's A1	(Sharpe's)	63	71·4
	Average of the sixty other lines ..		65·4	92·7

* Sutton's Sensation is merely an improved selection of Vilmorin White-fleshed Purple Top (Hadfield and Calder, 1935). The original Vilmorin strain was not included in the seventy lines under trial.

Outstanding amongst the ten varieties showing resistance was Sutton's Sensation. Although this variety is highly resistant it is not immune, as mosaic symptoms appeared on a few plants later in the season. The seven strains of Wilhelmsburger grown in the trial all showed resistance to infection. Not only did this variety show resistance to turnip-mosaic, but it was also much less susceptible to a secondary attack by soft-rot.

Control Measures.

In New Zealand turnip-mosaic has become of economic importance only in areas of intensive cultivation. From this it would appear that the disease is most likely to become troublesome in seed-producing areas.

The following recommendations are made for the control of turnip-mosaic in crops grown for seed: (1) Dipping the leaves of plants, at the time of transplanting, in a solution of nicotine or nicotine sulphate to kill insect-vectors (concentration: Nicotine, 1 part to 2,000 parts water; nicotine sulphate, 1 part plus 4 parts soft-soap to 800 parts water). (2) Regular inspection of the crop and rogueing of all infected plants. (3) The avoidance of other cruciferous crops in the vicinity. (4) Keeping the area as free as possible from volunteer seedlings. (5) When mosaic has appeared, spraying the plants with a nicotine spray (concentration as above) to destroy aphides.

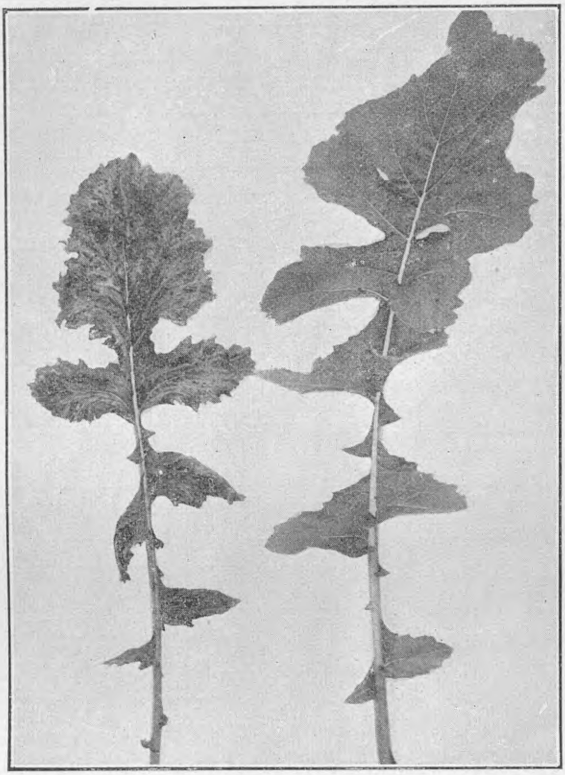

FIG. 4. LEAF OF MOSAIC-INFECTED TURNIP.
Healthy leaf on right.

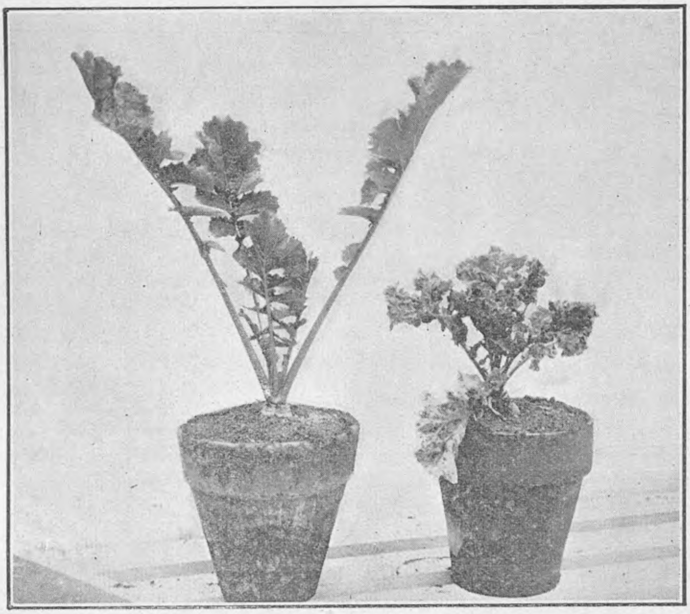

FIG. 5. MOSAIC-INFECTED TURNIP.
Healthy plant on left.

Summary.

(1) Turnip-mosaic, a virus disease of swedes, turnips, and rape, is recorded as occurring in a number of districts throughout New Zealand.

(2) The symptoms of the disease are a mosiac mottling and crinkling of the leaves and a stunting of the plants.

(3) Infected turnips and, under certain conditions, swedes become susceptible to a secondary attack by bacterial soft-rot.

(4) Although not reported to be of economic importance in field crops, turnip-mosaic has been a serious problem on experimental areas at Palmerston North and Marton, and has been troublesome on a seed-producing area at Colyton.

(5) Yield trials with rape have shown that it causes on this host approximately 25 per cent. reduction in yield.

(6) The disease has been transmitted artificially by the leaf-rubbing method.

(7) The aphides *Brevicoryne brassicae* and *Myzus persicae* have been shown to be vectors.

(8) No seed transmission was secured in a small trial involving 432 plants grown from seed of infected swedes.

(9) The disease has been transmitted to cabbage, cauliflower, broccoli, and Brussel's sprouts. It causes only mild symptoms on these hosts.

(10) It may also be transmitted to tobacco, where it produces brown necrotic lesions confined to the points of infection.

(11) Field observations indicate that Sensation swede (a Sutton's selection of White-fleshed Purple Top) is highly resistant to mosaic infection, while Wilhelmsburger, Webb's No. 2 strain of Imperial, and Sharpe's A1 are moderately so.

(12) Recommendations are made for the control of turnip-mosaic in seed crops.

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A development that may be expected to follow naturally from the unified thought and co-operative effort that are considered desirable in the work of the Department is a trend towards standardized practice, which, reflecting the best knowledge available, should lead to greater general efficiency, begetting both increased production and improved quality in our farm products. *Annual Report, Minister of Agriculture.*

PASTURES AND THEIR IMPROVEMENT IN RELATION TO THE MANAGEMENT OF FOOT-HILL FARMS IN CANTERBURY.

WITH SPECIAL REFERENCE TO PLOUGHABLE AREAS.

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THE foothill areas of Canterbury consist of a large portion of the province, extending from the Conway River in the north to the Waitaki River in the south, a distance of some 230 miles. This same area varies in width from a few miles behind Methven and Mayfield to some 80 miles in a part of North Canterbury, with much variation between these limits. Except in parts of North Canterbury, the climate generally is more severe and the rainfall higher than on the Plains. There is, of course, much variation. The soil, in general, is second class, but much variation exists, so that good rich pockets and small flats are not uncommon. Large areas of tussock and also of third-class land—poor, clay, scrub country—are prominent in certain districts. A rough estimate of the area of the foothill farms in Canterbury is 2,000,000 acres.

A typical farm or small sheep-run in this area consists of some medium flat land, a fair proportion of rolling downs with steep gullies, and possibly an unploughable tussock or scrub area. The total ploughable area varies considerably between properties, but on an average might be one-half to three-quarters of the area of the farm, the total area of which might be 1,200 acres. The average carrying-capacity would be one to one and a half sheep per acre, and a few cattle would be carried. The sheep, in the main, are half-breds, but in many of the wetter and colder districts and on the sour, clay soils Romney sheep are preferred. Corriedales constitute a fair proportion of the sheep of North Canterbury.

Ewe hoggets are kept each year for flock maintenance. Surplus four- and five-year-old breeding-ewes, fat and store lambs, some fat ewes, store wethers, cull ewe lambs, and cull two-tooth ewes, together with wool and some cattle, constitute the main source of farm income. In recent times a few specially favoured properties with some suitable land have grown small areas of wheat and rye-grass seed. The production of these crops, however, is a precarious undertaking on account of the risks of winter flooding and strong winds and wet weather at harvest.

GENERAL FARM PRACTICES IN THE AREA.

Apart from the breeding of sheep and the general routine of sheep husbandry, the farm-management centres round the provision of winter feed, spring lambing feed, and some fattening feed. The constant breaking-up of old run-out pastures and the sowing-down of new ones is a very important phase of the management policy.

Turnips provide the bulk of the winter feed, green oats and newly sown temporary or permanent pasture what lambing green-feed there is, and rape, kale, and turnips sown with grass or alone the fattening feed. On well-managed properties oat-sheaf chaff and, to some extent, hay provide the reserve winter feed. There is nearly always adequate summer feed, although in parts of North Canterbury, on account of the dryness, summer and early autumn feed are often a more acute problem than winter feed.

New pastures are sown each year in the normal course of supplementary-feed production. They are nearly always sown with one or other of the supplementary-feed crops previously mentioned, and are not usually sown with a view to securing a first-class permanent pasture. The success of the establishment of pastures sown in this fashion depends on the seed-mixture used, the soil condition at sowing, the strike and vigour of the supplementary crop, the severity of the grazing when the supplementary crop is being eaten off, and other factors which usually are considered not from the point of view of securing first-class pasture, but rather from that of a first-class supplementary crop. The result is that such new pastures, at their best, can only be mediocre. They soon deteriorate to inferior swards, which sweet vernal and brown-top readily invade and soon dominate.

The soils in these areas respond to top-dressing with phosphate and lime, a practice which, because of the poorness of the new pasture, can rarely be considered economic. At any rate, systematic pasture top-dressing is rarely practised. Though the best permanent pastures are desired they are secured only occasionally by the "chance" or "hit and miss" principle of the use of unsatisfactory seed-mixtures and sowing-down methods. Even when the best seed-mixtures are sown and "chance" good pastures are secured, these are rarely top-dressed and therefore are not maintained.

Present Pastures.

The greater proportion of the pastures on the foothill areas are poor, and consist mainly of brown-top, sweet vernal, danthonia, some creeping-fog, trefoil, hair-grass, and other low-producing species. Some volunteer white clover and odd cocksfoot and rye-grass plants are present in a few pastures. Often dogstail, and occasionally timothy, are to be found. Brown-top and sweet vernal, though, are the dominant grass species, and often form dense turfs of badly grazed and unpalatable roughage. These pastures give a low carrying-capacity.

Improperly sown new pastures, because of their openness at the start, soon become invaded with these low-producing species. Without manurial treatment the good species that may be sown and that have survived the maltreatment associated with the turnip or other supplementary companion crop cease to retain their vigour after the first year. Such pastures steadily deteriorate, giving a progressively lower grazing-capacity, and subsequently the brown-top becomes sod-bound, with a still lower grazing-capacity. If it were not for the cost of renewal and the fact that all the other pastures on the farm are waiting to be renewed, such a deteriorating newly sown pasture could, with advantage, be ploughed, and again renewed in its third or fourth year. The pasture, however, may not be renewed for eight or even more years.

A low carrying-capacity of a poor-quality feed means low production, and consequently acts as a limit to farm income. Because of this, the pastoral problem on the foothill areas is most important, and, provided there is good farm-management generally, the farmer's maximum profits depend upon the success with which this problem is handled.

AN IMPROVED METHOD OF SOWING GRASS ON THESE AREAS.

As already stated, turnips are sown for winter feed, green-feed is required in spring, and some fattening feed is usually grown. By a reorganization of the cropping programme to allow the sowing of turnips alone or with a very light seeding of Italian rye-grass, the land, after the turnips are eaten off, can be ploughed in the spring, given ideal treatment in the average season, and sown to grass in November–December or January–early-February. On land where annual weeds such as spurrey are troublesome, ideal preparation of the seed-bed should be continued until February to allow early autumn sowing. The inclusion of ½ lb. per acre of rape, kale, or chou moellier gives an extra bulk of fattening feed without harming the new grass by smothering or by excessive tramping as when feeding-off a heavy supplementary crop. The grass (and clovers), because of the fallow, the manure used, and the time of sowing, forms a dense sward of desirable species from the commencement, thus giving little opportunity for the invasion of inferior species. Liberal top-dressing in the first year, followed by annual top-dressing, together with suitable grazing-management, maintains a first-class sward of high carrying-capacity on any of these areas.

The value and importance of sowing in this fashion lies in the fact that a dense complete sward of desirable species is obtained at the outset. If followed up by a regular systematic top-dressing policy such a sward can be maintained indefinitely, whereas a poor open pasture on this class of ploughable land can never, within the bounds of practical and economical farming, be improved except by ploughing and resowing.

PASTURE SPECIES SOWN: SEED-MIXTURES.

Improved permanent pastures have been secured by sowing various mixtures under different conditions of soil and climate. The species included in these mixtures have been true or certified perennial rye-grass, cocksfoot, timothy, dogstail, ordinary red clover, certified white clover, subterranean clover, Montgomeryshire red clover, and lucerne. All of the following mixtures, as well as others not given, have been sown on different farms. On several farms two or three of these mixtures have been used on different fields at different times.

Seed-mixture Sown (Pounds per Acre).

—	(1.)	(2.)	(3.)	(4.)	(5.)	(6.)	(7.)	(8.)	(9.)	(10.)	(11.)	(12.)	(13.)
Certified perennial rye-grass	30–35	28–30	28–30	30–35	30–35	28–30	28–30	28–30	4–5	4–5	28–30	28–30	28–30
Cocksfoot: Minimum germination, 75 per cent.	..	8–12	8–12	..	..	8–12	8–12	8–12	12–15	12–15	..	8–12	8–12
Certified white clover..	..	..	1–2	1–2	1–2	1–2	1–2	1–2	1–2	1–2	..	1–2	1–2
Red clover	4–5	4–5	3–4	3–4	..	3–4	3–4	3–4	3–4	..	3–4	..	..
Montgomeryshire red clover	..	..	..	..	3–4	..	..	..	..	3–4	..	3–4	3–4
Subterranean clover ..	..	..	..	..	..	1–2	..	..	..	..	..	1–2	..
Lucerne	..	..	..	..	..	..	..	..	..	2–4	2–4	2–4	..
Timothy	..	..	..	..	..	..	1–2	..	..	..	..	..	..
Dogstail	..	..	..	..	..	..	..	½–1	..	..	..	..	..
Total	34–40	40–47	40–48	34–41	34–41	41–50	41–50	40½–49	21–27	22–30	33–38	43–54	40–48

It will be seen at a glance that all permanent-pasture seed-mixtures contain true or certified perennial rye-grass, most of them include cocksfoot, and a very large proportion include wild or certified white clover. Red clover also is very commonly used when sowing down these improved permanent pastures. During the last year or so, with the cheapening of Montgomeryshire red-clover seed, this plant has been used in a few instances. It is anticipated that it may gradually replace red clover as farmers themselves gain more experience of the value of high-producing permanent pastures and the use that Montgomeryshire red clover can be in these swards. Timothy and dogstail are added to the mixture by some farmers in certain districts. Subterranean clover is being sown in the seed-mixture used on the poorer soils in parts of North Canterbury, and could be used more extensively with advantage. Lucerne is sown in the grass mixture only in parts of North Canterbury, and here it performs the very useful function of giving feed longer into the dry weather than other species. Because cocksfoot is partially smothered by and eaten out in a vigorous rye-grass stand, some farmers have omitted it from their mixtures. On all the better and heavier soils this does not appear to be a disadvantage. Regardless, almost, of soil or locality under Canterbury foothill conditions certified white clover should always be sown. It is the foundation of improved and top-dressed permanent pastures. On the poorer soils subterranean clover should, on at least a large proportion of the farm, be a companion to white clover in soil and pasture improvement. Of the mixtures given, No. 3 and No. 4 are the most commonly used. A few farmers are using Nos. 5, 6, and 13. In North Canterbury No. 10, No. 11, and No. 12 are in favour. No. 1 cannot be recommended for a permanent pasture, and No. 2 is inferior in value to No. 3 unless a good growth of volunteer white clover can be brought about by top-dressing. Dependence on volunteer white clover, however, is definitely not advisable.

Manurial Treatment and Grazing-management.

Liberal manuring and liming when sowing and during the first year of the life of the new permanent pasture is most important. Common practice is to use 1 cwt. to 1½ cwt. of superphosphate per acre at sowing-time. Top-dressing is commenced in the first autumn with 1 cwt. to 1¼ cwt. of superphosphate and 4 cwt. to 5 cwt. of carbonate of lime. Subsequently about 1 cwt. of superphosphate is applied each autumn, and 4 cwt. to 5 cwt. of lime at two- or three-year intervals. With this manuring on the poorer soils a stage of pronounced weakness is often apparent during the second year of the life of the sward.

In one instance, on poor clay soil on one of these foothill farms, 3 cwt. of superphosphate and 3 cwt. of lime (carbonate) were sown with the seed in early February, 1 cwt. of superphosphate and 5 cwt. of lime applied in April as soon as the new sward would carry the drill (used for top-dressing), 1 cwt. of superphosphate applied the following spring, and 1 cwt. of superphosphate applied the same or following autumn, which was last autumn. The pasture is now one and a half years old. It is an excellent sward. The certified white clover and the red clover have developed, the rye-grass has already passed through a slight weakening stage, and the cocksfoot is growing well on this poor soil, which " would not grow good permanent pasture " according to all local evidence. This is on a farm at present carrying half a sheep per acre. The new pasture, the first of the improved type on this farm, has averaged just over two sheep per acre since sowing, as well as producing 20 bushels of perennial rye-grass last summer.

The grazing-management has been along the usual lines of judicious controlled grazing—*i.e.*, the new pasture has neither been punished nor allowed to get out of hand. It has, during the period, been grazed to suit the pasture.

A special feature of the grazing-management, however, in the first and second summers following spring sowings and the first summer following autumn sowings is to graze the pasture lightly or to spell it entirely for approximately a two-months period in summer—November–December or December–January appear the best periods—for the purpose of allowing clovers to develop. The particular pasture in question was shut for rye-grass seed on the 1st November, mowed and header-harvested in January, and not grazed until 23rd January, by which time there was a good second growth of red and white clover.

The poorer the soil the more important is this treatment on account of the value of clovers in the building-up of the rye-grass of the sward. On really good soils little spelling, if any, may be necessary. This practice of spelling should not be such that growth gets out of hand, but merely sufficient to allow the clovers, which are readily eaten out in a sward of relatively unpalatable permanent rye-grass, especially on poorer soils, to develop freely and become established as an integral part of the new permanent pasture.

Importance of Top-dressing.

Some farmers have occasionally put this policy of pasture renewal into practice and omitted on one or two paddocks, or, worse still, perhaps, on the first pasture sown the necessary manurial treatment. For the first six months, year, or perhaps eighteen months, according to the quality of the land, the new pasture has been apparently all that was expected, but soon the rye-grass has become hard and unpalatable, clovers have failed to develop, and inferior species have entered readily. Disappointment has been the result, and the policy for improvement abandoned.

It has become demonstrated amply that unless a suitable annual top-dressing programme has been conscientiously followed any policy for pasture improvement on these soils is only of passing value. Experiences to date are convincing that there is no permanent gain by properly sowing valuable pasture-seed mixtures without fertilizer.

Some Benefits from Improved Permanent Pastures on Foothill Farms.

Improved permanent pastures of high carrying-capacity mean improvement to the farmer's property. His assets are increased. The only measure of this increase in assets is the increase in productive value (or net returns). This is very largely dependent upon the area sown to good pasture and maintained as such. Very few farmers, if any, in the foothill area have definitely planned a pasture-improvement policy along the lines indicated for more than five or six years, so that assuming an annual sowing-down of 5 per cent. to 7 per cent.

of the farm (and without capital expenditure little more than this area can be sown down annually) the yearly increase in assets must of necessity be small. There remains a large area yet to be dealt with, and much scope for increasing carrying-capacity, and thus assets, on most of these properties.

Over the short period of development mentioned, several properties have increased their sheep numbers by 20 per cent. to 25 per cent., a large number by smaller percentages, and one property by 46 per cent. It is safe to forecast that many of these properties will more than double their carrying-capacity as development progresses.

Efficiently managed, improved, and top-dressed pastures also enable more lambs to be fattened on the mothers, and frequently, in consequence, allow a greater total number of fat lambs to be produced than would otherwise be the case. Thus the percentage of lambs sold as " stores " is reduced. There is ample evidence of this.

Under the improved conditions outlined there is the usual or greater quantity of winter feed for sheep. A greater and longer autumn growth, some and more winter growth, and a greater and earlier spring growth is obtained from improved and top-dressed pastures than from inferior ones. This additional growth in the " off " season may be such that, although sheep numbers may be very greatly increased, the provision of additional areas of winter supplementary feed such as turnips is unnecessary, though under these conditions hay or ensilage, or both, provide the reserve. An extra grass-feed supply in winter is often reflected in an increase in lambing percentage and lambing survival. An increased wool clip per sheep shorn is one of the first benefits of good pasture and adequate feed. It is not uncommon to have increases in lambing percentages of 5 per cent., 10 per cent., and even 15 per cent. The wool clip has been improved on several properties by $1\frac{1}{2}$ lb. per sheep (and this half-bred wool, too). In one instance the clip per sheep has been raised from $7\frac{1}{4}$ lb. to $9\frac{3}{4}$ lb.

On many foothill farms hogget mortality, due mainly to worms and malnutrition, is high. On one property, by the aid of clean, uncontaminated new pasture used for winter feed along with chaff and hay, hogget mortality has been reduced without drenching over a three-year period from 20 per cent. to 3 per cent. It is not claimed that the improved new pastures were in themselves responsible for this, but the policy of pasture renewal introduced four years ago allowed the hoggets to be grazed on clean feed. On other properties also significant reductions in hogget mortality have been secured.

All the above benefits, if not due directly to improved pastures in themselves, are distinctly associated with and very largely dependent upon practising a pasture-improvement policy. There is no other more economical method of securing on these areas the benefits outlined.

Financial Aspect.

On nearly all foothill farms there is a team or power unit used in the cultivation and cropping programme. The new policy that allows the proper sowing of grass does not usually entail any great increase in the area cultivated each year, but rather a rearrangement of the cropping rotation. There is, however, a little extra surface cultivation for new permanent pasture. For a typical farm carrying 1,600 sheep the cropping under the old and the new methods might be compared in the following manner :—

	Old. Acres.	New (first few Years). Acres.
Turnips and grass	80	..
Turnips	..	80
Rape and grass..	40	..
Rape	..	40
New permanent pasture	..	80
Green-feed oats and grass	40	..
Green-feed	40	40
Oats (for chaff)..	40	40
	240	280

There is really no significant extra team or power-unit costs for cultivation, the few extra acres being handled usually by the present units at more or less a fixed overhead charge. Grass-seeds may cost an extra 5s. to 10s. per acre, or even more, but this cost is offset by a reduced area being sown down and by a smaller seeds account for the saving of green-feed. The manurial costs are, however, increased, and at progressively greater annual cost as development (which includes top-dressing) proceeds. This sometimes is partly offset by the sowing of permanent rye-grass for seed. Usually, however, top-dressing has to be reckoned as a direct charge against the benefits derived from growing improved pastures—a charge which is substantially offset by increased carrying-capacity, extra fat lambs, heavier wool clip, and so on.

Over the years, other things being equal, a policy of pasture improvement can only result in increased net returns. This has been demonstrated in practice by progressive and successful farmers. Where development, however, is more rapid than that permitted by the usual cropping programme, then, not only are seed and cultivation costs increased, but also proportionately larger numbers of ewe hoggets and four- and five-year-old ewes must be kept from sale, thus reducing receipts. At the same time manurial and top-dressing costs rise rapidly. Income from these improvements lags to some extent, and so trading accounts may show deficits while capital accounts for the same properties show improvements. Ready cash is usually needed for rapid development, which cannot be recommended unless capital expenditure and the long view are reckoned upon. Over-anxious and enthusiastic farmers sometimes develop their properties more rapidly than their resources make advisable.

WHY A PASTURE-IMPROVEMENT POLICY IS NOT AND HAS NOT BEEN GENERALLY ADOPTED.

Some explanation why grass is and has been sown in an unsatisfactory fashion with turnips, rape, and other supplementary crops now seems necessary. Failure to adopt the practice of top-dressing when only poor pastures of a more or less temporary nature were available should need no comment.

The idea of a supplementary crop and a pasture being produced for the one and same cultivation and manurial cost has always appealed. Further, good permanent-pasture seed-mixtures, including true perennial rye-grass, have not been generally available, and thus, regardless of the method of sowing and subsequent treatment, the temporary rye-grass in the seed-mixture has quickly died out and left much bare ground for the establishment of inferior species. This rapid "running-out" has necessitated the renewal of large areas each year, with the result that pastures more or less have had to be sown every available opportunity—*i.e.*, with every supplementary crop—in an attempt to cope with the large areas awaiting the plough. This state of affairs has been characteristic of many farms, and unavoidable on those where temporary perennial rye-grass and red clover alone have constituted the pasture-seed mixture. As previously explained, the method of sowing also adds to the subsequent poorness and openness of the new pasture. Top-dressing on these areas has never been able to compensate for an unsuitable seed-mixture sown indifferently or otherwise.

The balanced-feeding value of turnips and grass and rape and grass is also an important factor favouring the sowing of grass with a supplementary crop. Progressive farmers, however, who are practising an improved grassing policy and cannot feed a good run-out of pasture, hay, or chaff, or both hay and chaff, along with their turnips usually sow with them ½ bushel per acre of Italian rye-grass. The turnips are grubbed in the usual fashion and the land ploughed for the sowing of new permanent grass in the approved method, regardless of the Italian rye-grass that may still be present.

An Example of Progress on a Foothill Farm.

A few particulars of progress and development under an improved grassing policy on a foothill farm should be of interest. The farm is situated near the Rakaia Gorge, on the Lake Coleridge road. The altitude is about 1,500 ft. Falls of snow in winter are often experienced. The area of the property is 800 acres, of which 60 acres are in plantations and 100 acres are in steep hilly tussock. The remainder comprises flats and gentle downs. A medium-quality loam grows natural pasturage of brown-top, sweet vernal, trefoil, &c., as well as some tussocks.

In 1932 turnips and grass were sown together and provided the winter feed as well as the new pasture. No fattening feed was grown at that time. The cropping last season—1935–36—consisted of 45 acres of turnips and swedes, 64 acres of new permanent pasture sown with ½ lb. rape per acre. In the past chaff has provided what winter reserve feed has been used. The total area sown to new pasture to date in the improved method is 130 acres. Particulars of stocking, sheep shorn, wool-yields, total death-rate (all sheep), and lambing percentages over a period of years are given in the table on following page.

Particulars of Stock Numbers, Sheep shorn, Wool-yield, Total Death-rate (all Sheep), and Lambing Percentages for Period 1930 to 1936.

Year.	Stock, 30th June.		Sheep shorn.	Wool-yield per Sheep.	Total Death-rate in all Sheep.	Lambing Percentage (calculated on Ewes put to Ram).
	Sheep and Cattle.	Sheep Units. (1 Cattle Beast = 6 Sheep Units.)				
				Lb.	Per Cent.	Per Cent.
1930 ..	..	..	869	..	..	67
1931 ..	860 sheep 57 cattle	1,202	751	$6\frac{3}{4}$	6	72
1932 ..	856 sheep 70 cattle	1,276	791	$7\frac{3}{4}$	6	70
1933 ..	1,057 sheep 7 cattle	1,099	939	7	13	66
1934 ..	1,100 sheep 15 cattle	1,190	939	$7\frac{1}{4}$	13	78
1935 ..	1,235 sheep 17 cattle	1,356	925	$9\frac{3}{4}$	8	86
1936 ..	1,632 sheep 20 cattle	1,752	..	..	..	..

The first new pasture to be sown in the improved fashion after turnips consisted of 30 acres. It was sown in early November, 1933, with 35 lb. permanent rye-grass, 10 lb. cocksfoot, and 5 lb. red-clover seed per acre, and also 1 cwt. superphosphate per acre. Grazing was commenced in January, 1934. Top-dressing with 3 cwt. per acre of carbonate of lime in June, 1934, and 1 cwt. superphosphate per acre in early September, 1934, was carried out. It was also top-dressed in the autumns of 1935 and 1936 with 1 cwt. superphosphate per acre on each occasion.

The grazing-capacity as dry sheep per acre since establishment is given below by months :—

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1934 ..	7·63	14·50	9·20	8·96	3·59	..	..	..	0·70	5·20	2·30	1·40
1935 ..	9·70	11·30	3·10	6·90	1·09	4·54	..	1·47	1·21	4·21	5·60	10·57
1936 ..	6·77	0·28	7·24	2·20	1·89	..	..	..	..	..	..	..

The average number of dry sheep carried per acre for a period of thirty months was 4·43. This carrying-capacity is especially significant in view of the fact that the carrying-capacity of the farm as a whole prior to this winter has been only $1\frac{1}{2}$ sheep per acre. The light grazing in November and December, 1934, was purposely carried out to allow of clover development as discussed earlier. Up to this last autumn, when some damage by grass-grub has been experienced, this particular pasture was a good dense sward with a low proportion of sweet vernal and some trefoil in association with the higher-producing species. Cocksfoot was not very prominent, but on this land volunteer white clover is excellent. So far brown-top is practically non-existent in this pasture.

ACKNOWLEDGMENT.

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THE USE OF CONCENTRATES WITH FACTORY BUTTERMILK IN FATTENING BACON PIGS.

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IT is well recognized that the addition of suitable concentrates to dairy by-products enhances considerably the nutritive value of the latter foodstuffs, but it is equally well recognized also that concentrates cannot be used, however desirable the practice may be from the nutritive point of view, if such use is not accompanied by a greater profit from pig-fattening than can be obtained from feeding dairy by-products alone. Accurate information upon the rates of meal-feeding with different types of meals and dairy by-products profitable to use at varying prices for meals and for the fattened product is not only very limited, but is also of importance.

Pig-fattening trials with dairy by-products have been carried out in many parts of the world, but unfortunately the results, in a very large measure, are not applicable to New Zealand because they nearly all relate to the minimum amounts of dairy by-products that can be used to advantage to supplement cereals, since in these countries, cereals are in abundant supply and dairy by-products are scarce. Throughout the major dairying and pig-raising districts our problem is exactly the opposite. It may be stated thus: What are the minimum amounts of meals which we can feed to advantage with maximum quantities of separated milk, buttermilk, and whey, the latter being our surplus foods and the former our scarce and therefore relatively expensive materials ?

While it is certain that heavy meal-feeding at the rates shown to be desirable in other countries—viz., 2 lb. to 3 lb. per gallon of separated milk—are definitely unprofitable under our normal prevailing prices, it is possible that the limited use of concentrates may pay under favourable conditions. Current farming practice supports this view, and, where meals are employed, the quantities used are normally extremely small relative to the ration of dairy by-products fed. Thus the rate may vary from 1 part of meal to 30 parts up to 100 parts of by-product as compared with the Danish system of feeding where the rate is commonly from 1 to 2 parts of meal to 1 part of by-product. Due largely to the paucity of information on the subject, little uniformity of practice exists even amongst farmers using concentrates; while a large number confine their attention to the utilization of dairy by-products alone.

It is important that the subject cannot be decided wholly upon the relationship of the price of meals to the price of pork and bacon. Thus factory whey is of little value alone as a fattening food, being deficient in essential flesh-forming constituents. Supplementing with minimum quantities of suitable concentrates to make good this deficiency is essential before whey can be utilized adequately in pig-fattening at all. Further, even on the economic side, the problem is no simple one. While it is possible in carefully controlled feeding trials to compare the relative cash returns from dairy by-products used alone and from dairy by-products used with meals in various quantities and varying types, such results do not present a complete picture of the financial results of supplementing with meals. The feeding of meals possesses certain advantages, the precise financial effects of which are impossible to estimate with accuracy. The time taken to fatten a pig enters largely into the question for various reasons :—

(*a*) Even small amounts enhance the value of the by-product fed. Although the daily consumption of milk is not reduced by a low plane of meal-feeding, the total fattening period is reduced, and a saving effected in the total amount of milk required per pig. This results in a greater turnover and a quicker turnover, both of which affect production-costs by reducing the overhead charges on each pig fattened.

(*b*) This shortening of the fattening period by the limited use of concentrates may be of particular value when milk-supplies fall at the end of the season, by allowing of profitable marketing of pigs that otherwise would have to be specially handled either by carry-over in the winter or marketing at low weights of inferior quality. In this way the judicious use of meals may play a definite part in the successful fattening of two litters per year—a practice often impossible on milk alone, yet one essential for low overhead costs.

(*c*) It frequently happens that prices of pig-meat fall at certain periods of the year, or that a fall of price is anticipated. If the farmer can adopt a system by which he can produce an accelerated rate of growth it often pays him to do so, though ordinarily that system of feeding may not be profitable.

These points should be kept in mind when examining the results of the feeding trials herein described. These trials have been designed primarily to investigate the economic aspects of the use of concentrate meals as supplements. The financial results for the reasons set out above underestimate rather than overestimate the case for meal-supplementing in pig-fattening.

A further important aspect of meal-supplementing which has been investigated coincident with the economic side, has been the effect of the use of limited amounts of meals upon the commercial quality of the bacon carcass. Quality in the finished product is such an important factor to-day in profitable production that any feed trial designed to provide data upon the relative merits of various methods must consider the carcass quality. Moreover, much of the criticism of the quality of our export baconers by the British market has been attributed to the system of feeding, and numerous suggestions have been made from time to time by responsible authorities that considerable improvement would result from the greater use of concentrates along with our dairy by-products. The data collected in this connection will be the subject of a separate paper.

TECHNIQUE EMPLOYED.

All trials have been conducted by the "Group" method. The various groups in any one series have been composed of pigs of known breeding and comparable pre-weaning history, selected shortly after weaning, and evenly "balanced" between the various groups according to breed, breeding, initial live-weight, age, and sex. All groups in any one series are comparable in these respects. Care has been taken to ensure similar housing, pen accommodation, and general management in feeding for all groups, the only difference being the actual rations employed. The quantity of milk fed has in all cases been governed by the appetite of the pigs—the quantity which each group would clean up readily when fed three times daily. In meal-supplemented groups, the concentrates have been fed at the morning and evening feed in equal amounts. All feed has been accurately measured. Initial live-weights have been taken before feeding in the morning after an all-night fast. Every pig has been carried to approximately the same final dressed carcass weight—viz., 140 lb.—by removal from the experiment for slaughter when a live-weight of approximately 200 lb. has been reached. Economic results have been based upon the food required to produce 100 lb. of dressed-weight gain. This has been calculated from the actual final dressed weight obtained on slaughter, and the "initial" dressed weight, obtained by deducting an amount for offal of $33\frac{1}{3}$ per cent. from the initial live-weight. This system has been adopted in preference to stating results in terms of live-weight. Pigs are paid for on a dressed-weight basis, and the data have therefore a direct bearing upon cash returns. Live-weight is not so useful in this respect, and, in addition, is very difficult to ascertain with accuracy owing to the many factors not under control affecting it. The writer's experience over several years of pig-feeding trials has indicated the use of live-weights to be associated with material difficulties, particularly when the greater part of the rations fed is composed of liquids, and despite the possibility of error introduced by estimating "initial dressed weight," the use of dressed weight is likely to be associated with greater accuracy.

After slaughter the commercial quality of each carcass has been carefully examined, and subsequently, in the majority of cases, the pigs have been shipped to London for examination and report by English experts.

It must be noted that the trials reported in this paper cover the use of factory buttermilk; trials using separated milk and whey will be the subject of a separate report. While the results outlined are thus not strictly applicable in detail to the use of separated milk, it is fairly safe to assume that they have a general bearing on the use of the latter material, as the two foodstuffs are similar in type. Information from trials with separated milk so far available lends support to such a view.

SERIES A.

The use of Different Types of Meal over the Weaner-baconer Weight Range.

Forty-four Tamworth-Berkshire first-cross pigs from recorded litters were evenly balanced into four groups, each of 11 pigs. All pigs were by the same sire, and were placed under trial when twelve weeks old. During the pre-weaning period, and for the month thereafter, all had received limited daily rations of a cereal meal amounting to $\frac{1}{4}$ lb. to $\frac{1}{2}$ lb. per pig daily, in addition to buttermilk. The rations of each group during the progress of the trial were as follows:—

Group 1—Control: Factory buttermilk only.

Group 2—Meat-meal* : Factory buttermilk plus ½ lb. of meat-meal per pig daily.
Group 3—Meat-meal and pollard† : Factory buttermilk plus ¼ lb. meat-meal plus ½ lb. pollard per pig daily.
Group 4—Cereal-meal‡ : Factory buttermilk plus ¾ lb. cereal-meal per pig daily.

GROWTH-RATE AND FOOD-CONSUMPTION RESULTS.

The growth-rate and food-consumption results are set out in Table 1 :—

Table 1.—Series A : Effect of varying Types of Meal Supplements.

—	Group 1 : Control—Milk only.	Group 2 : ½ lb Meat-meal.	Group 3 : ¼ lb Meat-meal, ½ lb. Pollard.	Group 4 : ¾ lb. Cereal-meal.
Growth-rate.				
* Initial weight	486 lb.	396 lb.	366 lb.	360 lb.
Average	44·2 lb.	36 lb.	33·2 lb.	33 lb.
† Final weight ..	1,603 lb.	1,563 lb.	1,564 lb.	1,570 lb.
Average	145·7 lb.	142 lb.	142·2 lb.	143 lb.
* Total gains	1,117 lb.	1,167 lb.	1,198 lb.	1,210 lb.
Average	101·6 lb.	106 lb.	109 lb.	110 lb.
Average days on trial ..	123	120	120	113
Average daily weight-gain	0·82 lb.	0·88 lb.	0·91 lb.	0·96 lb.
Food-consumption.				
Total—				
Buttermilk	7,980 gals.	7,480 gals.	7,480 gals.	6,710 gals.
Meat-meal	..	653 lb.	326 lb.	..
Pollard	..	..	653 lb.	..
Cereal-meal	..	..	..	1,026 lb.
Per 100 lb. gain of dressed weight—				
Buttermilk	714 gals.	641 gals.	624 gals.	555 gals.
Meat-meal	..	56 lb.	27 lb.	..
Pollard	..	..	54 lb.	..
Cereal-meal	..	..	..	84·8 lb.

* Dressed weight calculated. † Dressed weight actual.

It will be observed from the above that in every case the meal-supplemented pigs consumed less buttermilk in the production of 100 lb. of dressed-weight gain, fattened at a greater rate, and, in consequence, required less time to make marketable weight than the pigs fed buttermilk alone. At the same time the control group put up a good performance, the figure, 700 gallons of buttermilk per 100 lb. dressed-weight gain being of considerable interest in indicating the value of this dairy by-product in pig-fattening.

Of the three types of concentrate used, Cereal-meal (Group 4) gave the best results on a food-consumption and growth-rate basis. It will be noted that in this group the feeding of approximately 85 lb. of cereal-meal per 100 lb. of meat produced resulted in a saving of

*Meat-meal; pure meat-meal, 60 per cent. to 65 per cent. crude protein, 10 per cent. fat. †Pollard. New Zealand commercial sample. ‡Cereal-meal; mixture of 55 per cent. barley-meal, 10 per cent. pea-meal, 20 per cent. pollard, 5 per cent. maize-meal, 10 per cent. meat-meal.

160 gallons of buttermilk as compared with the control group for the same increase in weight. This is equivalent to a saving of 22 per cent. in milk-requirement. Similarly Group 3 gave a saving of 12·5 per cent. and Group 2 of 10 per cent. of buttermilk over the amount required when used alone.

ECONOMY RESULTS.

Table 2 sets out the respective cash returns in pence per 100 gallons of buttermilk fed under the four systems. These have been calculated for varying bacon and meal prices, the cost of the meal used having been deducted from the gross returns in the case of the meal-fed groups, the balance only being credited to the buttermilk used.

Table 2.—Series A : Cash Returns per 100 Gallons Buttermilk (deducting Cost of Meals).

——	Group 2 : Meat-meal.			Group 3 : Meat-meal and Pollard.			Group 4 : Cereal-meal.		
Bacon price per pound ..	4d.	5d.	6d.	4d.	5d.	6d.	4d.	5d.	6d.
Control buttermilk only	56d.	70d.	84d.	56d.	70d.	84d.	56d.	70d.	84d.
Meal at £6 per ton ..	56·od.	71·9d.	87·5d.	54·8d.	70·8d.	86·8d.	61·od.	79·od.	97·od.
Meal at £8 per ton ..	54·od.	69·7d.	85·6d.	51·6d.	67·6d.	83·6d.	57·4d.	75·4d.	93·4d.
Meal at £10 per ton ..	52·od.	67·7d.	83·3d.	48·6d.	64·6d.	80·6d.	53·8d.	71·8d.	89·8d.
Meal at £12 per ton ..	50·od.	65·6d.	81·2d.	45·5d.	61·5d.	77·5d.	50·2d.	68·2d.	86·2d.

The intimate dependence of the economy of meal-supplementing upon the bacon-meal price relationship can be seen from the data presented in this table. With meal costing £6 per ton and bacon worth 5d. per pound all three meal groups show greater cash returns than the control group. When the price of bacon falls to 4d. per pound, however, Group 3 becomes unprofitable. A rise in meal price to £10 per ton leaves Group 4 only showing a greater cash return per 100 gallons of milk, and this only when bacon is worth 5d. per pound or more.

As indicated previously, it must be remembered that these figures understate the financial returns from the use of meal; the lower overhead costs possible as a result of the saving in milk and fattening-time must be credited to the meal-feeding systems. The precise effect in this connection unfortunately cannot be assessed from the data available from this experiment. It is likely to be considerable, however, as witness in Group 4 where the 20-per-cent. saving in milk would permit six pigs to be fattened to bacon weights under this system of feeding for every five fattened using buttermilk alone. The saving of ten days per pig in time will also affect cash returns under average conditions. These points are of great importance, particularly since on the majority of dairy-farms the seasonal supply of dairy by-products introduces severe difficulties relative to fattening when milk-supplies fall towards the end of the season and unfinished pigs in large numbers still remain to be marketed. The exact effects of these factors in practice are intimately bound up with management generally, and are capable of measurement only by examining farm pig-raising operations as a whole. In this connection it is of direct interest to note in a recent survey of pig-management on Manawatu farms* where the whole pig-keeping

*Management of Pigs on Dairy-farms. *N.Z. Journal of Agriculture*, July, 1936.

operations came under review showed higher net cash returns per pound of butterfat in favour of farms using meal concentrates at similar rates to those employed in this trial, even although experimentally the margin of profit appears to be small. It is considered that the influence of the factors mentioned above played a definite and material part in producing this result.

Though therefore subject to the disadvantage of underestimating the case for meal-supplementing, the figures arising from the foregoing trial are of considerable interest, and do indicate the approximate prices at which meals would have to be purchased, and the prices which would need to be received for bacon, for the use of supplements to be profitable at the rates employed. Table 3 sets out the position in this connection more clearly.

Table 3.—Series A : Profitable Meal Price - Bacon Price Ratio.

Price of Bacon =	4d. per Pound.	5d. per Pound.	6d. per Pound.	Per Pound.
	£ s. d.	£ s. d.	£ s. d.	
Group 2 ..	6 0 0	7 10 0	9 0 0	= Price of meal per ton.*
Group 3 ..	5 0 0	6 0 0	7 0 0	= Price of meal per ton.
Group 4 ..	9 0 0	11 0 0	13 0 0	= Price of meal per ton.

* Per ton of 2,000 lb.

This table gives the price per ton for meal at which the cash return from buttermilk approximately equals the return when the latter is used without meal. Thus, in Group 4, cereal-meal would have to be bought at £11 per ton or less when bacon is worth 5d. per pound in order for this system of feeding to show a profit margin. With bacon at 5d., the pollard-meat-meal mixture of Group 3 would need to be bought at £6 per ton or less, and the meat-meal of Group 2 at £7 10s. or less.

SERIES B.

Use of Cereal-meal at varying Rates over the Porker-baconer Weight Range.

Following the trial described above, the following was laid down to investigate the effect of varying the rate of meal-supplementing. In Series A different types of concentrate fed at similar rates were compared. Cereal-meal having given the best result was selected as the concentrate, and three groups each of twelve pigs were taken and evenly balanced as previously indicated. The pigs were of similar breeding to those of Series A, but were heavier at the commencement of the trial, averaging approximately 80 lb. dressed weight, as compared with 40 lb. dressed weight in Series A. This trial thus covers what may be termed the "porker-baconer" weight range, as distinct from the first trial which covered the "weaner-baconer" weight range. The rations of the different groups were as follows :—

Group 1—Control : Factory buttermilk only.
Group 2—Light meal : Factory buttermilk plus ¾ lb. cereal-meal per 100 lb. live-weight per day.
Group 3—Medium meal : Factory buttermilk plus 1½ lb. cereal-meal per 100 lb. live-weight per day.

A variation in the method of rationing the meal might be noted. In Series A the meal was employed at the same rates per pig per day throughout the trial. In Series B the rate varied with the growth of the pigs, the amount increasing with increased weight. The pigs were weighed fortnightly, and the meal ration adjusted according to the gross weight of each group on the basis indicated above. General methods of feeding, housing, and pen accommodation were similar to the conditions operating for Series A.

GROWTH-RATE AND FOOD-CONSUMPTION RESULTS.

The growth-rate and food-consumption results are set out in Table 4.

Table 4.—Series B : Effect of varying the Rate of Supplementing.

—	Group 1 : Milk only. (Control.)	Group 2 : Milk + ¾ lb. Cereal-meal.	Group 3 : Milk + 1½ lb. Cereal-meal.
	Growth-rate.		
* Initial weight	1,000 lb.	1,007 lb.	1,001 lb.
Average	83·3 lb.	84 lb.	83·3 lb.
† Final weight	1,610 lb.	1,642 lb.	1,678 lb.
Average	134 lb.	137 lb.	140 lb.
* Gain in weight	601 lb.	635 lb.	678 lb.
Average	50 lb.	53 lb.	56·5 lb.
Average days on trial	62·0	55·5	49·5
Average daily weight-gain	0·80 lb.	0·95 lb.	1·14 lb.
	Food-consumption.		
Total—			
Buttermilk	5,267 gals.	4,367 gals.	4,082 gals.
Cereal-meal	..	837 lb.	1,390 lb.
Per 100 lb. gain of dressed weight—			
Buttermilk	876 gals.	687·7 gals.	602 gals.
Cereal-meal	..	132 lb.	205 lb.

* Dressed weight calculated. † Dressed weight actual.

Again less buttermilk was consumed by the meal-supplemented groups per 100 lb. of dressed weight produced, and a greater rate of fattening maintained than on buttermilk alone. Supplementing at the 1½ lb. rate gave a greater saving in milk and time than supplementing at the ¾ lb. rate, but it is of interest to note that the saving in milk was not directly proportional to the increased amount of meal used. That is, Group 2, using only half as much meal saved 21·5 per cent. milk, as compared with Group 3 (31·2 per cent.). The saving in time amounted to six days and a half and twelve days and a half per pig respectively. This effect of a lower proportional increase in efficiency with heavier rates of meal-supplementing is in keeping with similar results of numerous trials carried out by the writer with both separated milk and whey under similar conditions ; small quantities of meal though producing a smaller gross effect produce a greater proportional effect than larger quantities.

As compared with the results of Series A, the greater amounts of food required to produce 100 lb. of pig-meat in this series are of considerable interest. Thus, comparing Groups 1 and 4 of Series A with Groups 1 and 2 of Series B shows that significantly more buttermilk was required for the production of the same amount of increased weight in the buttermilk-alone groups, and more buttermilk plus meal in the meal-fed groups, *i.e.*,—

Series A: Weight range 40 lb. to 140 lb. required 714 gallons milk, or 555 gallons milk plus 84 lb. meal, per 100 lb. pig-meat produced.

Series B: Weight range 90 lb. to 140 lb. required 876 gallons buttermilk, or 688 gallons milk plus 132 lb. meal, per 100 lb. of pig-meat produced.

While the two series are not strictly comparable, the only material difference between the groups compared above is the weight-range over which they extended, and, although the trials were not designed to investigate the point, the results are so striking as to indicate that the weight-range factor has probably been largely responsible for the difference in the economy of food noted. Such a result is consistent with the fact that small animals have a lower maintenance requirement than large animals, and in consequence a larger proportion of the ration of the former is available for conversion into increased weight.

ECONOMY RESULTS.

Table 5 sets out the economic results on a cash return per 100 gallons of buttermilk basis. Costs of meal used have been deducted in the case of the meal-supplemented groups, the balance only being credited to the buttermilk used.

Table 5.—Series B: Cash Returns per 100 Gallons Buttermilk (deducting Cost of Meals).

——	Group 2 : ¾ lb. Meal.			Group 3 : 1½ lb. Meal.		
Bacon, price per pound ..	4d.	5d.	6d.	4d.	5d.	6d.
Control, buttermilk alone ..	45·5d.	57·od.	68·4d.	45·5d.	57.od.	68·4d.
Meal at £6 per ton ..	44·4d.	58·9d.	73·4d.	43·od.	59·8d.	76·7d.
Meal at £8 per ton ..	39·8d.	54·3d.	68·8d.	34·7d.	51·6d.	68·4d.
Meal at £10 per ton ..	35·2d.	49·7d.	63·2d.	26·6d.	43·5d.	60·4d.
Meal at £12 per ton ..	30·6d.	45·1d.	58·6d.	18·4d.	35·3d.	58·2d.

The most significant feature arising from these results is the fact that only at higher prices for bacon and at lower prices for meal than those normally ruling in New Zealand was there a margin of profit over the control group fed on buttermilk alone. Meals can seldom be purchased at £6 per ton, while the price of bacon is normally well below 6d. per pound the relative prices which would need to exist for a profit margin from meal-supplementing as in Group 2. A slightly higher price could be paid for meal as used in Group 3 if bacon is worth 6d. per pound. The low efficiency of food-consumption of the pigs in this series would appear to be partly responsible for this result, and if this be so it throws considerable doubt on the wisdom of the common practice of pig-fatteners in using meals during the later stages of growth of pigs rather than during the early stages. "Topping off" on meal would appear to be a questionable practice on a profit basis under normal prices.

In so far as the two rates of supplementing are concerned, the results of this series show that supplementing at the lighter rate was productive of greater cash returns than supplementing at the heavier rate at normal price-levels ; both, however, were unprofitable compared with control. This feature of a smaller loss at price-levels at which a loss exists, and a smaller profit at prices conducive to a surplus, associated with the lighter rate of supplementing as compared with the heavier rate is a characteristic feature of the effect of different planes of supplementary feeding, and from a practical point of view means that under New Zealand prices where the meal-bacon price ratio is unfavourable to any extensive profitable use of concentrates feeding of small quantities is a less risky practice than the use of medium to heavy quantities.

SERIES C.

Effect of Meal-supplementing over Varying Weight Ranges.

In order to investigate further the possible effect suggested from the results of Series A and B of the range of growth over which meal supplements are used upon the economy of food-consumption and upon the cash returns from by-products, a third series of trials designed for the purpose have been completed. These also provide additional data on the general problems of meal-utilization. Five groups each of eight first-cross Tamworth-Berkshire pigs were taken. All pigs were of similar breeding to those used in the first two series, and had a similar pre-weaning history. The trial extended over the weaner-baconer weight range, but the stages of growth during which meal was used as a supplement to the milk ration varied. Feeding, housing, and pen accommodation conditions were comparable for each group, and similar to those of the previous trials. The respective rations were as follows :—

Group 1.—Control : Buttermilk only.

Group 2.—Meal, weaner-porker (whole period) : Buttermilk plus 1 lb. of meal per 100 lb. live-weight per day over whole fattening period.

Group 3.—Meal, weaner-porker (early period) : Buttermilk plus 1 lb. of meal per 100 lb. live-weight per day from 50 lb. to 120 lb. live-weight, thereafter to 200 lb. live-weight, buttermilk only.

Group 4.—Meal, heavy to porker, light, porker to baconer (heavy early, light late period) : Buttermilk plus 2 lb. meal per 100 lb. live-weight per day from 50 lb. to 120 lb. live-weight, 1 lb. meal thereafter to 200 lb. live-weight.

Group 5.—Meal, porker to baconer (late period) : Buttermilk plus 1 lb. meal per 190 lb. live-weight per day from 120 lb. to 200 lb. live-weight. From 50 lb. to 120 lb. live-weight, buttermilk alone.

The buttermilk was fed three times daily in quantities which the pigs readily consumed. The meal was fed with the milk at the morning and evening feed. It will be noted that the rations given cover the use of meal as a supplement during the whole period, during the early period, and during the late period of fattening, as well as introducing the modification of feeding at a heavy rate during the early stages, and at half this rate thereafter. The meal used was in all cases cereal-meal as used in the previous trials.

FOOD-CONSUMPTION AND GROWTH-RATE RESULTS.

Table 6 sets out the growth-rate and economy of food-consumption results calculated on a dressed-weight basis.

Table 6.—Series C: Effect of Supplementing over varying Weight Ranges.

—	Group 1: Control.	Group 2.	Group 3.	Group 4.	Group 5.
			Growth-rate.		
* Initial weight	272 lb.	276 lb.	283 lb.	284 lb.	274 lb.
Average	34 lb.	34·5 lb.	35·4 lb.	35·5 lb.	34·2 lb.
† Final weight	1,167 lb.	1,195 lb.	1,166 lb.	1,138 lb.	1,175 lb.
Average	146 lb.	149 lb.	146 lb.	142 lb.	147 lb.
* Gain in weight ..	895 lb.	919 lb.	883 lb.	854 lb.	901 lb.
Average	112 lb.	115 lb.	110·4 lb.	107 lb.	112·6 lb.
Average days on trial ..	187½	170	177½	155½	173
* Average daily weight-gain	0·59 lb.	0·67 lb.	0·63 lb.	0·69 lb.	0·65 lb.
			Food-consumption.		
Total—					
Buttermilk	7,520 gals.	5,459 gals.	6,578 gals.	4,304 gals.	6,217 gals.
Meal	..	1,109 lb.	349 lb.	1,366 lb.	768 lb.
Per 100 lb. gain of dressed weight—					
Buttermilk	840 gals.	594 gals.	745 gals.	504 gals.	690 gals.
Meal	..	120 lb.	40 lb.	160 lb.	85 lb.

* Dressed weight calculated from live-weight. † Actual cold dressed weight.

Examination of the results in Table 6 will indicate that the growth-rate and fattening-time of the respective groups was in keeping with the amounts of meal fed, groups receiving the larger quantities fattening at a faster rate. It will also be noted that the growth-rate of all groups was lower than that obtaining in the previous trials. This effect is considered to be due to the more severe climatic conditions existing during the progress of this series. Weather was markedly colder, and rainfall abnormally higher for the season as compared with the conditions obtaining during the previous series. With pigs fattened out-of-doors it was only to be expected therefore that growth would be slower. This lower efficiency in growth-rate was similarly carried to economy of food-consumption, each group showing a higher food requirement for the production of 100 lb. of dressed-weight gain than in Series A, where the trial covered a similar growth-range.

The relative efficiency of the different systems of supplementing can be more clearly seen from Table 7, where the relative amounts of meal fed and milk saved per 100 lb. of pig-meat produced allow the milk saved per pound of meal fed to be calculated (Column 5).

Table 7.—Series C: Efficiency of Meal-utilization.

No. of Group.	Meal used per 100 lb. Gain.* (1.)	Milk saved per 100 lb. Gain. (2.)	Milk saved. (3.)	Days saved per Pig. (4.)	Milk saved per Pound Meal used. (5.)
	Lb.	Gals.	Per Cent.		Gals.
Group 2	120	246	29·3	17½	2·00
Group 3	40	95	11·4	10	2·37
Group 4	160	336	40·0	32	2·10
Group 5	85	150	18·0	14½	1·77

* Dressed weight.

From the figures in Column 5, Table 7, it appears clear that the efficiency of meal-utilization is greater when concentrates are fed over the early stages of growth than over the later stages. A high level of efficiency is also apparent when they are employed so as to take advantage of the greater efficiency of food-utilization of the pig at young stages of growth, by being fed throughout the whole fattening-period. Thus Group 3, where the meal was fed up to porker weights only, thereafter being discontinued, shows the highest efficiency, with 2·37 gallons of milk saved per pound of meal fed. Group 4, where a heavy rate of feeding occurred up to pork weights, followed by a lighter rate to bacon weights, shows up well with a slight advantage over Group 2, where meal was fed at the same rate throughout. In both these cases 1 lb. of meal saved approximately 2 gallons of buttermilk. Feeding meal from pork to bacon weights only produced the least efficient results, 1 lb. of meal saving 1·77 gallons of milk (Group 5).

A further significant feature from these results is the fact that, although Group 3 shows the maximum efficiency of utilization, the gross effect is small, as indicated by the total amount of milk saved of 11 per cent. as compared with a saving of 40 per cent. in Group 4 and 30 per cent. in Group 2. This is due to the small total quantity of meal fed, as must be the case when it is employed in such limited quantities to small pigs. This point is of practical significance : while the feeding of meal during the early stages of fattening only would appear to result in the most efficient utilization per pound of meal fed, the total effect on milk-reduction is small. A system of feeding as in Groups 2 and 4 which takes advantage of the former point but which, in addition, through the use of a greater total quantity of meal, produces a far greater gross effect in milk-saving and fattening-time, would appear to be the better method of feeding. The results are also suggestive that a still heavier rate of supplementing during the early stages only might be advantageous.

ECONOMY OF RESULTS.

The relative cash returns per 100 gallons of buttermilk are set out in Table 8 for various prices for bacon and meal.

Table 8.—Series C : Cash Returns per 100 Gallons Buttermilk (deducting Cost of Meals).

——	Group 2.			Group 3.			Group 4.			Group 5.		
Price of Bacon ..	4d.	5d.	6d.	4d.	5d.	6d.	4d.	5d.	6d.	4d.	5d.	6d.
Control group ..	47·5d.	59·5d.	71·5d.	47·5d.	59·5d.	71·5d.	47·5d.	59·5d.	71·5d.	47·5d.	59·5d.	71·5d.
Meal at £6 ton ..	53·0d.	70·0d.	86·5d.	49·8d.	63·0d.	76·5d.	56·5d.	76·5d.	96·0d.	49·0d.	63·5d.	78·0d.
Meal at £8 ton ..	48·0d.	65·0d.	81·5d.	48·5d.	61·7d.	75·2d.	48·5d.	68·5d.	88·0d.	45·0d.	58·5d.	73·0d.
Meal at £10 ton ..	43·0d.	60·0d.	76·5d.	47·2d.	60·4d.	73·9d.	40·5d.	60·5d.	80·0d.	40·0d.	53·5d.	68·0d.
Meal at £12 ton ..	38·0d.	55·0d.	71·5d.	45·9d.	59·1d.	72·6d.	32·5d.	52·5d.	72·0d.	35·0d.	48·5d.	63·0d.

It will be noted that at 4d. per pound for bacon all groups show a profit margin over the use of buttermilk alone providing meal costs £6 per ton or less. When the price of meal rises to £8 per ton, however, Group 5 becomes unprofitable with bacon worth 4d. per pound. At £10 per ton for meal Group 5 becomes unprofitable even with bacon worth as much as 6d. per pound, while the remaining three groups are still profitable even with bacon returning 5d. per pound. With meal costing £12 per ton Group 3 is still profitable at 5d. per pound, while Group 4 shows a margin at 6d. per pound. These results are in line with the efficiency of meal-utilization, Group 3, using meal during the early stages only, being profitable at higher meal prices and lower bacon prices than any of the other systems of feeding.

It is important, however, that although the Group 3 system of supplementing is profitable at higher prices for meal and at lower bacon prices the margin of profit is small, due, as already emphasized, to the small total quantity of meal used. Group 4 system shows to outstanding advantage in this respect. Although unprofitable price-levels are reached sooner than in the case of Group 3, the margin of profit when a profit is obtainable is far greater. It is also evident that Group 5 system on a cash return per 100 gallons of milk basis has little to recommend it, being productive of a definite loss at normal price-levels.

It must further be emphasized that if the saving in milk and fattening-time be taken into account the advantages shown in these respects by Groups 2 and 4 give them a still greater advantage on the profit side over the other systems of supplementing. Table 9 sets out the prices at which meals must be purchased by the farmer for the various systems of feeding used in this trial to show a cash surplus over the use of buttermilk alone.

Table 9.—Series C: Profitable Meal Price - Bacon Price Ratio.

Price of Bacon	4d. per Pound.	5d. per Pound.	6d. per Pound.	—
	£ s. d.	£ s. d.	£ s. d.	
Group 2	8 0 0	10 0 0	12 0 0	= Meal price per ton.
Group 3	10 0 0	12 0 0	14 0 0	= Meal price per ton.
Group 4	8 0 0	10 0 0	12 0 0	= Meal price per ton.
Group 5	7 0 0	8 0 0	9 0 0	= Meal price per ton.

From Tables 8 and 9 it would appear that feeding as in Group 2 or as in Group 4 offers the most attractive systems of fattening with the use of supplements so far as the growth-range factor is concerned. With the latter where 2 lb. of concentrate per 100 lb. live-weight per day was fed up to porker weights (120 lb. live-weight) and 1 lb. thereafter to bacon weights (200 lb. live-weight), as much as £12 per ton could be paid for meal when bacon is worth 5d. per pound. Remembering that this system also saved 40 per cent. in the amount of milk required to fatten a pig and over one month per pig in fattening-time, the large increase in turnover and more rapid output thereby possible should result in a worth-while profit margin in favour of this method of meal-utilization and as compared with using milk alone.

Relationship of the Results of these Trials with Practice.

The results of the three series of trials reported in this paper emphasize that the whole question of meal-supplementing is no simple one, and its profitableness is intimately bound up with the relationship of meal and bacon prices and with the system of utilization followed.

The first point emphasizes that, so little is the margin of profit at average prices and with common methods of feeding, either more will have to be received for the product or less paid for the concentrates before meal-supplementing can play any extensive part in the industry.

Bearing this fact in mind, the second point becomes of even greater significance. With a small margin only available, the actual method of supplementing must be closely watched, and in this connection the trials completed emphasize that the type of concentrate, the quantity used, and the stage of growth over which it is used are three important factors likely to affect the profitableness of any meal-feeding programme. It is suggested, therefore, for the guidance of farmers that—

(*a*) The amount of meal concentrates used should be limited to 100 lb. to 150 lb. of meal for every 100 lb. of dressed meat produced. This can be secured by feeding at the rate of 1 lb. to 1½ lb. per 100 lb. live-weight per day.

(*b*) That the concentrates be used at the above rates when meal is procurable at from £8 to £10 per ton when bacon is worth 4d. to 5d. per pound.

(*c*) That the concentrates should be fed particularly during the early stages of growth and advisedly at a heavier rate during the early stages than during the later stages.

(*d*) That "topping off" pigs on meal as a regular practice be avoided; that this should be employed only when essential as an aid to marketing unfattened pigs when milk-supplies alone are in inadequate supply.

Value of Buttermilk in Pig-fattening.

One further aspect of interest arising from the trials is the data obtained upon the fattening-value, in the production of bacon pigs, of factory buttermilk, a by-product which is available in considerable quantities in New Zealand. With a production of some 150,000 tons of butter, approximately 45,000,000 gallons of this foodstuff is available annually for conversion into pig-meat.

The figures show that between 700 and 800 gallons of buttermilk produced 100 lb. of dressed pig-meat in pigs fattened from the weaning stage to bacon weights. Expressed another way, 100 gallons produced 13·3 lb. of bacon (dressed pig-meat). Theoretically, the manufacture of 1 ton of butter should result in the output of approximately 1 ton or 200 gallons of buttermilk. In actual practice the yield is nearer 300 gallons per ton of butter, due to the addition of water during the manufacture process. It might be noted that it is this added water which is probably largely responsible for the lower food-value shown by the buttermilk as compared with skim-milk, which it closely resembles in composition. The latter material yields under comparable conditions 100 lb. of dressed-weight gain from 500 gallons.

On a basis of a yield of 300 gallons of buttermilk per ton of butter, the possible yield of pig-flesh per ton of butter should be approximately 40 lb. of dressed weight. This figure should prove useful as a guide to the cash value of this by-product under any given set of conditions—*i.e.*, at 4d. per pound for pig-meat buttermilk should have a gross cash value under average management conditions of 13s. 4d. per ton of butter. Note that the figure is merely indicative of *gross* cash value; all incidental costs of production, which are many and variable, must be taken into account in estimating the probable *net* cash value should the data be used by farmers tendering for factory buttermilk outputs or by factories contemplating the installation of their own pig-fattening equipment.

Acknowledgments.

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DAIRY-HERD TESTING IN NEW ZEALAND.

REVIEW OF THE 1935-36 SEASON.

W. M. Singleton, Director of the Dairy Division, Department of Agriculture, Wellington.

Reorganization.

On the 27th February, 1936, an Order in Council was gazetted bringing the future control of group herd-testing under the New Zealand Dairy Produce Board, provision being made for the new organization to function as from the 1st April, 1936.

Prior to this new arrangement the only control of the work was that provided by the restricted authority of the Dominion Group Herd Testing Federation, essentially a voluntary organization and without statutory power.

Under the new arrangement the Dairy Board has power to regulate and control the group herd-testing system and the calf-marking schemes associated therewith. It is now compulsory for all group organizations to register with the Board and to abide by rules laid down by the Board, and no association is permitted to operate without the sanction of the Board.

The actual supervisory work is being done by a committee of the Board. The Herd-testing Central Executive has been replaced by what is known as a Herd-recording Council. The Dominion Group Herd Testing Federation has ceased to function, except from the point of view of periodic meetings and the selection of representatives for appointment to the Herd-recording Council. Mr. C. M. Hume, previously Federation Supervisor of Herd-testing, is Officer in Charge of the work under the Dairy Board.

So far as finance is concerned, the Government has agreed to make certain annual grants until 1941, at which time the matter is to come up for review in the expectation that the Dairy Board will thereafter provide the whole of the necessary finance. During the financial year 1935-36 the sum of £4,000 was expended by way of Government subsidy to herd-testing.

At this stage, which marks the beginning of a new period in the history of New Zealand's dairy-herd-testing movement, it is appropriate to take a glance at the period which has just closed, and which commenced with the introduction of the group system in 1922, though the year 1928 should also be noted as the date from which the Government granted an annual subsidy to herd-testing.

The following table enables a survey of the general position during the period referred to from the point of view of number and percentage of herd cows tested under the group and association systems :—

Table 1.

Season.	Tested Cows.	Tested Cows expressed as Percentages of Total Cows in Milk.
1922-23 ..	84,825	7·5
1923-24 ..	151,214	12·7
1924-25 ..	196,850	16·5
1925-26 ..	169,776	14·4
1926-27 ..	170,150	14·4
1927-28 ..	224,130	18·0
1928-29 ..	259,594	20·1
1929-30 ..	283,731	20·4
1930-31 ..	271,404	18·0
1931-32 ..	259,857	16·4
1932-33 ..	286,054	16·6
1933-34 ..	297,647	16·4
1934-35 ..	265,944	14·5
1935-36 ..	245,355	13·5

In a broad summing-up, and making due allowance for influencing factors, the net result of the effort and expenditure of the past fourteen years must be regarded as disappointing. Between 1922 and 1927, when the group herd-test was being built up, herd-testing showed marked development. The Government subsidy appears to have had a favourable though merely temporary effect, creating a further upward trend to 1928-29 and 1929-30, the peak years of the movement, when over 20 per cent. of our total cows in milk were under test. Since then, however, we have steadily lost ground. In 1935-36 only 13·5 per cent. of the cows were tested, and it is necessary to go back some twelve years to find a comparable figure. Viewed in the light of the rapid increase in dairy-cow population, which, theoretically at least, should make testing all the more necessary, and remembering also the recent depression years, prospects for the future are by no means encouraging.

Important factors in connection with the dairy herd would appear to be (1) the herd sire, (2) the feed, (3) the health of the animal, though this is not necessarily the order of importance. Experience and experiment have shown that, in breeding, the sire is the over-ruling influence, and that in average crossbred herds there is not so much difference in the offspring as the result of the dam. The definite advantage of using a pedigree sire with satisfactory butterfat backing over several generations has long since been amply demonstrated. Testing-systems should therefore first provide for sufficient proven pedigree sires to enable a wide selection. Given the herd, ample and suitable feed and scientific feeding practice are essential to high and economic average production. The health of the animal takes into consideration feeding and handling, but also embraces the treatment and prevention of dairy-stock diseases, and on many farms average cow production is adversely affected by the presence of stock ailments. Herd-testing is of definite value as a guide under each of the headings mentioned, but herd-testing alone cannot result in the progress desired.

The Past Season.

As shown in Table 1, some 245,355 cows were systematically tested during the past season under one or other of the recognized herd-testing systems, this total representing a decrease of 20,589 cows, or 7·74 per cent., over the 1934–35 total of 265,944. Average butterfat-production of tested cows, however, showed an increase of 5·63 lb., being 257·64 lb. in 1935–36 as against 252·01 lb. for the preceding season. A more favourable climatic season was doubtless a predominating influence in this connection.

Table 2 relates to New Zealand's dairy-cow population from the point of view of cows in milk and dry, and covers the past ten years. For the first time in many years we have failed to record an increase, the total remaining practically the same as for 1934–35.

Table 2.—Dairy Cows in Milk and Dry as at 31st January of each Year.

Season.	Total Cows.	Cows in Milk.	Dry Cows.	Percentage of Dry Cows to Total.
1926–27	1,303,225	1,181,545	121,680	9·3
1927–28	1,352,398	1,242,729	109,669	8·1
1928–29	1,371,063	1,291,204	79,859	5·8
1929–30	1,441,410	1,389,541	51,869	3·6
1930–31	1,601,633	1,499,532	102,101	6·4
1931–32	1,702,070	1,582,664	119,406	7·0
1932–33	1,845,972	1,723,913	122,059	6·6
1933–34	1,932,511	1,816,402	116,109	6·0
1934–35	1,952,094	1,827,962	124,132	6·4
1935–36	1,951,507	1,823,358	128,149	6·6

Table 3 provides a classification of tested cows according to land district, and includes a column for percentage of cows tested. It will be noted that the more important dairying districts show a falling-off, only Gisborne in the North Island and Westland and Otago in the South Island experiencing an increase, the latter in percentage of tested cows only, as the number tested is slightly lower than for the previous season.

Table 3.—Numbers of Cows tested Twice or more, and Percentages of Total Cows in Milk, classified according to Land Districts.

Land District.	1931–32.		1932–33.		1933–34.		1934–35.		1935–36.	
	Cows tested.	Percentage of Total Cows in Milk.	Cows tested.	Percentage of Total Cows in Milk.	Cows tested.	Percentage of Total Cows in Milk.	Cows tested.	Percentage of Total Cows in Milk.	Cows tested.	Percentage of Total Cows in Milk.
North Auckland ..	56,091	19·6	59,408	18·8	55,801	16·4	47,658	13·7	45,347	12·8
Auckland	99,806	20·6	111,517	21·1	120,982	21·3	110,107	19·0	101,565	17·2
Gisborne	9,145	20·4	10,634	19·9	12,460	21·8	12,069	20·7	13,202	26·2
Hawke's Bay ..	4,933	9·2	5,910	10·3	5,581	8·9	5,476	9·0	5,025	7·3
Taranaki	31,179	13·8	32,302	13·6	38,878	15·7	31,599	12·7	24,987	10·9
Wellington ..	30,569	13·6	34,992	14·6	38,290	15·2	38,622	15·5	36,784	14·0
North Island ..	231,723	17·6	254,763	17·8	271,992	17·8	245,531	15·9	226,910	14·6
Nelson	6,637	23·7	7,430	23·8	4,445	13·6	4,714	14·8	4,654	14·4
Marlborough ..	2,647	16·2	2,334	13·6	2,067	11·9	1,269	8·0	1,165	7·7
Westland	5,030	39·6	2,844	20·4	2,801	19·2	2,006	14·0	2,124	14·3
Canterbury ..	2,344	3·1	4,359	5·4	4,957	6·0	4,195	5·2	3,325	4·3
Otago	4,480	7·9	4,800	7·9	3,752	6·1	2,605	4·4	2,599	4·7
Southland ..	6,996	9·4	9,524	11·7	7,633	9·3	5,624	6·9	4,578	6·2
South Island ..	28,134	10·6	31,291	11·0	25,655	8·8	20,413	7·2	18,445	6·9
Dominion ..	259,857	16·4	286,054	16·6	297,647	16·4	265,944	14·5	245,355	13·5

NOTE.—"Total Cows in Milk" is at 31st January in each year.

Table 4 shows the number and size of the various organizations. The term "organization" denotes an individual unit—for example, an association operating ten groups would be included as ten, not one. A further decline in the association system is apparent. Last season the group system accounted for 94·77 per cent. of the cows tested.

Table 4.—Number of Cows, Herds, and Organizations represented in Season's Summaries received. (Basis : All Cows in Milk 100 Days or over.)

—	1933–34.	1934–35.	1935–36.
Group Testing.			
Number of groups	213	222	223
Number of herds	5,120	4,559	4,233
Number of cows	266,481	240,993	225,843
Average number of herds per group	24	20	19
Average number of cows per herd	52	53	53
Average number of cows per group	1,251	1,086	1,013
Association Testing.			
Number of associations	73	58	51
Number of herds	1,105	889	599
Number of cows	20,408	15,938	11,171
Average number of herds per association ..	15	15	12
Average number of cows per herd	18	18	19
Average number of cows per association ..	280	275	219

Table 5 is a general production summary. Figures relating to 4,832 herds are included in this table, of which 4,233 were tested under the group system and the remaining 599 under the association own-sample test. The corresponding figures for 1934–35 were 5,448 herds—4,559 group and 889 association.

Table 5.—Grand Summary of all Herd-testing Results on the Basis of all Cows in Milk 100 Days or over received for the Last Two Seasons.

	1934–35.			1935–36.		
	Number of Cows.	Days in Milk.	Butterfat-production.	Number of Cows.	Days in Milk.	Butterfat-production.
			lb.			lb.
Average for all cows ..	256,931	258	252·01	237,014	258	257·64
Average for all Group cows ..	240,993	260	253·65	225,843	259	258·62
Average for all Association cows	15,938	227	227·08	11,171	232	237·73
Highest Group average ..	638	270	308·55	474	270	318·59
Lowest Group average ..	856	241	194·18	1,392	206	168·90
Highest Association average ..	66	277	339·70	100	267	311·52
Lowest Association average ..	120	201	156·15	108	194	138·92
Highest Group herd ..	20	290	484·00	6	288	517·00
Lowest Group herd	10	117	80·30	11	126	53·00
Highest Association herd ..	6	278	448·00	6	264	425·44
Lowest Association herd ..	10	122	64·46	4	121	66·59
Highest Group cow	..	248	828·00	..	298	793·00
Highest Association cow ..	..	289	777·00	..	339	641·00
Average daily production of butterfat for all Group cows	..	..	0·98	..	..	0·99
Average daily production of butterfat for all Association cows	..	..	1·00	..	..	1·02

In Table 6 average butterfat-production of tested cows is classified according to land district, four seasons being shown for purposes of comparison.

Table 6.—Average Production, according to Land Districts, of all Cows under Herd-test for which Seasons' Summaries were obtained.
(Basis : 100 Days or over.)

Land District.	1932–33.			1933–34.			1934–35.			1935–36.		
	Cows in Summary.	Average Days in Milk.	Average Butterfat.	Cows in Summary.	Average Days in Milk.	Average Butterfat.	Cows in Summary.	Average Days in Milk.	Average Butterfat.	Cows in Summary.	Average Days in Milk.	Average Butterfat.
			lb.			lb.			lb.			lb.
North Auckland	57,771	255	245·53	54,007	250	241·11	46,037	255	243·38	43,701	250	232·96
Auckland	108,504	264	254·67	116,769	260	262·09	106,983	263	249·12	98,704	263	259·27
Gisborne	10,265	251	254·73	11,967	251	247·50	11,686	251	239·83	12,492	247	235·33
Hawke's Bay	5,595	255	263·61	5,389	253	258·75	5,300	250	247·73	4,915	254	278·35
Taranaki	31,686	265	276·19	37,790	264	286·32	30,781	267	277·88	24,243	266	273·65
Wellington	32,012	253	255·61	36,491	255	275·64	37,010	253	253·07	35,705	257	274·93
North Island ..	245,833	260	255·62	262,413	257	262·41	237,797	260	251·86	219,760	259	257·24
Nelson	7,215	239	269·27	4,322	245	272·36	4,564	251	261·61	4,378	250	276·02
Marlborough	2,151	239	249·70	1,944	228	232·63	1,204	255	264·83	1,099	255	293·61
Westland	2,816	236	260·89	2,773	241	273·17	1,997	234	270·04	2,088	238	254·68
Canterbury	4,129	223	233·38	4,449	236	255·26	3,785	216	222·35	3,011	241	272·23
Otago	4,685	238	249·02	3,568	229	264·85	2,136	241	266·40	2,209	250	273·66
Southland	9,350	235	256·32	7,420	227	264·66	5,448	237	255·91	4,469	238	245·15
South Island ..	30,346	235	255·11	24,476	234	262·76	19,134	237	253·84	17,254	242	262·77
Dominion	276,179	257	255·57	286,889	255	262·44	256,931	258	252·01	237,014	258	257·64

APPRECIATION.

It is expected that this will be the last occasion on which the Dairy Division will compile the annual summary of herd-testing statistics such as has appeared in this *Journal* each year. The Herd-recording Branch of the Dairy Board will undertake this work in future. It is now some twenty-seven years since—1909—the Dairy Division founded systematic herd-testing in New Zealand. During that period it has received the unfailing courtesy and support of the various organizations connected with the herd-testing movement, and desires to record it's appreciation of services rendered.

POTASH TOP-DRESSING OF AUCKLAND PASTURES.

RESPONSE FROM POTASH AT WAIHI.

J. E. BELL, Instructor of Agriculture, Pukekohe.

IN the last report* on pasture top-dressing in Auckland Province the position was summarized as follows: "Superphosphate is generally the cheapest and most efficient phosphate for pasture top-dressing, but on some soils lime is necessary to enable the best results to be obtained from superphosphate. Slag is also quite efficient, but is not superior to superphosphate or superphosphate and lime. Rock phosphates are generally inferior to superphosphate or slag. Potash responses are not frequent, and, where responses are secured, they are generally slight."

Since this was written the position as far as potash is concerned has changed somewhat, for in one district and in isolated trials in other districts distinct and payable responses occur. Nevertheless, for most parts of the province the position still obtains that the use of potash gives no response or negligible and unpayable responses as a top-dressing on grassland. Where the good potash responses are evident, the further improvement of the sward is slow unless potash is included in the top-dressing campaign, and the effectiveness of the phosphates and lime applied is very much limited. It follows that much money is being wasted in applying phosphates and lime to soils markedly deficient in potash. In the Auckland Province soils are almost everywhere deficient in phosphates, and phosphatic top-dressing is most commonly practised. Lime is also deficient in about half the province, and in some districts to a marked degree.

The statement has been made that potash is a silent worker, meaning that it improves production from pastures and yet visible effects from its application to pasture are not apparent, and that it differs from phosphates and lime, from which beneficial effects can be seen to a marked degree when they are applied to phosphatic-deficient or lime-deficient soils. Agricultural works contain little information on the effect of potash on pastures—whether it has any visible effect and what that effect is. If a fertilizer could merely increase growth of the existing sward and not change its constituents or affect the grazing, the

*P. W. Smallfield, Pasture Top-dressing in Auckland Province, this *Journal*, April, 1935.

difference would be hard to detect in a grazed pasture, and a fertilizer which did this and made no other change could well be called a silent worker. However, it is impossible for a fertilizer to increase growth and not affect the composition of the sward unless that sward was at the height of perfection or contained only one plant species. Almost all swards contain many species, and if a treatment increases growth it is always to the advantage of the more vigorous and to the disadvantage of the less vigorous constituents. Potash cannot be called a silent worker, because, if it is applied to potash-deficient soils, its effects are visible. The first noticeable effect of potash is in increased clover-growth. If no clovers are present in the sward then potash can effect but little change ; but if clovers are present—they may be stunted and difficult to see—then improvement of the sward is possible. This increased clover-growth is likely to be apparent within a few weeks of application. Definite signs of improvement are not often lacking one year after application on potash-deficient soils, because there are very few swards that contain no clover. However, danthonia swards subject to much burning frequently contain no clover, and improvement of these has therefore little possibilities.

The pasture sward is a battlefield in which continual war is being fought by the different species present for existence. One of the factors which affects the fortunes of the combatants is the kind of management by stock. Some species flourish under more severe grazing than others : some dislike grazing altogether. Another factor is fertility. On grasslands in the Auckland Province fertility is naturally poor, and is therefore an important factor. If the fertility of a soil is improved by an application of potash the soil is rendered capable of supporting the clovers present in a more vigorous state and they grow better, and in doing so they may crush out other species in the sward. As time goes on and the potash deficiency is alleviated by additional applications of potash, the clovers fight among themselves for supremacy. Slowly growing clovers are quickly subdued by ones of faster growth, and as the sward thickens annual clovers, even of the more highly productive kind, are repressed. Where conditions are suitable for its vigour a perennial species will always oust an annual one, for the weakness of the latter lies in the seedling stage. The annual has, season after season as a young seedling, to fight for a place in the sward against established vigorous perennial plants. A highly productive permanent clover with an all-the-year-round production, such as white clover, quickly assumes the ascendancy when the potash deficiency is met, providing, of course, that there are no other major physical or manurial deficiencies. White clover well established and growing vigorously improves the nitrogen-supply in the soil, and by its more continuous growth throughout the year maintains this supply better than any other clover. Nitrogen is one of the important plant-foods for the grasses of the pasture sward. Pasture-plants, for optimum growth, require a continuous large supply of nitrogen, and this is supplied more effectively by white clover than by any other clover-plant.

Potash, by inducing vigorous white-clover growth, indirectly improves the nitrogen-supply, and this improvement is reflected in increased vigour of the non-legumes in the sward. All the non-legumes in the sward are encouraged to grow at a faster rate, and competition goes on among them. The faster-growing ones suited to

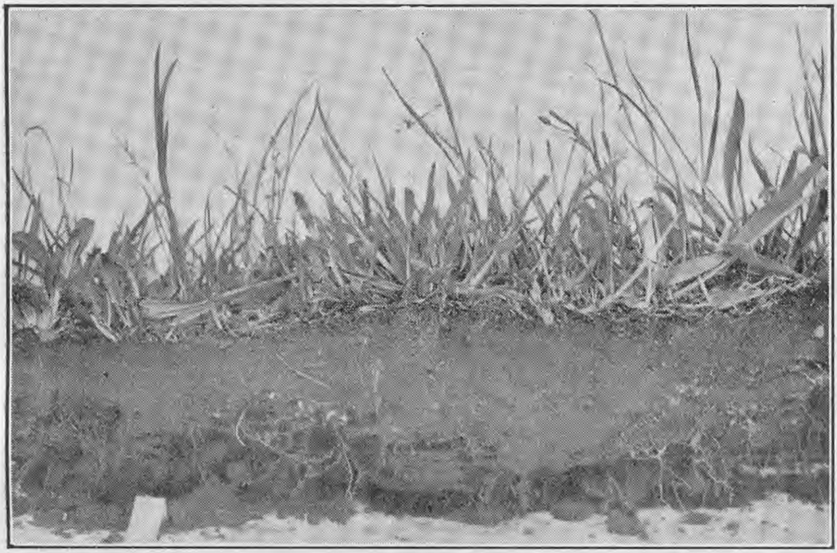

FIG. 1. NO POTASH (EXPERIMENT NO. 306).

A sward which has received 15 cwt. of phosphate plus 5 cwt. of lime in the past five years. In spite of the generous phosphatic top-dressings, the clovers are so stunted that they can only be seen by the closest examination of the photo. The presence of wild linseed and lamb's tongue indicates the poverty of the sward.

[*Photo by H. Drake.*

FIG. 2. POTASH (EXPERIMENT NO. 306).

This photo was taken from the potash plot alongside the plot receiving no potash, represented by the photo in Fig. 1. The sward was similar to that in Fig. 1 before the application of potash. The potash has made the clovers, as it were, "spring to attention."

[*Photo by H. Drake.*

the grazing conditions outstrip the other plants, and in some cases eliminate them entirely. In a reasonably well-grazed sward rye-grass, if present, assumes control, but rye-grass, not having the ability of white clover to cover the ground, does not eliminate the other grasses, as white clover through its stoloniferous growth suppresses other clovers. Thus dressings of potash finally improve a sward through distinct phases. First, increase in growth of all the clovers present, the elimination of slower-growing and of annual species, and the establishment of a thick, vigorous sole of white clover, then improvement of the pasture-grasses of higher production and the suppression of the more poorly productive ones. At the same time the weeds are greatly suppressed or eliminated by white-clover growth. Some weeds more fitted to the better growth conditions survive to a limited extent.

The aim of every farmer should be to obtain on all his pastures a vigorous sole of white clover. In potash-deficient soils this is not possible with the use of lime and phosphate, even with heavy applications. The addition of potash enables the white clover to thrive, bringing about increased grass-growth and increased production of farm-products, and will put the phosphate and lime top-dressing of the sward on a more economic footing. Even the effect of the stock-droppings are limited by the lack of potash in the soil. Stock-droppings on potash-treated plots provided a richer verdue than the droppings on plots not so treated in potash-responsive soils.

Waihi Responses.

The Waihi Plains, Ohinemuri County, do not consist of level country but comprise gently rolling downs, in area about six miles long by four miles wide. They are surrounded almost entirely by high scrub-covered or bush-clad hills. The soils are derived from volcanic-ash showers. The country is well watered by streams. The soils on the rolling downs are sandy loams. Alongside the streams are small level stretches of land comprising alluvial soils of a heavier nature than the sandy loams. Small patches of the alluvial soils are covered by a small amount of peat.

On the alluvial soils the pastures are quite good and are composed mainly of rye-grass and white clover, with much sweet vernal, crested dogstail, timothy, cocksfoot, and rib-grass. On the peat areas the pasture is also quite highly productive, but contains much Yorkshire fog and some *Lotus major*. The much more prevalent sandy-loam soils have been grassed with some difficulty. The soil being light, consolidation for a grass-seed bed has been hard to accomplish, and the pastures after a few years have deteriorated to a poor type of pasture. The soils are deficient to a very large degree in phosphate, and these poor pastures have been improved to a great extent by phosphatic top-dressing. Fields on the sandy-loam soils are in various stages of development from sweet vernal, Chewings fescue, *Poa pratensis*, hair-grass, catsear, lamb's tongue, suckling clover, *Lotus major* swards to rye-grass, white-clover, cocksfoot, timothy, rib-grass swards. The pastures are generally rather poor and contain a short supply of white clover and rye-grass, and there is much *Poa pratensis*, sweet vernal, catsear, lamb's tongue, rib-grass, *Lotus major*, and suckling clover. Some fields on the three different soil types on the plains contain a fair proportion of paspalum, which grows quite well.

FIG. 3. NO POTASH (EXPERIMENT NO. 306).

A top view of the sward shown in Fig. 1. Here the stunted clover can be more clearly viewed. Note the lamb's tongue, catsear, wild linseed, and bare ground and inferior grasses. [*Photo by H. Drake.*

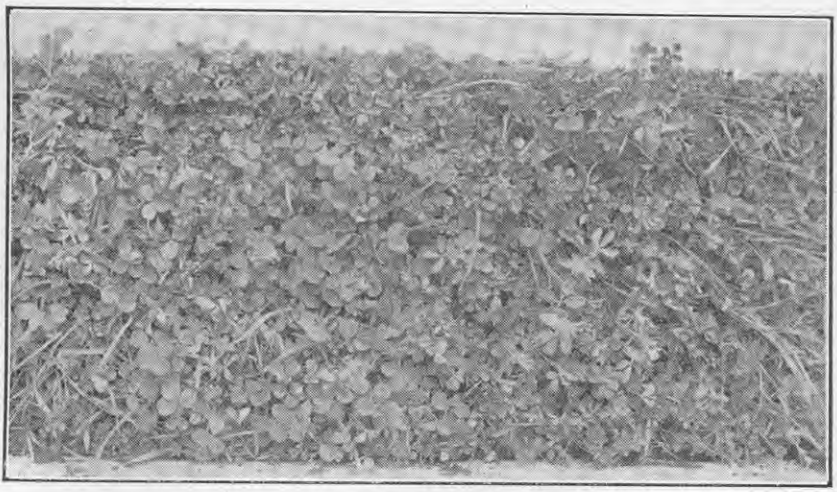

FIG. 4. POTASH (EXPERIMENT NO. 306).

A top view of Fig 2. Note the increase in growth and cover of the clovers, suckling and white, and some lotus. Note how the clovers have shaded the weeds, which can be scarcely seen, and also how the white clover is overtopping the suckling clover through its superior growth. [*Photo by H. Drake.*

The climate is a wet one, the average rainfall for Waihi being 87 in. per annum, and this rainfall is evenly distributed. The winters are rather cold, with a fair amount of cold winds, but the summers are not unduly hot. The pastures are in a normal season kept well supplied with moisture and grow well throughout the summer. Supplementary crops are rarely grown, and farmers rely on hay and silage made from permanent pasture for winter feed. Successful farming, therefore, depends almost entirely on the establishment and maintenance of highly productive swards of grass.

Trials to test the value of potash and lime in the Waihi district were laid down in September, 1934. On the alluvial soils alongside streams there was no response to potash, and its use there is unwarranted. On the peat the results are not definite. On the undulating lighter country potash made the first improvement in clover-growth in the spring a few weeks after the plots were laid down. The clovers present in the sward, suckling clover, *Lotus major*, and white clover, showed improvement in growth and vigour, and the effect was so outstanding that the potash portions stood out at a distance in some trials because of the deeper green colour caused by the increased cover of the clovers of the surface of the sward. In the summer following, 1934–35, the climatic conditions were dry, and the effect from potash largely disappeared. In this, potash differs from lime, the effect from which appears more marked on clover-growth in dry summers and is not so apparent in the flush spring months. Throughout the winter following, the response from potash improved until the spring, when the responses were again marked. The following summer, 1935–36, was a wet one, and responses from potash continued to be strong. A feature of the responses in the past summer was the much better grazing of the potash-treated plots in January. The white clover is fairly quickly replacing the *Lotus major* and suckling clover, and in some of the plots these poorer-producing species have been eliminated. Where the pasture is fairly good, comprising better grasses such as rye-grass, cocksfoot, timothy, and white clover, there is not much change in the cover of the different grasses, nor is it possible, because there is little room for improvement in that direction; but with the increase in white-clover vigour there has been a growth improvement of the grasses and a great improvement in the production of the sward. On the poorer pastures the transformation is more startling because there is more room for improvement. As the white clover assumes charge, the previously stunted and inconspicuous rye-grass grows vigorously, and poorer grasses and weeds such as hair-grass, catsear, and lamb's tongue disappear. A few of the rib-grass and weed plants more fitted to endure higher-fertility conditions under the management survive, or may increase to a limited extent. The better grasses appear more prominently in the sward because they grow taller, and in tillering occupy wider territory.

Of the six trials on the undulating sandy loam of the Waihi Plains, all have shown definite response to potash, and it appears that potash top-dressing on those soils in the locality will give payable returns.

Analyses of soil-samples have been made of the soils where the trials are being carried out at Waihi. The following table shows the results of the analyses, type of soil, and the potash response obtained for each experiment :—

Experiment.	Percentage present of Available Potash.	Potash Response.	Soil Type.
16/1/299	0·018	Good ..	Sandy loam.
300	0·025	,, ..	,,
301	0·098	,, ..	,,
302	0·037	Very good ..	,,
304	0·029	Good ..	,,
306	0·018	,, ..	,,
303	0·053	Nil	Alluvial loam.
305	0·047	,, ...	,,
307	0·140	Slight ..	Peat over alluvial loam.

That there is no correlation between response to potash in the field to the potash content of the soil is quite apparent from a study of the above table. Soils from experiments 16/1/301 and 16/1/307 are extraordinarily high in available potash and yet show a response to potash. Analyses were taken from the top three inches of the soil. The only conclusion that can be assumed is that soil analysis is as yet a very poor guide to the need for potash applications to the soil.

(To be continued.)

BROWN-HEART OF SWEDES.

DRY-MATTER AND SUGAR CONTENT OF AFFECTED ROOTS.

FIELDS DIVISION.

FROM some of the trials carried out with borax on the control of brown-heart in swedes, details of which were published in this *Journal* (August, 1936), at the suggestion of Mr. J. C. Neill swedes showing brown-heart infection and sound swedes were forwarded to the Dominion Analyst for examination.

The following notes are extracted from the Dominion Analyst's report on the samples submitted :—

" The swedes were sampled by cutting a section longitudinally from each root, the whole section being then pulped by passing through a mincer, and weighed portions of the pulp used for the estimation of the moisture and sugar contents. Sugars were determined chemically, the polarimetric method being unsuitable owing to the presence of reducing-sugars. The figures given for sugar in the tables of results represent the total reducing-sugars after inversion calculated as sucrose. Moisture was determined by drying to constant weight at 70° C. in an electric oven, but in some cases by the Starke and Deare process. The results show consistently that, when compared with sound swedes of the same variety, those affected with mottled-heart contain an appreciably lower percentage of sugar in all cases."

The analyses of the several roots comprising each sample have been averaged in the following table :—

Mean Dry-matter and Sugar Content of Swedes infected with Brown-heart as compared with Sound Swedes.

Origin of Samples.	Sound Swedes.		Brown-heart-infected Swedes.	
	Dry Matter.	Sugar.	Dry Matter.	Sugar.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Totara Flat, Westland	10·0	5·9	9·65	5·1
Koiterangi, Westland	12·0	6·5	10·9	5·1
Winton (Grandmaster variety) ..	8·5	4·4	8·5	3·6
Winton (Wilhelmsburger variety) ..	11·7	6·15	9·6	3·8
Stirling District, Otago	9·7	5·65	9·2	5·1
Stirling District, Otago	11·0	6·0	10·0	5·3

—*J. W. Woodcock.*

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 22nd October, 1936, to 19th November, 1936, include the following of agricultural interest :—

No. 74573 : Manure-distributor ; C. R. McLean. No. 74983 : Animal-cover ; W. Patching, Ltd. No. 75227 : Flax, treating ; M. F. Bourke. No. 75365 : Gluten from wheaten flour ; P. S. Georgeson. No. 76438 : Hoist for stacking hay ; H. R. Tomkies. No. 76537 : Seed-sower ; L. L. Cordery. No. 76538 : Manure-sower ; L. L. Cordery. No. 74263 : Preservation of blood ; J. S. Wilson. No. 74602 : Manure-distributor ; J. Munro. No. 75103 : Removing hair or wool ; O. Grunwald and E. E. Weiss. No. 75165 : Fruits and vegetables, preservation of ; W. G. Hampson. No. 76382 : Citrus fruit, treatment of ; W. C. Hill. No. 76528 : Butter, treating ; F. D. Fogarty and J. Black. No. 76581 : Cattle-drench ; C. J. F. Ratjen.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price, 1s. prepaid.

There was a substantial increase, of 38,309 tons, in the deliveries of fertilizers by rail. In the light of departmental investigations and experience relative to the use of fertilizers, this trend augurs well for future farm production.—*Annual Report, Minister of Agriculture.*

SEASONAL NOTES.

THE FARM.

Preparation for New Pastures.

NATURALLY farmers whose results are not satisfactory seek advice relatively much more often than farmers whose results are quite satisfactory. Such advice is commonly along the lines of inspecting a poor result and of trying to provide an explanation of why the result was not better. Hence those engaged in giving advice soon accumulate considerable experience about the causes of failures. This experience tends to show that failures in the establishment of permanent pastures are due commonly to one or both of the following causes : (1) sowing too late in the autumn ; (2) sowing on a rough, loose seed-bed. The point of current practical interest is that both of these causes originate frequently in beginning the preparation of the seed-bed at too late a stage in the year's work.

The key to the position is the fact that the seeds of certain important pasture-plants usually included in seed-mixtures for permanent pastures are really small seeds. This is readily realized when it is borne in mind that, though rye-grass and cocksfoot are large seeds as common pasture-seeds go, they run about a quarter of a million and a half a million seeds to the pound respectively, and it is clear that when allowance is made for the seed-coat of the individual seeds, the remainder, which is the vital part of the seed and which provides the seedling, is really small. Typical of smaller commonly used seeds are white clover, timothy, and *Poa trivialis,* which run about three-quarters of a million, one and a quarter million, and three million seeds to the pound respectively, while brown-top is a somewhat extreme species in that it runs about seven and a half million seeds to the pound.

The size of such seeds is of practical moment, because in all cases where small seeds are to be sown it is of the utmost importance that the seed-bed be worked very fine and that preparatory cultivation result in soil that contains plenty of moisture and is well consolidated in order to facilitate movement of moisture through it from lower levels. If a seed-bed is lumpy and not firm, seeds necessarily are covered at greatly varying depths, and hence if some of the seeds are covered to a suitable depth others must be covered either too deeply or not deeply enough. As good pasture-seed is somewhat expensive, it is as a rule not used in excessive amounts, and consequently loose or lumpy seed-beds are likely to lead to pastures which are too thin right from their initial stages. Even when possible, it is seldom easy to correct such a weakness.

The necessary fineness and firmness of seed-bed is obtained by judicious use of cultivators, harrows, &c., but an important part of the preparation precedes such work—when the initial ploughing is carried out. Ordinarily, in ploughing, an air-space is left beneath the furrows, and hence, until the furrows are broken down, the upper layers of soil are partly at least cut off from their supply of moisture from the subsoil. Further, the development of the root-system tends to be hampered by air-spaces. Natural weathering, which calls for the lapse of time, is the most effective and economical factor in the removal of such air-spaces, and if the ploughing is done early enough a good seed-bed will be available at the time of sowing, whereas very poor results may follow late ploughing, especially in a dry year.

Late sowing of seed leads to poor establishment of pastures more often than many realize. This arises from the fact that the poor results following late sowing frequently are overlooked, because late sowing seldom leads to a complete failure. In many districts some danger is attached to sowings later than March. At times, because of unusually mild seasons, sowings which would be too late in the majority of seasons are quite successful, and because of this similar late sowings are made commonly, and many of the poor results that ensue usually are attributed to all possible causes except the real cause, which is the bad management involved in such late sowings. It is of particular importance that clovers are especially likely to suffer in late sowings. It has also been well demonstrated that the development of rye-grass and other pasture-plants in late sowings is at times subjected to great checks from which it often seems probable that the resultant sward never recovers fully; this is mainly because of the good initial footing secured by inferior plants.

If the pasture is to be sown after an arable crop, it is often good practice, especially on reasonably clean land, to disk rather than to plough: the greater firmness of the seed-bed given by the disking is likely to be an advantage, and the additional fertility provided by the animal manure in fed-off crops is kept near the surface, where it most readily benefits the young pasture-plants.

Avoidance of Faults in Seed-mixtures.

The seed-mixtures used are often faulty; sometimes unsuitable species are included or suitable species are left out; sometimes all suitable species are included but the amounts of each used give rise to a weakness; sometimes suitable species are used in suitable amounts but poor strains of some are employed whereas much superior strains are readily available; and, finally, the seed-mixture sometimes is suitable in all respects except that the seed is of poor germination capacity or purity: neglect in regard to this point, of course, means that proper care relative to other matters is largely nullified. All of which goes to show that the obtaining of suitable seed-mixtures is not a simple task—that it is a task for which time may be required to enable proper attention to be given to some of the matters calling for consideration, and hence that the purchase of seed-mixtures should not be made in the hurried manner which it may become necessary to follow when the task is deferred until just before the seed is to be sown and when there may be not enough time to obtain satisfactorily complete information about the lines of seed available. In the buying of seed it is of importance not to overlook, as so many seem to do, that the price or the appearance of seed does not at all reliably indicate its true value. By utilizing the services of the Department of Agriculture much information can be obtained free of cost about the true value of seeds, just as information can be obtained about seed-mixtures suitable for particular conditions and purposes.

Any weakness which develops in a permanent pasture at the outset because of the seed-mixture or the time of sowing is likely to persist through the life of the pasture, or to be eliminated only as the result of considerable expense. Incidentally, the introduction of certified seed intensifies this position, and so makes it more advisable even than previously to proceed correctly in establishing permanent pastures.

General Pasture Work.

Unless pastures from which hay or silage has been saved have been top-dressed recently and fairly liberally they may be expected to give profitable returns, as a rule, from a dressing of superphosphate applied as soon as the hay or silage has been saved. Such top-dressing is likely to be valuable regardless of the stage of growth at which the pastures were mown; pastures mown at the leafy stage usually give greater direct returns because they develop more vigorous aftermaths than similar ones mown at in later relatively stemmy or rank condition, but the latter often are weakened and in greater need of the strengthening given by the suggested top-dressing.

Apart from areas for specialized production, the production of seed by permanent pastures during their first year should be avoided. Seed-production by such young pastures is likely to lead to injury which may result in permanent stunting of quite valuable, more slowly developing species. When young pastures cannot be controlled adequately by the stock available, topping with a mower may be advisable.

Occasionally it proves advantageous to allow thinned deteriorated pastures to run to seed during the summer provided such pastures contain effective numbers of useful plants the increase of which in the sward by reseeding would be an improvement. If such reseeding takes place, it should be followed by thorough harrowing of the sward in the autumn when rain sufficient to bring about safe germination of the shed seed may be expected. However, it is well to bear in mind that if the species it is desired to increase in numbers have decreased because of a level of fertility insufficient to give them vigour enough to withstand the competition of species of lower fertility requirements, then reseeding will fail to give them a permanently increased place in the sward unless a suitable standard of fertility is maintained by top-dressing or other appropriate practices.

General Cropping work.

Although sowing of lucerne in November or December generally is preferable, in many districts, when the occasion has arisen, it has been sown successfully in January.

A matter sometimes neglected is the cutting of cereals at the most suitable stage of ripeness. Investigation has shown that the best stage at which to cut wheat generally is when the green colour has been replaced by yellow in the section of the stem between the top knot and the head of about 99 per cent. of the straws. At this stage all knots are still green and no dough can be squeezed from the grain, which, however, is still soft enough to cut with the thumb nail.

The best time to cut oats depends to a large extent upon the use to which the crop is to be put. When value is attached to the straw for feeding purposes the crop should be cut early. This is when there is just a shade of yellow over the field ; at this stage the food materials have not passed as extensively as later out of the leaves and shoots, and the nutritive value of the crop as a whole is higher than later when it has become more woody. As the result of early cutting the grain does not develop fully and is of lower weight and quality. The best time to cut oats for general purposes is when the crop has developed a uniform yellowish appearance and before its final touch of green has disappeared. The grain will then be able to mature in the stook and there is little risk of loss during harvesting.

Barley should be allowed to become dead ripe before it is cut. At this stage the straw is practically dry, the grains are hard, and the ears tend to bend over.

Potatoes usually repay considerable attention at this season : hoeing, weeding, and moulding up generally are necessary, and often spraying for late or Irish blight (*Phytophthora*) would prove profitable. Especially in districts in which late blight has been severe in the past, spraying usually proves fully satisfactory only when used to prevent instead of to destroy attacks of blight, which is somewhat difficult to keep fully in check once it has obtained a footing : this is especially so when warm moist conditions prevail. Spraying not carried out correctly may prove ineffective or may damage the crop. Detailed information about the correct procedure in spraying is obtainable on application to the Fields Division.

Special Forage Crops.

Turnips and swedes which are still to be sown in the New Year should be sown with as little delay as possible. Hardy Green Globe is suitable for

January sowing. After the middle of January in most places it is safer to sow turnips than swedes, because the turnips develop more rapidly and do not suffer so readily or severely as swedes may suffer from insect pests in summer and autumn. Both swedes and turnips usually respond well to a dressing of fertilizer of which superphosphate is a prominent ingredient: 2 cwt. to 3 cwt. an acre is widely favoured in districts of good rainfall, while a dressing of about half this amount is favoured in districts of relatively poor rainfall.

There is still time in January to make additional provision, if it is considered likely to be needed, for a supply of feed for winter and early-spring use. A suitable crop is temporary pasture consisting of 25 lb. to 30 lb. of Italian or Western Wolths rye-grass and 5 lb. to 6 lb. of red clover to the acre sown in late summer or early autumn. To enable this crop to contribute substantially to the supply of winter feed, which usually is a main objective, it must be sown early, and many disappointments have resulted from late sowings. This is particularly true of the South Island, and true also of cereal crops sown in the fall of the year for use as catch-crops giving winter feed. A temporary pasture can be counted upon usually to yield a heavy hay or silage crop in the following summer.

Autumn-sown cereal crops to be used as catch-crops giving winter feed are of value when the land available for late-summer or autumn sowing is required in the following spring for another crop such as a root crop. Either oats or barley, both of which are sown at the rate of about 2½ to 3 or more bushels an acre, may be used. In a trial at Massey Agricultural College of crops sown on 6th March black skinless barley excelled in respect to quick production of green feed, but was inferior to Algerian oats for production of winter feed—*i.e.*, growth during June, July, and August—while Cape barley was not outstanding in any respect, being inferior to the others in growth prior to June and approximately equal to black skinless in June to August growth. Autumn-sown cereal catch-crops after turnips or after another cereal crop at times may be sown with good results with a very small amount of preparatory cultivation; disking may give sufficient tilth for the seed-bed required. With such crops a dressing of 1 cwt. to 3 cwt. an acre of superphosphate usually is profitable: it may be expected to increase both the rate and the amount of growth.

Summer Cultivation of Great Value.

Frequent and striking demonstration has been provided in the field of the fact that, unless associated with adequate cultivation, the liberal use of suitable and expensive fertilizer and the sowing of adequate quantities of the best seed available are both together likely to give unsatisfactory results. This is especially true in respect to dry districts or dry seasons, and attention to it is of basic importance in that large portion of New Zealand characterized by an annual rainfall of not more than 35 in. The great importance of the suppression of weeds in summer arises partly from the substantial way in which weeds rob crops of their supply of moisture from the soil. From these facts may be deduced the great value of keeping free from weeds those crops, such as mangels, potatoes, and carrots, sown in rows wide enough apart to allow of suppression of weeds by cultivation subsequent to seed-sowing.

Utilization of Special Summer Feed.

The use of special summer feed grown to supplement the pastures is often not commenced early enough. The influence on the value of the total production of the stock instead of the total yield in weight of the crop should be the primary consideration in using special crops. If special crops are considered on this basis it readily may be found, for instance, in dairying that a crop of turnips of 20 tons an acre used early in the New Year when urgently needed because of lack of other supplies of highly digestible feed is more valuable than a crop of turnips of 30 tons an acre available later on when other highly digestible feed is also available in amounts sufficient for the current needs of the stock. In important dairying areas the supply of highly digestible feed directly available from pastures is inadequate on many farms from shortly after Christmas onwards for several weeks.

It should be remembered that stemmy feed which often is so abundant in summer is far from ideal from young developing stock. Such stock for their proper and economic development require abundant supplies of highly digestible feed rich in bone-forming and flesh-forming materials, and in all these respects stemmy feed contrasts adversely with leafy feed.

Normally young lucerne sown in November or December should be left unmown as long as is practicable in order to foster the development of a large and strong root-system, which is likely to be of great value in subsequent competition with invading plants. But if young lucerne is being seriously out-grown by weeds, it probably will prove advantageous to mow it towards the end of January.

—*R. P. Connell, Fields Division, Palmerston North.*

THE ORCHARD.

Cultivation.

CULTIVATION should continue to receive special attention so as to prevent the excessive evaporation of soil moisture and to prevent the forming of a crust on the surface of the soil. All grass and weeds should be removed from around the base of the tree. When the soil is infested with a twitch-grass, this should be lightly skimmed off and thrown into the centre between the rows of fruit-trees, where it can more easily be treated by the cultivating-implements. Where the trees have been treated in this manner it is advisable to replace a few shovelfuls of soil to prevent the roots becoming bare. Although this necessitates extra work in an orchard, the orchardist receives great benefit, owing to the fact that weeds, grass, &c., when left undisturbed prevent scattered showers, which usually fall in the summer-time, from getting into the soil. In addition to this, weeds, when left, prevent aeration of the soil and form an ideal place for breeding of pests and diseases.

Thinning.

Where thinning has not already been completed, stone-fruit growers should proceed without delay to thin out sufficiently to give the remaining fruits ample opportunity for proper development. Growers of pome fruits, too, often neglect this important operation. The excuse freely given is that no time was available for the work, and that the expense is too heavy. Those growers who have regularly thinned their crops have proved beyond any doubt that thinning pays, and that it assists the tree to carry more regular crops.

Disbudding.

Disbudding should be regularly attended to now, and all shoots below the grafts should be removed. All superfluous shoots should be removed from the roots and trunks. Surplus and misplaced growth in the heads of the trees—particularly young trees—should now be carefully cut out or pinched back, where this has not been attended to already.

Spraying.

The continuation of spraying, as previously advised, will be necessary until at least the end of January, and in many instances a further one or two applications may be necessary for the control of the various fungous diseases and insect pests in pome fruits. Good control of red mite is extremely important if the fruit is to be kept free from mite and their eggs, and the tree healthy. If the foliage is allowed to become bronzed in colour, due to mite infection—as unfortunately occurs only too frequently—it is logical to conclude that the foliage cannot function as it should do, and that as a result many of the buds which have set their fruit will prove to be too weak to set fruit in the following season. Sprays consisting of combinations of lime-sulphur and lead arsenate should be applied without delay after mixing in order to avoid undue deterioration and possible injury.

Stone-fruits should still receive attention by periodical applications of lime-sulphur 0·083 per cent. plus colloidal sulphur 2 lb. per 100 gallons for control of brown-rot, shot-hole, leaf-rust, &c. An application just prior to the fruit reaching maturity is of the utmost importance in the control of brown-rot.

Nicotine sulphate, 40 per cent. (1–800), should be applied where necessary for the control of green or black aphis.

If nicotine sulphate is not combined with other spraying-materials, 1½ lb. of soft-soap per 100 gallons should be added to enable the nicotine sulphate to become effective.

Leech (pear-slug) can readily be kept in control on plum, pear, cherry, and quince trees by spraying with 1½ lb. arsenate of lead plus hydrated lime 3 lb. per 100 gallons, whenever the pest makes its appearance.

Leaf-roller caterpillar on apricots, peaches, or nectarines can be kept in check by spraying with 1 per cent. of summer oil, as these trees do not tolerate arsenate of lead. When using the summer oil it is advisable not to apply the oil until at least two weeks after the application of a sulphur spray.

Export of Fruit.

The time is at hand for the making of arrangements for the supply of packing-requisites, and the estimating of the quantity of fruit intended for export.

Picking and Packing.

In the harvesting of stone-fruits it is important that every care be exercised in handling the fruits. It is also necessary that they be well graded and packed in the most attractive manner possible. The earliest-ripening varieties of apples will soon be ready for picking. The matured fruits should be selected from the trees as soon as they are ready, and sent to the market, as remunerative prices are usually obtained for these early supplies. Small and immature fruits should not on any account be picked, but should be left on the tree to mature.

Cover-crops.

The growing of cover-crops in established orchards has been proved of considerable value in maintaining the general vigor of the trees, particularly on land that is naturally deficient in humus. Leguminous crops are recommended for this purpose on account of their value in adding nitrogen to the soil. Blue lupin is extensively sown for this purpose, and is suitable for most districts.

The time for sowing cover-crops varies according to the local conditions. In the colder districts, where a long winter with severe frost is likely to check growth, it is desirable to sow early in January. In the warmer districts, where growth continues during the winter months, sowing in the latter part of February or early March is recommended. The use of 2 bushels of lupin-seeds plus 1½ cwt. of superphosphate and up to 3 cwt. of carbonate of lime per acre is advised for cover-crops.

—*B. G. Goodwin, Orchard Instructor, Christchurch.*

Citrus-culture.

By the time these notes appear the setting of the main crop of both lemons and oranges should be completed. Following the somewhat lighter pickings of the past season, the coming crop should be a good one. Favoured with a good setting, the grower sees the first indication of a reward for his labours. However, several months of careful management lie ahead before the fruit may be harvested and the realizations from its sale obtained. It is necessary nowadays to produce good-quality lemons and oranges, for competition is so keen that it appears certain that those who produce a large percentage of low-grade fruit will ultimately have to give way to the more efficient growers. It is generally admitted that the first step towards an improvement in the citrus industry is the production of increased quantities and the marketing of higher-grade fruit. There are many factors which influence the quality of citrus fruits, and, while a few of these are beyond the control of the grower, there is much that can be done to raise the grade standard of the crop.

Thrips is a pest which causes a silvery russet on the fruit, and in consequence is responsible for a considerable lowering of the grade of the affected fruits. More attention should be paid to the control of this insect. Control measures are outlined in the October notes. The present time should be suitable for an application of lime-sulphur 1–60 (polysulphide content 15 per cent.), as under ordinary circumstances an interval of about one month will have occurred since the application of Bordeaux. It should not be necessary to apply summer oil for at least another month—that is, until mid-January.

Leaf-roller caterpillar : The damage which this pest is causing is being overlooked in many groves. Oranges appear to be more subject to attack than lemons. Young orange-trees suffer through caterpillar damage to the young growth, which is often completely eaten up, and there is also a loss due to the affected fruits being blemished by superficial skin injury. Where this caterpillar is doing noticeable harm to trees and crop in a grove, arsenate of lead powder $1\frac{1}{2}$ lb. to 100 gallons should be included in both the spring and autumn applications of Bordeaux.

The hot summer weather heralds the period of greatest activity of citrus scale insects.

Citrus white-wax scale (*Ceroplastes destructor*) where present should receive attention at the present time. A close watch should be kept for the emergence of the minute young scales, which at first resemble specks of brown dust. An application of summer oil, if thoroughly applied while the young are hatching freely, effects a clean-up.

Citrus red scale (*Chrysomphalus aurantii*), often described as the world's worst citrus pest, if present in a grove, requires attention during the hot summer months. Its activity varies according to the weather conditions. The scale is very much more active in a hot dry summer than in a wet season. Under New Zealand conditions summer oil 1–33, provided it is applied thoroughly, is quite effective in cleaning up this pest. Spraying should not be done by the calendar when the young are hatching freely. The young scales during the " crawler " stage are more readily killed than the old ones, and the spray should be applied. If there is trace of this pest in a grove, at least one application of the summer oil should be made ; while if the infection is at all extensive at least two applications should be made at an interval of approximately four weeks. The time for spraying, generally, is during the months of January, February, or March. It is advisable not to delay the application unduly. If the scales are allowed to become fully grown before they are killed they still adhere to the fruit and are difficult to remove, while the young scales which are killed fall off readily, particularly while the fruits or parts of the tree to which they are attached are growing. Where trees are so dense that complete coverage with the oil is rendered difficult, it is desirable that some pruning be done in order to make all parts of the trees accessible to the spray.

Citrus red mite (*Paratetranychus citri*) may become troublesome if a hot dry spell is experienced. This species is one of the easiest of the red mites to deal with. A heavy fall of rain has been known to effect a clean-up. However, when the mites are at all numerous and the dry weather appears likely to continue, it is advisable to apply summer oil 1–100. If not controlled this pest does considerable harm to the foliage and causes it to become a light-yellowish colour.

Borer may be active at this time of the year. Where it is found to be working in light wood, the cutting-out and burning of this should be done without hesitation. When it has gained access to valuable limbs, an attempt should be made to locate and kill the larva by the insertion of a stout piece of wire in the tunnel made by the insect. It should be remembered that when a hole about the diameter of an ordinary lead pencil is visible, this is a sign that the adult insect has emerged from the tree. It is the smaller holes with castings which indicate the presence of an active borer. Wounds made during the cutting-out of bark blotch are liable to afford easy access for the young borers, and this is one of the reasons why such wounds should receive a very careful coating of wound-dressing of the bitumen-emulsion type. This should be gone over again periodically to maintain complete coverage.

New plantings : If a prolonged spell of dry weather is experienced, it may be necessary to water trees which were planted in the spring. It should be remembered that there has not yet been sufficient time for much root-development, and if the soil is of a friable type it dries out quickly. Whether to water or not is a matter for the judgment of the grower after a study of the condition of the trees. If water is applied, it should be put on in sufficient quantity to allow of penetration well down to the lowest roots. In the past a timely watering in a dry season often has been the means of saving the trees in a newly planted citrus orchard.

—*A. R. Grainger, Orchard Instructor, Tauranga.*

POULTRY-KEEPING.

Causes of Early Moult.

WHY do so many birds of the average farm flock stop laying in December and go into an early moult ? This is a question that has been asked on several occasions.

There may, of course, be several contributing causes, such as an inferior class of stock, parasitic infestation, unsuitable housing, or incorrect feeding. However, if a whole flock of birds stop laying and a large number go into a moult before the New Year, it is safe to say that the chief cause is a shortage of feed. Instances have been brought under notice where, although the birds have been given a good quantity of feed, egg-production has dropped suddenly and many birds have gone into a moult during December or early in January.

The successful poultry-farmer who has regularly culled his flock expects to get about a 60-per-cent. production from his adult birds during December, and on a general farm where fowls have a free range there is no reason why a good strain of birds should not equal that production. At times farm flocks are fed too much grain and not sufficient variety, especially during the hot summer months.

Where trouble has been experienced in the past with too many birds going into an early moult, it would be well to make a trial from now on of giving the birds a little more feed and a greater variety of it. While a variety is suggested as desirable, care must be taken not to make any sudden change, to which laying birds do not take kindly. A slight addition, giving variety to the ration, often sharpens the birds' appetites, and, as increased food-consumption means increased egg-production, a little extra may keep a flock producing for some weeks longer, thus giving an increased profit. There are several ways of making this slight change. For instance, some farm flocks are fed an all-grain ration: in such cases it should pay to give a mash once a day in addition to the grain. A mash of two measures of pollard to one of bran and mixed in a fairly dry condition with skim-milk serves the purpose. If this is not convenient, a change may be made by soaking grain for twenty-four hours and giving a little each day in addition to the usual feed. Skim-milk to drink, as well as water, is a welcome change.

Too much grain has a tendency to cause birds, especially heavy breeds, to put on too much condition. On the other hand, a mash containing milk or meat-meal tends to promote egg-production. Again, if the grain ration consists of wheat alone, the addition of a little oats, barley, or cracked maize adds variety, although at first the birds may not take to the new grain.

Where a dry-mash system of feeding is adopted, the hoppers may be closed for a few hours and a wet mash of the same ingredients fed in troughs. Again, where only wet mash is fed, a little dry mash can be placed in the troughs at noon, or a light extra feed of wet mash can be given at noon. Where late or rather backward birds seem to be making little progress, an extra feed of wet mash often helps considerably.

As previously mentioned, any change, however slight, should be made gradually with judgment and care: the chief object is to induce the flock to eat a little more, but, naturally, to be successful all poor, weak specimens should be culled. If the moult has not started, the suggested slight addition, and a little more variety about this time, often enable more birds to pay their way.

Feeding of Turkey Chicks.

The three essentials to successful rearing of turkeys are—(1) good, healthy, well-matured breeding-stock; (2) suitable environment as regards soil and climate; and (3) proper care as regards cleanliness and feeding, especially until the poults are at least able to more or less look after themselves.

It is well to bear in mind that seldom does a person make a success of turkey-rearing who breeds from immature stock. For this reason it is never advisable to breed from first-year birds, especially hens. The breeders should be selected from the best of the two-year and older birds. It is also well to introduce fresh blood at least every three years, as stock from birds that have been too much inbred are most difficult to rear. Turkeys do best on dry and fairly high country where they can have a good free range. Damp, heavy, low-lying country is not suitable. Young turkeys are very susceptible to the ill effects of stale food. Turkey eggs may be hatched successfully in incubators and the poults reared in brooders, but in this country practically all turkeys are hatched and reared in the natural way.

Turkey hens make quite good mothers, but it is advisable to confine them with the young ones for the first ten days or so according to the weather. A good roomy coop with run attached should be provided, in which the turkey can stand erect and move about. If such conditions are not provided some of the poults are likely to get trampled to death. Where a coop has been used before, it should be thoroughly cleaned and washed out with a good strong disinfectant, care being taken to see that the disinfectant reaches all cracks and corners in order to destroy mites and disease germs. The coop with run is best placed in dry, clean ground where other poultry have not been running, and should be moved regularly, especially while the birds are confined.

As insects are liable to infest young turkeys at any time, one must be ever on the watch and fight against them. The best way is to dust the hen before she starts to sit, and again during the period of incubation—a suitable dusting-mixture can be made of equal parts of fine, dry, road dust, coal ashes, and sulphur. This should be dusted well into the feathers, especially under the wings and round the vent. The mixture, to be effective, must be very fine, so that it is drawn into the breathing tubes of the insects, thus suffocating them. If a little sweet oil is rubbed into the heads and under the wings of the young poults it will assist in keeping them from becoming infested. As young poults are susceptible to sunstroke, it is well to see that they can get protection from the direct rays of the sun. If they appear listless, slow-moving, and inclined to stagger, this indicates sunstroke, but if they have plenty of protection from the hot sun and do not seem to thrive, and constantly peep, peep, one may suspect insects, and treat them accordingly.

There are many different methods of feeding turkey chicks, and if a particular method has proved successful it is well not to change. The following method is suggested to those who may not have had success: About twenty-four hours after hatching sprinkle a little fine sand and oyster-shell chicken-grit on paper or boards on the floor of the coop, and about an hour after give a light feed of a mixture consisting of bread-crumbs and rolled oats, mixed crumbly with beaten-up raw egg. Four feeds of this mixture may be given the first feeding-day, just as much as the chicks will clean up. The mash should not be left to get stale. On the second day the same mixture should be given with the addition of a little finely cut (about the size of wheat grains) succulent green-stuff, such as dandelion-leaves, onion-tops, tender lucerne, or lettuce. On the third day some dry curds from which the whey has been squeezed and a little pollard can be added. This mixture may be fed for seven or eight days, and then an alternate feed of a good chick-grain mixture should be given. However, the curds and green food should be increased, and a little dry curds can be left for the poults to pick at. Gradually the mash is changed until it is made up of two measures of pollard and one measure each of dry curds, bran, and green stuff. When the poults are about five weeks old three feeds per day are sufficient, one of grain and two of mash, the grain-mixture consisting of three parts of cracked wheat and one of cracked maize. After the first week a dish or hopper of dry mash can be left in the coop for the birds to pick at as they wish. Boiled potatoes or other vegetables can be mixed in the mash, but green feed and curds are very important items.

Clean water should be within reach at all times. Whole-milk may also be given, but great care should be taken to see that the drinking-vessels do not become sour. The young ones should always be fed in dishes or small troughs, and not on the ground. This is in order to guard against contamination. Although the poults should be protected from bad weather, they should not be pampered, but should be encouraged to roam after about ten days, provided, of course, the grass is dry.

The turkey-rearing section should be apart from the fowlyard and on clean ground. Before marketing the best should be selected and kept for future breeding stock.

—*C. J. C. Cussen, Chief Poultry Instructor, Wellington.*

THE APIARY.

Use of Queen-excluders.

THE coming month should prove the advantages to be gained by the use of excluders. In the colder districts they are of inestimable value in enabling the beekeeper to finish extracting before the hot weather has altogether departed. Generally, they should be used only during the main honey-flow. All sealed brood should be raised above the excluder, and the queen confined in the brood-chamber or drawn-out combs. After a few days the brood in the super should be examined in case queen-cells have been started, as it is almost impossible to find brood-combs which do not contain a few eggs, and the bees often raise queen-cells on brood from which the queen has been separated. The queen continues to lay on the empty combs provided, and, as the brood in the upper story hatches, the combs become filled with honey—a great boon to the beekeeper who does not wish to extract brood-combs. By delaying the use of excluders till the main flow has started, one of their chief disadvantages—the promotion of excessive swarming—is largely obviated, as in most localities swarming stops automatically when clover blooms freely.

Extracting Operations.

By the end of December extracting should be commenced in the warmer parts of the Dominion, though farther south it may not commence till some little time later. The utensils for handling the honey should be thoroughly cleansed and scalded and set up in the position they are to occupy during the season. Everything should be tested to see that it can stand the strain of the season's work. Extracting is such high-pressure work that there is little time to stop for repairs once it commences in earnest. The uncapping-knives should be sharpened, strainers fitted with clean cheese-cloth, brakes and belts inspected, and all machinery oiled and cleaned so that matters may run smoothly during the few weeks that the main business of the apiary is in progress.

The honey may be extracted as soon as the combs are three parts capped, and the operation repeated two or three times during the season; in fact, keeping the extractor running from the time the main flow sets in is perhaps the most satisfactory way of dealing with a honey crop, and is to be recommended where there is a possibility of thick honey being gathered. However, in clover districts, when the beekeeper possesses plenty of supers, the honey may be left in the hives till the end of the flow, and all the extracting done at one time. Although this ensures prime, well-ripened honey, it makes the handling of the crop very heavy work, and gives more trouble from robbers, which are always very much in evidence at the end of the season. In addition, in the colder districts heavily supered hives are apt to become chilled during the later part of the summer, and cold honey is much more difficult to extract than warm.

Once the honey leaves the hives it should be handled as cleanly and expeditiously as possible. Two or three zinc trays are a big help in disposing of drips, &c. One placed on the barrow which conveys the supers of combs to the honey-house, and another on the floor of the house to receive the supers prior to uncapping, saves much soiling of clothes. These trays should have small blocks or supports fastened in each corner to raise the supers a little, so that the drippings from burr combs, &c., may be drained away from the bottom edge of the supers. The trays are easily washed at the end of the day and drained dry ready for the next using. The extractor, uncapping-can and honey-tank when not in use should be kept covered with clean washing covers, and care should be taken that all bees, flies, and other extraneous things are excluded from the honey. From the peculiar nature of honey-production it is impossible to clean utensils day by day as is done with most foodstuffs, and it is imperative that honey be prevented from coming into contact with dirt and foreign substances.

Provision of Supers.

On no account should the beekeeper neglect to provide his swarms with storage-room. If the weather is normal, from ten to fifteen days after a strong swarm is hived it should be provided with a super. Not only is this necessary in order to obtain a surplus, but if it is not done the newly created colony will probably swarm again. A swarm is most vigorous and usually makes more headway than an established colony, and therefore should be encouraged by the provision of ample room. Many deplete their honey crops considerably by failing to realize the fact that early swarms particularly almost always yield a large surplus in a favourable season.

Ventilation of Hives.

Every care should be taken to provide the bees with plenty of ventilation during the height of the summer. All entrances should be enlarged to their utmost capacity, and, where the bees show a tendency to excessive fanning or clustering out, the hive should be raised from the bottom-board, and any obstruction such as weeds, grass, &c., cleared away from the entrances. Most important of all, ample room should be provided by means of supers, as the overcrowding of the hive tends to make the bees loaf if it does not produce excessive swarming.

Foul-brood.

As soon as settled weather sets in the beekeeper should examine carefully his hives for disease, and, if necessary, treat as soon as possible, so as to give his bees a chance to gather a surplus from the main flow. On no account should the operation be delayed until the bees are bringing in large quantities of the nectar that the beekeeper requires for extracting. The " shake " or McEvoy method is the only one advocated, and the combs and frames should be treated and disposed of as soon as possible after the hives are dealt with.

Queen-raising.

The beekeeper should devote all the time he can spare to the important work of replacing old and failing queens, and if his stocks are of good quality he should endeavour to raise as many queens as possible in his own yard. Cells built under the swarming impulse are splendid for this purpose, and there are many ways of artificial queen-raising which are to be recommended. All the cells to be hatched should be given to nucleus hives to care for; queen-cells are seldom a success when introduced to full colonies. As soon as the young queens are mated and laying, they should be placed in poor colonies, after killing the old queens, and their places filled by other ripe cells.

—*E. A. Earp, Senior Apiary Instructor, Wellington.*

HORTICULTURE.

Vegetable Crops.

WITH the keen demand for early crops, such as potatoes and peas, there is usually little delay in harvesting them; but with such crops as shallots, garlic, and autumn-sown onions, which ripen during the month of January, a delay sometimes occurs which is detrimental. They should be harvested as soon as ripening has fairly commenced, a precaution which is most important in humid districts. Drying and curing must be done thoroughly, especially where they are to be consigned to a distance, as in a soft condition they readily bruise and lack the appearance and keeping-quality of bright, firm bulbs. Shallots and garlic especially are best dried off under cover, as rain getting in between the sections of the bulbs is frequently the cause of fungous moulds becoming established. Cold frames, or plant-cradles with a waterproof blind, are suitable places for the purpose. After drying, these small bulbs keep their condition here best if they are " strung " on a piece of double flax and hung in a cool, well-ventilated position. They then keep firm right into the following summer—a thing they do not do if piled, or even when placed in well-ventilated cases. The shallots are specially suitable for pickling, being tender and mild. After three months or so in a good vinegar they are a popular condiment.

Land from which early potatoes are cleared should be dug, limed, and planted in celery and leeks. That from which peas and beans have been harvested may be given similar treatment and planted in cauliflower, broccoli, savoys, &c. These plantings should be done without delay in the cooler districts, and elsewhere they are usually best completed during the month of January.

Where celery is grown in trenches the early crop will be approaching full growth and ready for blanching. Any suckers and dead leaves about the base should be removed and the plants well watered ; possibly it will be well also to apply a small dressing of nitrate of soda. A day or so later, when the foliage is dry, the leaves of each plant should be loosely drawn together by taking a turn round it with a line, the end of which is fastened to a stake firmly set in the ground at the end of the row. Then soil should be broken down fine and shovelled into the trench from each side until it is filled to a depth of 4 in. or 5 in. This process should be repeated at intervals of a fortnight, until earthing-up is completed. Varieties of the self-blanching type planted in a bed at about the ordinary ground-level require only to be surrounded with 12 in. boards on edge (or their equivalent) to blanch the stems satisfactorily in a period of about three weeks.

Late crops of dwarf beans, peas (of an early variety), short-horn carrots, globe beet, turnips, silver beet, parsley, radish, spinach, and lettuce are now sown to maintain a varied supply during the autumn months. Where the land is dry, open the drills and water them well before sowing the seed and covering it.

It is now that the crop of late potatoes is liable to the attack of a fungous disease known as late-blight, *Phytophthora infestans ;* wet, warm weather is particularly favourable to its spread. In wet, warm localities and seasons this crop should now be sprayed with Bordeaux 3–5–40—that is, 3 lb. bluestone, 5 lb. hydrated lime, and 40 gallons water (5 oz. bluestone, 8 oz. hydrated lime, 4 gallons water). The mixture should be made carefully according to the usual directions, as it then adheres well and is most effective. It should be applied as soon as it is mixed, as it loses its condition if held over, even for one day. It should be applied as a fine spray so as to cover well the under-side of the leaves, and it should be repeated at intervals of two or three weeks as necessary. Washing-soda may be used in the place of the lime in making this mixture. Under severe weather conditions a mixture at double strength may be applied.

The first appearance of this disease usually consists of dark areas on the leaves, often first at the edges, with a grey mould on the under-surface. In weather favourable to the attack, and where spraying is neglected, these infections spread and merge until the tops of the plants are destroyed and tubers near the surface become infected. Where such a development threatens, the tops should be mown off and removed and the tubers lifted for early consumption. By planting the late crop rather wide between the rows and high moulding-up tuber infection is more likely to be avoided. This method is also of great assistance in repelling the attack of the potato-moth, *Phthorimaea operculella,* which is commonly prevalent in dry, warm districts and seasons during the autumn months. Should moth-damage seriously threaten, the crop should be sprayed with a solution of 1¼ lb. arsenate-of-lead paste (or 10 oz. of arsenate-of-lead powder) in either 40 gallons of water, or the same quantity of Bordeaux mixture, in which case it serves a double purpose. For making 4 gallons of this spray mixture 2 oz. of paste or 1 oz. of powder is required. The arsenate is first placed in a small bowl and worked up into a cream with a little water before stirring it into the larger quantity of liquid.

The harvest of the tomato crop in the unheated glasshouse is at the peak during the month of January, with the outdoor crop commencing to ripen towards the end of the month. The crop realizes the best price if it is graded for maturity and quality. A well-managed crop can hardly go wrong on these lines ; but, with inexperienced picking, fruit which should be picked may be left over, and, although firm, may be too forward at the next picking. It is then probably either graded out and wasted, or packed, and the retailer then bears the loss of the waste; unless, as is most likely, the fact of mixed maturity is perceived in time and the wholesale price is reduced sufficiently to pay for the waste ; for the market price of a case of fruit is assessed on the lowest grade it contains. Reasonable grades as regards maturity and quality consistently maintained secure for the brand a reputation which ensures a ready sale and sound prices. At this season of the year the ripening process proceeds rather quickly under transport conditions, and nice judgment is required when packing for distant markets. Many experienced growers underestimate the speed of this development when the fruit for a time is subject to the warm, close conditions incidental to transportation.

The tomato-plant, like the potato, is not as responsive to the applications of lime as are such crops as cabbage, celery, lettuce, and spinach. An experiment was recently concluded by the American Society of Horticultural Science to ascertain more exactly what were the lime-requirements of the tomato. Marglobe tomatoes were planted in a number of plots in which the hydrogen-ion concentration (acidity) ranged from 4·4 to 6·8. The smallest plants were grown on plots registering an acidity of 4·4 to 5·0, which may be described as very acid. Between 5·2 and 5·4 there was a significant increase in the weight of the plants, but they were still rather smaller than those on the less-acid soil reactions 5·5 to 5·7. The greatest average plant-weight occurred between 6·2 and 6·4 ; but it was not significantly greater than that obtained between 5·5 and 6·2. A significant decrease of weight occurred again on plots with reactions over 6·7. The optimum range of acidity for this crop is considered to be from 5·5 to 6·4.

The symbol pH is used to indicate the hydrogen-ion concentration. The neutral point in the scale is pH 7·2. Higher figures indicate alkalinity, the highest so far ascertained being 9·7. The figures below 7·2 indicate the degree of acidity, the lowest so far ascertained being pH 2·8. From this it will be seen the most suitable soil condition in this respect for the tomato crop is only slightly acid.

The Homestead Garden.

In planning the homestead garden nothing is more important than the shelter-trees and lawns, which form a setting for the crops and ornamental plants. Good evergeen shelter and deciduous shade trees suitably arranged are the fundamental features of a successful garden in the country, and too much consideration cannot be given them. The requirements vary widely according to the quality of the land, temperatures, and rainfall. But there are some principles which should be carefully observed. For instance, the shelter-trees should not be seriously inflammable. Many a plantation of pine with gorse hedges in a district or situation which has a dry summer season has been the scene of serious tragedy. The danger is all the greater in the vicinity of a highway. In such cases a non-inflammable margin, at least, would be a desirable precaution. Neither should the shelter be too high nor too close to the buildings—a mistake which is easily made on land of good quality, especially in a warm climate. Pines, spruce, and the larger conifers are generally best suited for this purpose to the higher altitudes and second-class country. At lower levels cypress and native and exotic evergreens usually best serve the purpose. On land of moderate quality *Cupressus macrocarpa* is a useful tree ; on better land *C. Lawsoniana* or *C. torulosa*, which are more refined, grow sufficiently large ; while such trees as *Eucalyptus viminalis* and *E. Macarthuri* may often be included with advantage. Among native evergreens growing to a height of about 25 ft. species of *Pittosporum* and *Olearia* are excellent for shelter purposes of this kind. And by the seaside the karaka

(*Corynocarpus laevigata*) and pohutukawa (*Metrosideros tomentosa*) are often valuable. Such trees stand cutting where necessary; but it is important when planning shelter for the homestead to select the trees and arrange them in such a way that systematic trimming is rarely necessary. A great deal of labour can be avoided by doing this, and the work need not suffer in any way. It is important that the foliage on the weather margin should be close and compact, especially at the base of the shelter. On the sea-coast a hedge of coprosma often provides this satisfactorily; or on dry, light soil where a stock-proof hedge is desired the African boxthorn fulfils the purpose admirably without making work by growing strongly. Where the land is of better quality, the seedless barberry may well take its place. A shelter-belt on these lines where tall grass in hedge-bottoms and odd corners is cut about the month of December when in flower and before it dries is practically immune from the danger of fire, provides effective shelter, and forms a good background for ornamental planting.

Useful deciduous trees for providing shelter and shade only in summer are the willows and poplars where water is abundant, and, on alluvial land, the walnut. The sycamore is often useful for the purpose, and makes good growth even under poor conditions. The Spanish chestnut should receive consideration in good, well-drained positions, especially in warm, hilly country. By keeping these suggestions in mind, and studying the growth of the various trees in one's own district, shelter-planting may be planned with some success if it is done now with due consideration. Old plantations also often require attention now. In many the pine-trees are mature and are best felled and replaced by new plants. In others many gaps may be replanted, and on the windward side the margin closed by planting a hedge or evergreens of moderate height; by such means they may be maintained in an efficient state.

In the established garden seedling herbaceous perennial and biennial plants recently raised are planted out in nursery rows to grow on in readiness for planting out in a permanent position during autumn or early spring.

The herbaceous border now requires considerable attention, thinning, staking, and tying new growth. A good display depends very much on the manner in which this is done.

Towards the end of the month of January established evergreen hedges may usually be trimmed with best results.

—*W. C. Hyde, Horticulturist, Wellington.*

ESTIMATES OF THE SEASON'S LAMBING.

FOLLOWING are estimates of the current season's lambing in New Zealand computed from estimated average percentages furnished by Inspectors of Stock. Corresponding figures for the five previous years, together with the actual number of lambs tailed therein, are also given for comparison :—

Year.	Number of Breeding-ewes.	Estimated Average Percentage of Lambing.	Estimated Number of Lambs.	Actual Number of Lambs tailed.
		NORTH ISLAND.		
1936 ..	10,300,826	90·50	9,322,476	..
1935 ..	9,697,231	83·68	8,114,361	8,500,075
1934 ..	9,524,065	88·70	8,447,643	8,555,477
1933 ..	9,318,943	91·23	8,502,050	8,385,569
1932 ..	9,170,996	89·16	8,177,657	7,988,569
1931 ..	9,247,005	86·49	7,998,247	7,813,887
		SOUTH ISLAND.		
1936 ..	8,368,135	90·10	7,539,576	..
1935 ..	8,115,186	89·45	7,259,281	7,196,542
1934 ..	8,047,361	89·88	7,232·750	7,134,015
1933 ..	7,890,756	88·14	6,955,252	6,889,128
1932 ..	7,892,064	88·42	6,978,494	7,027,059
1931 ..	8,361,724	87·13	7,285,914	7,161,104
		DOMINION.		
1936 ..	18,668,961	90·32	16,862,052	..
1935 ..	17,812,417	86·31	15,373,642	15,696,617
1934 ..	17,571,426	89·24	15,680,393	15,689,492
1933 ..	17,209,697	89·82	15,457,302	15,274,697
1932 ..	17,063,060	88·82	15,156,151	15,015,628
1931 ..	17,608,729	86·79	15,284,161	14,974,991

District Estimates.

The following table gives estimates of the current (1936) season's lambing for the several sheep districts :—

District.	Number of Breeding-ewes.	Estimated Average Percentage of Lambing.	Estimated Number of Lambs.
Auckland..	2,166,423	87·61	1,898,104
Gisborne - Hawke's Bay ..	4,126,839	89·27	3,684,057
Wellington - West Coast ..	4,007,564	93·33	3,740,315
Marlborough-Nelson-Westland	818,950	78·46	643,336
Canterbury-Kaikoura ..	3,609,269	91·83	3,314,534
Otago (including Southland)..	3,939,916	90·91	3,581,706
Dominion	18,668,961	90·32	16,862,052

—*Live-stock Division.*

In zeal and enthusiasm about the future development of our pig-keeping there seems at times to be an inclination to overlook the outstanding feature of the position—this is, the immense and profitable scope for expansion there is along the line of better exploitation of the foundation material we already possess, both in the better strains of our pigs and in our knowledge, which, though imperfect in some respects, is nevertheless considerable.—*Annual Report, Director-General of Agriculture.*

WEATHER RECORDS: NOVEMBER, 1936.

Dominion Meteorological Office.

NOTES FOR NOVEMBER.

NOVEMBER proved a dull, wet, and changeable month, and consequently from the point of view of the public comfort it was an extremely disappointing one. Although there were several brief periods of cold southerly conditions, particularly on the 8th and 9th and during the last three days, northerly winds predominated and temperatures were, on the whole, on the mild side. As a result, there has been a wonderful growth of grass and vegetation generally, and stock are in splendid condition. The lack of sunshine, however, has kept the grass soft, and in some districts lambs have not fattened well. Frequent rainfall caused interruption in shearing, and also a certain amount of mortality amongst shorn sheep. Generally, however, the month was a favourable one for the farmer.

Rainfall.—The total rainfall was above the average over the greater part of the Dominion, only a small portion of the coastal area in the South Taranaki Bight and Greymouth reporting a deficit. The greatest excess occurred in the Auckland Province, where some places experienced more than double the usual amount. Russell had 11·32 in. against an average of 2·22 in., and Whangarei 10·11 in., the average being 2·81 in. Some large excesses occurred also in Canterbury.

Temperatures.—In spite of an excess of rain, temperatures were nearly everywhere above normal. The departure in most cases was only a fraction of a degree, but in the southern half of the North Island several places registered over 2° F., and New Plymouth as much as 3° F. Frosts occurred on only a few occasions, but some places experienced rather sharp ones on the mornings of the 15th and 16th. Some damage was caused to plants on the 15th in Hawke's Bay.

Sunshine.—Sunshine was nearly everywhere below normal, the only one of the recording stations having an excess being Tauranga, where 215 hours were registered. Napier had 228·9, Blenheim 209·9, and Masterton 205·4 hours.

Pressure Systems.—The first two days of November were fine under the influence of an anticyclone. The only other anticyclone which brought fine weather over the Dominion as a whole was one which crossed between the 15th and 17th, the remainder usually passing too far north to benefit New Zealand.

Between the 2nd and 5th a cyclone moved across northern New Zealand in conjunction with a deep westerly depression passing in the south. The former was responsible for heavy rain and some flooding in North Auckland, while the latter caused a strong north-west gale in Canterbury during the night of the 3rd.

On the 8th, associated with a cyclone centred west of the Auckland Peninsula, strong south-easterly or easterly winds blew in the central provinces. Conditions were particularly boisterous in the Cook Strait area. Severe thunderstorms, accompanied by very heavy rains, occurred in Taranaki and the central parts of the North Island.

A series of depressions of the westerly type crossed the Dominion between the 11th and 14th and the 17th and 23rd, and, owing to the prevalence of north-westerly winds, rain during these two periods was confined chiefly to districts with a westerly aspect.

From the 24th to the close of the month a succession of cyclones passed from the northward over New Zealand, and widespread rain fell on most days in this period. On the 25th the central districts experienced a heavy north-west gale, a gust up to seventy-six miles per hour occurring on this day at the Kelburn Observatory, Wellington. A temporary improvement took place on the 26th, but on the last three days cold southerly winds and dull, misty, wet weather prevailed generally. The last of this series of cyclones was centred between Cook Strait and Chatham Island on the 30th.

RAINFALLS FOR NOVEMBER, 1936, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average October Fall.	Total Rainfall to Date.	Average Rainfall to Date.
North Island.						
	Inches.		Inches.	Inches.	Inches.	Inches.
Kaitaia	8·48	13	2·25	2·75	56·94	51·68
Russell	11·32	11	4·25	2·22	92·30	47·39
Whangarei	10·11	15	3·12	2·81	68·54	57·52
Auckland	3·19	17	0·61	3·59	48·91	46·17
Hamilton	5·91	14	2·55	4·01	50·58	46·04
Rotorua	8·00	14	3·29	4·18	61·67	51·25
Kawhia	7·69	12	1·35	4·52	55·87	50·42
New Plymouth	7·85	16	2·02	4·70	58·51	55·49
Riversdale, Inglewood	11·30	18	3·32	9·12	93·65	96·69
Whangamomona	5·38	13	2·16	7·39	64·82	71·92
Hawera	5·62	13	1·50	3·78	43·66	41·96
Tairua	11·89	13	5·10	3·63	56·87	60·07
Tauranga	6·03	15	1·37	3·29	54·14	48·81
Maraehako Station, Opotiki	9·02	18	1·55	3·16	65·85	50·45
Gisborne	4·07	12	1·94	2·88	41·41	42·83
Taupo	4·53	14	1·19	3·32	46·73	40·75
Napier	3·11	11	0·98	2·02	44·84	28·14
Hastings	1·91	12	0·62	1·82	38·11	29·98
Whakarara Station	4·20	10	0·84	..	51·81	..
Taihape	4·08	16	0·83	3·40	41·64	33·46
Masterton	3·35	12	0·75	2·69	44·51	35·47
Patea	3·91	17	0·72	4·01	45·71	41·29
Wanganui	1·88	10	0·30	3·24	36·05	33·42
Foxton	2·90	13	0·58	3·20	37·33	29·87
Wellington	6·09	16	0·92	2·99	52·37	39·37
South Island.						
Westport	8·91	18	2·28	8·85	81·45	88·35
Greymouth	8·87	20	1·78	9·10	86·49	92·90
Hokitika	13·90	22	3·20	10·45	100·54	104·57
Ross	17·07	22	4·28	13·86	123·46	123·44
Arthurs Pass	16·32	21	1·98	16·11	134·58	147·80
Okuru, South Westland	19·59	19	3·35	12·60	150·00	133·50
Collingwood	9·59	16	2·46	6·90	89·93	89·19
Nelson	4·83	15	0·79	2·92	40·47	34·86
Spring Creek, Blenheim	3·03	16	0·78	2·39	34·06	28·18
Seddon	2·48	12	0·57	1·85	26·91	22·84
Hanmer Springs	8·25	15	2·35	3·46	56·75	41·29
Highfield, Waiau	7·45	11	2·41	2·52	40·20	30·64
Gore Bay	3·84	9	1·23	2·12	34·08	28·70
Christchurch	4·80	13	1·80	1·78	33·44	22·67
Timaru	4·36	13	1·70	1·95	27·93	20·26
Lambrook Station, Fairlie	4·89	10	1·23	1·93	27·28	22·30
Benmore Station, Clearburn	5·73	16	1·71	2·05	25·95	22·30
Oamaru	2·09	9	1·40	1·92	22·57	19·76
Queenstown	2·72	18	0·64	2·71	34·40	27·99
Clyde	1·35	8	0·52	1·34	13·26	13·46
Dunedin	5·07	14	2·10	3·21	42·28	33·18
Wendon	3·63	14	0·70	2·72	29·43	27·14
Balclutha	3·73	19	1·38	2·48	33·07	23·06
Invercargill	4·94	25	1·10	4·28	44·59	41·65
Puysegur Point	16·61	20	3·09	8·25	104·43	78·09
Half-moon Bay	8·22	19	2·34	5·79	58·83	53·89