92

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THE LAND AND THE PRODUCER.

DEVELOPING GRASS LANDS.

NATURAL AND ARTIFICIAL PASTURES.

By Agrarian.

Dr. A. E. V. Richardson is one of Australia's highest authorities on the scientific management of pasture lands, and now that he is soon to return to this State articles and addresses by him will make a stronger appeal to South Australian farmers. His recent treatise on the development of grass lands is therefore of more than ordinary interest.

The natural pastures of Australia, says Dr. Richardson, are the basis of national income, for they support practically the whole of the sheep and cattle of the country. As wool and live stock contribute in such a large proportion to the wealth of the country, the study of the principles underlying the successful production of grass is of great importance. Grass is Nature's forage, the healthiest and most nutritious food for stock. Australia's native grasses are justly famous for their grazing and their drought-resistant qualities. They are noted for producing the finest and best wool in the world and for withstanding great extremes of heat and drought. No other plants have proved equal to our own for the drier parts of Australia. Other countries, notably the United States, have imported these plants and cultivated them extensively in the drier areas. The success of the pastoral industries of Australia is dependent on the native grass pastures, the indigenous salt bushes, and other edible forage plants; therefore it is essential that a close study should be made of these valuable indigenous plants.

Though Australia has a wealth of native grasses and fodder plants there are relatively few edible leguminous plants and no indigenous plants of the genus Trifolium—the clover family. Clover and trefoil greatly improve the succulence and the nutritive value of pastures, and materially assist in improving the fertility of the soil, because of their capacity to gather nitrogen from the air. Though the pasture plants of the drier portions of Australia are unrivalled for their grazing and wool-producing value, it is true that in the moister coastal region introduced grasses and fodder plants thrive exceptionally well. While, therefore, we should continue to rely on our native grasses for the great bulk of our pasturage, we should not hesitate to use introduced grasses and clover and fodder plants in the moister regions of Australia, where the soil and climatic conditions are very favorable for their development. The production of grass is worthy of the closest study, and a knowledge of the characteristics of grasses and the conditions of soil and climate suitable for the different kinds, and the seeding and management of grass lands must be recognised as a great help towards success on the land.

Sown Grasses in Europe.

The necessity for the cultivation of grasses and clover for pasture purposes is fully appreciated in old-world agriculture. In the United Kingdom there is approximately 48,000,000 acres under crop and grass. Of this area no less than 28,000,000 acres is under permanent pasture grasses. The permanent grass area exceeds the arable area by 8,000,000 acres. Even on arable land no less than 7,000,000 acres are given up to clover and grasses sown in rotation. In new countries, such as Australia, the great part of the flocks and herds are depastured on the indigenous grasses and edible forage plants, but increasing attention is being given to the cultivation of introduced grass and clover, especially in regions of good rainfall. The total area devoted to artificially sown grass in Australia is as follows:—

	Acres.
New South Wales	1,438,382
Victoria	1,269,493
Queensland	418,467
South Australia	21,987
Western Australia	14,158
Tasmania	666,954
Total	3,830,124

Cultivated Grass and Clover.

There are over 5,000 species of grass in the world, and of these approximately 400 [illegible] are indigenous to Australia. Of [illegible] number of species scarcely 1 per [illegible] have come into cultivation, and of these not more than 20 general (exclusive of farm crops) are extensively cultivated. The principal cultivated genera are Lolium (rye grass), Dactylis (cocksfoot), Festuca (fescue), Phleum (Timothy), Poa (meadow grass), Alopecurus (foxtail), Cynosurus (dogstail), Bromus (prairie), Paspalum, and Phalaris. There are over 200 species of clover (Trifolium), and of these none are indigenous to Australia. Of the clover only about 10 species are extensively cultivated. Very little has been done to develop varieties of forage grass, most of those cultivated being identical with the wild forms. There are probably 1,000 varieties of wheat, 500 of maize, but only one variety of cocksfoot or timothy. At the various experiment stations of the world, plant breeders are now at work raising varieties of grass, and it is probable that shortly perennial rye, cocksfoot, timothy, specially adapted to different soils and climates or suited to special uses, such as hay or pasture, will be available. Work is in progress at the State farms to breed varieties of Wimmera rye grass (Lolium subalatum). This grass as grown in Victoria has been shown to be exceedingly variable, and a number of distinct types have been isolated.

Economic Value of Pastures.

The great economic feature of pastures is that they provide a method of feeding livestock at low cost because of the perennial nature of the grass, and because little labor is required once the pasture is established. But this does not mean that on a farm the sole use of pasture grasses is necessarily the most profitable method of raising feed. A pasture will be profitable where the cost of producing cultivated foodstuffs is unduly high by reason of remoteness from a railway, or on steep land where cultivation would cause it to sour. It must be borne in mind that grass land invariably produces less dry matter per acre than cultivated crops, so that the price of the land determines whether it should be left in grass or devoted to crop production. The wheatgrower can afford to pay from £15 to £20, and even more per acre for Wimmera wheat land, but if such land were used entirely for grazing it might be difficult to earn interest on even £8 per acre. In some parts of Victoria cultivated pastures are essential in reclaiming timbered forest areas, e.g., Beech Forest and Gippsland. Unless grass is sown immediately after the timber is burnt, bracken fern rapidly takes possession of the land. Cultivated pastures, in common with native pastures, help to restore the fertility of the soil depleted by more or less continuous cropping. This is particularly true with respect to the restoration of nitrogen and organic matter. But with respect to mineral elements of nutrition, grazing does not add a single pound of mineral nutrients to the soil, though the grazing of pastures may lead to a concentration of mineral nutrients near the surface owing to the action of the deeper rooted grass in bringing these from the under subsoil. Hence, under grazing, the soil will increase in organic matter and in nitrogen (if clover forms a portion of the herbage), but without supplementary supplies in the form of artificial manures, the total stock of mineral nutrients in the soil must diminish. There are certain types of land which are best left in pasture. These are hilly land subject to erosion, low-lying country subject to flooding, rocky or stony land, swamp land, and heavy clay soils that can be tilled only at considerable expense. Even on high priced land, which could be readily tilled, the sowing of permanent pastures may be very profitable. Cultivated pastures furnish feed at low cost are essential in reclaiming certain types of land, and are especially suitable in certain systems as temporary pastures.

Deterioration of Grass Lands.

It is a matter of common observation that many of our natives pastures show signs of deterioration. The quality of the herbage has fallen off, and, in many cases, the live stock show evidences of malnutrition. Instances of this may be seen in every district, but the most striking cases are those in the older settled areas of good rainfall. Natural pastures deteriorate in several ways, overstocking and injudicious grazing, continual removal from the soil of the elements of nutrition by the annual crop of wool, lambs, and fat stock, without the replacement of these nutritive elements by means of fertilisers. In addition, in the heavier rainfall districts, mineral nutrients, e.g., nitrates and lime, are actually leached out of the soil by the heavy rains. Let us briefly consider these cases.

Overstocking.

By injudicious grazing and overstocking, the better and finer grass tends to disappear, and poorer types of indigenous vegetation and weeds are left in possession of the land. Overstocking is bad enough in normal seasons, but in drought years it leads to disastrous results. In such years the better types of native grass are eaten or killed out, owing to their slow growth and non-seeding habits. They are replaced by such plants as barley grass (Hordeum murinum), the useless soft brome (Bromus mollis), barren fescue (Festuca bromides), thistles of various kinds, Cape weed, and plants of low grazing value. The spread of noxious weeds, e.g., St. John's wort (hypericum), in the north-east, hoary cress (Lepidium draba), in the Werribee and Horsham plains, stinkwort (Inule graveolens), in the Korong Vale district, lobelia on the western plains in Victoria, has lowered the grazing value of many fine pastures, and has, in places, detrimentally affected land values. Even in normal times many stockowners carry stock in such large numbers that the good grasses have no chance to see, with the result that the better grasses are gradually replaced by introduced or noxious herbage of lower grazing value than the original pasture. It is natural that the grazier should endeavor to carry as large a number of stock as possible, but though he may gain a temporary advantage with heavy stocking, in the long runs the financial results must be unsatisfactory, as the grazing value of the pastures will steadily deteriorate. Pastures should neither be overstocked nor grazed in large areas. Comparatively small paddocks compel stock to graze the herbage uniformly, and prevent them eating only the best of the pasture, and, further, by their use, pastures may be rested. Drought years will always seriously affect the pastures, but the evil effects may be greatly lessened by the conservation of fodder in good seasons, improvement in the water supply, increase of irrigation areas, provision of greater transport facilities, which would permit of speedy agistment of stock in such years. In favorable years millions of acres in the interior are covered with grass and herbage in such profusion as to be beyond the power of the stock to consume it. Enterprising stockowners have cut quantities of grass hay, and made silage as a stand-by for droughty years. This method of conserving the surplus, combined with improvement in the water supply and provision of better transport facilities, will greatly minimise the losses of stock and the deterioration of the pastures which follow every severe drought.

Mineral Nutrients.

The continual removal of the elements of nutrition from the soil by annual crops of wool, lambs, and fat stock sold off the farm, without replacement of certain mineral nutrients by artificial fertilisers, will reduce the fertility of both rich and poor soils. This condition will be most evident in the older settled districts of the State, and especially in the moister localities, for in these areas the drain on the soil nutrients is more continuous, and the losses by leaching are considerable. The amount of mineral nutrients removed from the land by the annual crops of live stock is considerable. Of these nutrients, the phosphates are of special importance, on account of the law phosphate content of Australian soils. We may roughly calculate the extent of the depletion of our soils in this important soil nutrient. For the past 60 years the average sheep population of Victoria has been approximately 11,000,000, and that of the cattle population 1,400,000. The numbers of stock slaughtered in Victoria are not available for the early years, but a fair average for the past 60 years would probably be 3,000,000 sheep and 280,000 cattle annually. The average amount of phosphoric acid in a sheep carcase is 2½ lb., and in a cattle carcase 15 lb. Hence each year the total amount of phosphoric acid removed from the farms by the animals slaughtered would be 5,223 tons. If we add the amount removed by pigs and rabbits, and also the amount removed as milk, cream, cheese, and wool, the total amount would probably exceed 6,000 tons. This amount of phosphoric acid has been removed mainly from the grass lands during the past 60 years. Thus, throughout that period, something like 360,000 tons of phosphoric acid, which is equivalent to 1,800,000 tons of superphosphate, has been annually taken from the soil, and most of this material has been removed from the pasture lands. As a very small proportion of our grass lands and pastures has received any addition of phosphate in the form of artificial manures, it would appear that to restore the phosphate content of the soil to what it was in 1860 nearly 2,000,000 tons of superphosphate must be added to Victorian pasture lands. In addition to the removal of mineral nutrients by animals, there are losses by leaching from the soil, especially in regions of heavy rainfall. The main nutrients washed from the soil are nitrates and lime. No figures are available as to the extent to which these constituents are removed in Victoria. At Rothamsted, on a rainfall of 28 inches the losses of carbonate of lime from the soil by leaching have been shown to be no less than 8 cwt. per annum. Fortunately, both phosphoric acid and potash are firmly held by the soil, and the losses of these constituents by leaching are negligible.

Improvements of Grass Lands.

Grass lands may be improved in three ways; by sowing down with native or introduced grasses, growing a cereal or root crop, and using liberal dressings of fertilisers, top dressing the pastures with suitable fertilisers, e.g., superphosphates, or with certain soil amendments, e.g., lime or gypsum. The first method of improving the pastures is the sowing down of lands with native or introduced grass. Over the greater part of the continent the climatic conditions are too severe for the successful sowing of introduced grass. Only the native grass and fodder plants will thrive on the drier areas. The growing of introduced grass and clover is only possible in the higher rainfall areas—the coastal region and the highlands. The seeding of native grasses is a difficult and expensive matter on account of the low vitality of the seed, i.e., its low germinating power and the scarcity and high price of the grass seed on the market. The germination of seeds of certain species, e.g., danthonia (wallaby grass), and anthis thiria (kangaroo grass) is usually very low, fresh samples of seed often giving germination percentages of only 10-20 per cent. The andropogon (blue grass) and panicum (panic grass) show higher vitality, as do also the various species of astrebla (Mitchell grasses). The native grass that can be sown to best advantage is dependent mainly on the amount of rainfall and its seasonal incidence. In the summer rainfall region of Northern Australia the dominant species are the panic grass (panicum), Mitchell grass (astrebla), the blue grass (andropogon), and the various species of erianthus.

In the winter rainfall zone of Southern Australia the predominating native grasses are the various species of danthonia (wallaby grass), agrostis (bent grass), anthisthiria (kangaroo grass), stipa (spear grass), eragrostis, and poa. The various species of danthonia are, perhaps, the most useful of grasses suited to the southern areas. They furnished a great quantity of winter feed, which is highly palatable and nutritious for sheep feed. The kangaroo grasses are very widespread, but are somewhat coarse, and are very common on protected areas, e.g., forest and railway reserves. The stipa, or spear grass, grows rapidly, and furnishes an abundance of sheep feed during the greater part of the year. The seed of several species is very troublesome to sheep because of its pointed nature and its coarse twisted awn, which has remarkable penetrating power. This grass seed is specially detrimental to young lambs, as it may injure the eyes, and certainly penetrates the skin and lowers the value of the carcase. Every effort should be made to market the lambs before the grass seed begins to ripen. Poa, agrostis, and eragrostis are found in the cooler regions, and provide good feed for stock.

In the drier parts the salt bushes are of considerable importance. These are great drought resisters, and are highly adapted to hot, dry, localities, and soils with high saline content. Of the various genera, atriplex, kochia, and rhagodia are of greatest economic importance. Victoria has ten species of atriplex, six of kochia, and five of rhagodia. One of the most important species of atriplex is A. Semibaccata, a spreading prostrate plant which has been introduced and cultivated in California with considerable success. It is a curious fact that though California imports seed of these Australian fodder plants for cultivation on the drier land, we in Australia are indifferent to the cultivation either of these edible forage plants or our very valuable native grasses. There is no doubt that cultivation would greatly improve the native grasses in succulence and bulk. This may be seen from the excellent growth which they make when cultivated in small grass garden plots. There is little doubt, too, that good seeding habits would follow from systematic cultivation and selection. A great field of work awaits investigation in the improvement of Australian grass. The pastoral industry is such a valuable asset that every means should be taken to conserve our native grasses and to aim at improving them in bulk, succulence, seeding capacity, and in stock carrying capacity.

In the moister regions of Australia—the coastal areas and the highlands—the growth of introduced grasses offers a sure means of increasing the stock carrying capacity. For the areas dependent on summer rains, the summer growing grasses, e.g., paspalum, Rhodes grass (chloris), &c., are extensively used. Both these grasses are extensively grown in New South Wales. For areas within the winter rain region, i.e., the southern coast of Australia and the adjacent highlands, perennial rye grass, cocksfoot prairie grass, and Kentucky blue grass, are the most useful grasses, and white, perennial red, and alsike the most valuable of the clovers. On rich coastal flats strawberry clover (T. fragiferum) is a most valuable clover, and on relatively poor land subterranean clover (T. subterraneum) has proved of great value. For the lighter rainfall areas, Wimmera rye grass (lolium subulatum) is worthy of trial. In the preparation of the soil for a crop that is to occupy the land for many years, it is sound practice to do the work thoroughly. The wheat grower now spends so much as fifteen months' work on the preparation of a fine, firm, well consolidated seed beed for a single crop of wheat. The permanent grass crop which will occupy the land for many years, should have at least an equally thorough cultivation. The main requirements are a well cleaned, firm, mellow seed bed, in fine tilth and condition. To secure such a seed bed under cool and moist conditions, it will be necessary to precede the grass crop either by a well worked bare fallow, or by a fallow crop, preferably a root crop, which has been liberally manured and frequently intertilled. Either of these would make an excellent preparation for the grass crop. In the case of wet, low-lying areas, some form of drainage, either surface or underground, is essential to secure vigorous, healthy growth of the pasture. If the grower of grass could be induced to prepare the land with the same thoroughness as the wheat grower works his land, as good germination and successful establishment of a pasture would be ensured. The selection of suitable grass for a permanent pasture is a difficult problem. The soils and climatic conditions vary very widely in Victoria, and each set of conditions should be experimentally tested before the mixture can be determined. Grass was divided into [illegible]