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LUCERNE SPECIES and STRAINS

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Until fairly recently lucerne was just lucerne (or alfalfa) but with the spread of the plant to less suitable localities, disease and the effect of adverse environment have high-lighted the need to obtain new sources of plant material. Consequently it is desirable to know what material is available. A further reason for understanding the background of the world's strains of lucernes is the world-wide problem of seed production which results in all except the most favoured localities having to import seed from time to time. An account of the characteristics of the three main species is given in Table 1.

TABLE 1.

Lucerne Species

	1	2	3
Species	*Medicago Sativa*	(1x3) *M. Media*	*M. falcata*
Name	Common	Variegated	Yellow flowered
Flower	Purple	Variegated	Yellow
Habit	Erect	Semi-erect	Prostrate
Root	Tap Root	Some branched roots	Many branched roots
Leaflet	Long and Wide	Short & Narrow	Very short & narrow
Productivity	High	Medium	Negligible
Earliness	Early	Medium	Late
Winter Hardiness	Poor	Good	Excellent
Disease resistance	Poor	Good	Excellent

Lucerne originated in Asia Minor, *M. sativa* being found in the warmer climate of the lowlands and *M. falcata* in upland areas. *M. media,* a hybrid form, is an intermediate type. Further crosses and back crosses between these species give us five main strains as shown in Table II

TABLE II

Classification of Natural and Bred Strains

Medicago sativa	*M. sativa x M. Media*	*M. media*	*M. media x M. falcata*	*M. falcata*
Natural Strains				
Hunter River	Flamande	Grimm	(Cossack)	Don
Argentine ←	Marlborough	Ontario Variegated	(Ladak)	Siberian
Provence →			*Turkestan*	
Sth. African		Baltic	Nomad	
American Common		German	M. glutinosa	
		Poitou		
Bred Strains				
(Buffalo)	Du Puits	S. 205		
Saladina	Strain B. Atlantic	Hardigan	*Ranger*	
			Vernal	
			Rhizoma (Creeping rooted)	
		←	Narragansett	

N.B. Strains in italics are wilt-resistant, those in brackets are moderately wilt-resistant.

The classification of the natural strains is easily followed from their historical background. Lucerne first spread to Greece in 470 B.C. and later to the Roman Empire. It acquired its name from the valley of Lucerne. This introduction was of the *M. sativa* type. Other emigrations brought in the *M. media* species and crosses between them. Thus in Europe we find fairly pure *M. sativa* types such as Provence, *M. media* types as in the German and Poitou strains and intermediates such as the Flamande strains. Another line of emigration was across North Africa and to Spain under the Moorish influence, whence it received its name of alfalfa. This was a fairly pure *M. sativa* type. Spaniards introduced alfalfa to Chile in Elizabethan times and from here it spread across the Andes to Argentina and Uruguay and also north to Peru. Here lucerne found a suitable home and some 17 million acres are devoted to its culture, nearly 40 per cent of the world's acreage.

The gold rushes in California took Chilean alfalfa to western America. Here the plant found perhaps its best home; hot sunny days, cool nights, mild winters and a deep rich soil. Inoculation, liming and fertilisation were unknown and unnecessary. Lucerne did not spread widely in the eastern states for many years as winter cold, acid soils and deficient minerals did not encourage its use. A series of droughts in the years 1927-36 aroused interest in lucerne and a new empire of some 10 to 12 million acres developed in the middle west. This time it was no simple process of letting the area develop. It was a triumph of the agricultural scientist over extraordinary difficulties. Firstly, to overcome the unsuitable environment, seed bed preparation, inoculation, liming and adequate fertilisation were required. Secondly, winter-killing; the non-hardy, *M. sativa* type from the west was of no use, but an introduction of a variegated lucerne by a German immigrant, Wendelm Grimm and of an Indian strain, Ladak, gave the answer to this problem. Next came the disease bacterial wilt, which was partly answered by using the Caucasian strain Cossack, and Ladak. Turkestan, another Caucasian strain, while low in production had excellent wilt resistance. A combination of these has given rise to very resistant strains in Ranger and Vernal. Other pests and diseases created problems to be met by choice of new strains or by breeding to the hardy *M. falcata* parent. It was due to the enthusiasm of an early plant explorer, Dr N. E. Hansen, that this material gathered in Russia and Asia Minor about 1909, was available in experimental station nurseries. It is thus apparent that where no problems arise *M. sativa* is the principal strain used but where any degree of hardiness is called for, more or less *M. falcata* blood is indicated. Put another way—where the environment can be fitted to lucerne, *M. sativa,* strains are used. Where lucerne has to be fitted to the environment, then *M. falcata* crosses are required.

The *M. sativa* strains are classified as non-hardy. This includes Hunter River, Argentine, South African, Provence, and American Common. When our seed stocks are in short supply these are our main centres for obtaining seed. Some of them are not satisfactory for South Island use.

Our own Marlborough is usually considered to be a Provence type, although first supplies came from Argentine. However, it exhibits a great deal more variegation and is superior to many of the pure *M. sativa* types for our environment.

The division of strains in Table II is somewhat artificial in that lucerne is a cross-pollinated plant and is probably capable of more change in an environment than any other field crop.

Lucerne seed is usually taken from old thinned-out stands in which only one out of 100 of the original plants survives; consequently major changes can occur in a strain.

At Cambridge in England, vigorous testing has been carried out on a world collection of strains by Zaleski. There is a severe winter climate and the non-hardy *M. sativa* types do not show up at all well. Hardy strains such as Grimm are affected by grass invasion. Zaleski found a close correlation between total production, spring earliness, autumn productivity and earliness of flowering in which the rating of strains was Flamande, Marlborough, Provence, Hunter River, Argentine, Grimm, Rhizoma and Nomad. Winter mortality of Provence, Hunter River and Argentine was severe. Zaleski considered the test of a good variety to be early in spring, early flowering, productive in autumn, erect, with a long, wide leaflet. At his station Flamande types were easily superior. Fault may be found with their stemmy nature, but for North Island areas where grass invasion is a severe problem, the early and late growth of this type is a strong deterrent. In Lincoln trials, Du Puits (Flamande) shows these characteristics but is not markedly superior. It would probably give an extra cut. Flamande lucerne does not stand grazing. In yield trials in England, France, Holland, Denmark, Sweden, Oregon and Ontario, Du Puits outyields other varieties for the first two years. After that it may become weakened in unfavourable environments.

Except in such favoured areas as California, seed production is a vexed question the world over. Under grey skies the honey bee seems to be an ineffective pollinator. We rely therefore on wild bees and the population is usually insufficient. Injurious insects can reduce seed set and may require to be controlled. One promising avenue of approach is by breeding. There are distinct differences in seeding ability of strains and such differences are inherited. Hardigan is a strain with exceptionally good seed set. Zaleski pointed out a distinct fault of Marlborough—the keel takes an excessive pressure to make it trip. A selection within the strain for easily tripped flowers may encourage pollen gathering bees to visit lucerne.

We come now to the last development noted — the production of rhizomatous and creeping rooted strains. *M. falcata* has a characteristic of producing branched roots, and crosses with *M. sativa* show some of this character. Back crosses on to *M. falcata* may give even greater amounts of root proliferation than the *M. falcata* parent. Natural strains of rhizomatous lucernes are to be found. One is *M. glutinosa* under selection at Lincoln. Another is Nomad, found in Oregon. Both are small leaved, prostrate, short season types. However, selection within the strain may give higher producing lines. Breeding work to achieve this same end was commenced by Dr Moe of Vancouver in 1928 and has resulted in the release of the variety Rhizoma. This is a cross between Don and Ontario variegated. It produces rhizomatous branches up to six inches long from a crown two or three inches under the surface. Moe isolated strains with much greater creep but found creep and productivity in inverse ratio. Rhizoma is a good summer producer, drought resistant and winter hardy. In Lincoln trials it is one of the better strains. When released in North America it was given a great deal of publicity but in Eastern United States is now somewhat derisively described as " weakly rhizomatous." Being wilt susceptible, it is perhaps adversely affected in North America. Moe's original cross was also used by Odland at Rhode Island and Heinrichs at Swift Current. Odland produced Narragansett by introducing a good deal of *M. sativa* blood and much of the creeping nature has been lost.

The most interesting new material in the lucerne world is undoubtedly Heinrichs' creeping rooted lucerne. This plant is not rhizomatous but has a creeping root from which stem branches arise. One three-year-old plant seen was nine feet across and had 286 separate crowns. Its root system is very like that of morning glory, the field convolvulus. The object in breeding this strain was to obtain a perennial legume for the range lands which would withstand heaving in the intense winter, would regenerate even if the parent root-stock died and would be more drought resistant. It was considered that a plant spreading by root branches would be superior even to one with rhizomes. Rhizomes depend on surface moisture for their spread whereas creeping roots can spread in arid soil.

The main parents of this strain are Ladak and Siberian. With this parentage and selected under the adverse climate of Sackatchewan, it obviously will not be a high producing plant. For New Zealand its use may be limited to a source of breeding material.

What, then, are the lessons from overseas for New Zealand? With considerable variations in rainfall, temperature and utilisation it seems obvious that one variety is inadequate. The sub-humid areas of Canterbury, Marlborough and Hawkes Bay are probably well catered for by a dominantly *M. savita* strain such as Marlborough. However, in Canterbury at higher altitudes on less suitable soils a greater infusion of *M. falcata* blood may be superior, as it may in Otago Central with its severe winter. Du Puits should be tested in humid districts where grass invasion may be held at bay by its early spring and late autumn growth. The English practice of sowing a non-competitive companion grass, such as timothy, for the same purpose should also be tested. At times of seed scarcity when importation is necessary the suitability of the strain for New Zealand requires more consideration. An early variegated strain such as Poitou may be superior to American Common or South African. Zaleski's suggestion of selecting a Marlborough strain with a flower less difficult to trip should be investigated and likewise the American approach of selecting high seed producing strains.

Finally, tests should be made of the possibilities of creeping lucernes for grazing pastures on light lands, a project in hand at Lincoln.

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