THE BIOLOGY OF MATAGOURI

G. T. DALY

Plant Science Department, Lincoln College

Summary

Matagouri (*Discaria toumatou*) is a native shrub which plays a useful part in forming vegetation and soil on shingle fans, riverbeds and occasionally on eroded slopes. However, in hill grasslands the presence of matagouri generally reduces the productive area, slows stock movement and causes it to be called a weed. The area of matagouri-dominated hill country is considerable but appears not to be increasing. The most vigorous matagouri is at present on soils with good supplies of available phosphate. On soils in which there is a strong legume response, matagouri, if present, will respond to both phosphate and sulphate. Eradication of mature matagouri by grazing management is considered to be possible but time-consuming.

MATAGOURI (*Discaria toumatou*) is a spiny shrub or small tree prominent in the tussock grasslands of the South Island. In the North Island this wiry plant goes largely unnoticed, being confined to coastal sand-dunes. Scattered through some eight million acres of short-tussock grassland from sea level to 3,500 ft altitude, matagouri has become dominant over thousands of acres of summer-dry hill country.

The matagouri is an unusual species in being New Zealand's only spined shrub and one of the very few which lose all leaves every autumn. In addition, it is one of those extraordinary woody plants, which, though unrelated to the legumes, possesses root nodules fixing large amounts of atmospheric nitrogen.

LIFE HISTORY

Black shiny seeds of matagouri are shed explosively from capsules on parent plants during dry weather in late summer. Eighty per cent of the fresh seeds are dormant until subjected to several weeks of winter cold. In late September and October, thousands of seeds germinate on the ground surrounding mature plants. However, in grassland few if any of these seedlings survive the first summer. As soils dry out, the delicate, leafy seedlings wilt and die after becoming spindly from shading by grasses and clovers.

In gravel of riverbeds or fans, on eroding soils and rubbly, over-grazed grassland, some matagouri seedlings do survive. Eventually, dense thickets of mature plants can develop. These are natural successional communities and after about fifty years will begin to open up as a low matagouri forest. Into the mature matagouri communities on riverbeds and fans of the cool, moist inland valleys, native beech trees once came, while on the eastern hills periodic burning and grazing have maintained matagouri thicket communities with scattered taller plants.

MATAGOURI ON RIVERBED AND SHINGLE FANS

With a small leaf area and shoots green when young, matagouri has a surprisingly high rate of growth. A series of shingle fans increasing in age and dominated by matagouri has been sampled in inland Canterbury. A summary of the dry matter obtained per acre is presented in Table 1.

TABLE 1: MATAGOURI STANDING CROP DRY MATTER
(Tops and Roots are expressed in lb/acre; bottom two lines lb/acre/year)

Age in Years	0-2	10	25	55	70	110
Tops	5	20	2,400	39,200	55,800	159,000
Roots	5	20	300	7,300	8,100	123,300
Dry matter production of tops	3	180	1,460	1,160	2,680	
Litter fall	1	10	500	1,000	1,200	

It must be emphasized that water is plentiful in these young fans. In the free-draining gravel, available phosphate and sulphate are not limiting nitrogen fixation by matagouri plants which are abundantly nodulated. Consequently within a hundred years matagouri can grow to a height of 20 ft with a trunk diameter of 12 in. Plants of similar age in dry montane grasslands are usually less than half that size.

FIG. 1: Matagouri succession on shingle fans in inland Canterbury. Total nitrogen per square metre in vegetation, litter and ferment/humus layer and soil on fans of increasing age.

FIG. 2: *Matagouri* colonizing an unstable shingle fan, Castle Hill Basin. Fan surface age varies from 0 to 2 years at apex to 10 years in midslope and 25 years in right foreground.

Root nodules of the *matagouri* are very efficient nitrogen fixers and the young leafy branches have nitrogen contents of 2 to 3% of the dry weight. Thus autumn leaf-fall and other litter which accumulates beneath dense *matagouri* communities returns substantial amounts of biological nitrogen to the developing soil organic matter (see Table 1). Measurements of the sequence of *matagouri*-dominated fans referred to in Table 1 have been graphed as Fig. 1. Between 25 and 110 years community age, the amount of nitrogen fixed from the air by *matagouri* nodules may be 60lb/acre each year. This rate of fixation compares favourably with that of woody legumes such as gorse and broom.

Matagouri cannot be considered to be a weed when in successional communities on riverbeds, gravel fans, eroded soils and sand dunes. On the other hand, where the shrub is occupying grazing space on more mature, stable grassland soils, its disadvantages become prominent.

MATAGOURI IN DRY HILL COUNTRY

The age of *matagouri* shrubs can be estimated by counting the growth rings of stems and roots. By this method it is also possible to gain information about the past history of individual plants. For example, many *matagouri* plants in hill country grasslands may have a taproot between 30 and 50 years and stems 10 to 20 years of age. This indicates plant survival and regrowth after one or more fires. Most of the *matagouri* thicket communities may have established during periods of frequent fires and heavy grazing by rabbits.

During the past fifteen years of aerial topdressing, there have been reports of vigorous responses by *matagouri* to superphosphate. In some cases runholders have observed the shrub increasing in density to cover

FIG. 3: Seventy-five-year-old Matagouri scrub on a stable shingle fan in Castle Hill Basin. Beneath the Matagouri there is a ferment/humus layer and some soil profile development.

FIG. 4: Dry hill-country grassland dominated by thickets of Matagouri in North Canterbury. Foreground recently burnt, topdressed and oversown, middle unburnt for at least ten years.

previously clear grassland. Most of these increases appear to be due to the release of sprawling plants from grass competition through burning. In addition, rabbit browsing of young regrowth shoots has been markedly reduced in the past decade.

Because it fixes nitrogen like a legume, matagouri would be expected to respond to superphosphate on sulphur and phosphorus-deficient soils. However, it is rarely found on mature, leached, yellow-brown earth soils where clovers are highly responsive to added phosphorus and sulphur. Matagouri is largely confined to the yellow-grey earth and related young hill and steepland soils where reasonable amounts of phosphorus and sufficient sulphur are still available for some nitrogen fixation.

A pot trial has been used to test the response of nodulated seedlings of matagouri to 2 cwt superphosphate per acre topdressing on several soils. The soils ranged from a haldon, young relative of a yellow-grey earth carrying vigorous matagouri in the field, to a highly leached high country yellow-brown earth from Otago which did not support any matagouri. The results are presented in Table 2.

TABLE 2: RESPONSE TO SULPHUR AND PHOSPHORUS ON DIFFERENT SOILS

Average dryweight Matagouri plants at 8 months (g)				
	A	B	C	D
	<i>Haldon YGE</i>	<i>Kitaroa</i>		<i>Teviot</i>
	<i>Matagouri</i>	<i>YGE-YBE</i>	<i>Wehenga YBE</i>	<i>Leached YBE</i>
<i>Treatment</i>	<i>Abundant</i>	<i>Matagouri</i>	<i>Matagouri</i>	<i>Matagouri</i>
		<i>Small</i>	<i>Rare</i>	<i>Absent</i>
Control	3.5	0.5	0.1	0.1
S	3.2	1.2	0.2	0.1
P	2.7	1.1	0.3	0.7
S + P	3.4	2.1	0.4	0.4

The results are notable for the absence of matagouri stimulation in the haldon soil which supports vigorous stands of the shrub in untopdressed country. Seedling growth in the poor structured yellow-brown earths may have been limited more by lack of root aeration and low pH than by phosphate and sulphate deficiency.

MATAGOURI RESPONSE TO BURNING, GRAZING AND PLANT COMPETITION

A survey has shown that very hot fires in the growing season may kill or damage thicket-size matagouri. However, some larger plants survive to provide a continuing seed source. Following winter fires most of the shrubs resprout from the crown, though the old stems quickly die. Winter burning, though killing about 10% of the shrubs and temporarily checking the rest, increases the number of stems per plant. Within five years, effective grazing area may be reduced to 40 to 50% of the block. The initial growth check obtained by fire or machine flailing can be continued by heavy stocking with cattle and sheep. Animals will browse the fresh, spineless shoots of matagouri if the dead stems can be broken down and cleared. Table 3 gives the effect of sheep grazing on dense matagouri regrowth after winter burning on the Lincoln College hill farm near Waikari, North Canterbury.

TABLE 3: EFFECT OF LIGHT MOB-STOCKING ON REGROWTH OF MATAGOURI PLANTS, "HUNUA", NORTH CANTERBURY

<i>Regrowth/plant</i>	<i>Spelled (9 mon)</i>	<i>Mob-stocked (5 sheep/acre)</i>
Stem Height (cm)	90	10
Dry weight (g)	140	5

If mob-stocking at high levels could be maintained after burning — *e.g.*, 30 to 40 sheep per acre on small blocks — perhaps matagouri could be suppressed indefinitely.

Matagouri has been shown to be a poor competitor with vigorous pasture plants. Using 4 gal tins containing a range of young to mature soils and two-year-old matagouri plants, the response to competition for light and moisture from topdressed cocksfoot and red clover was measured. As shown in Table 4, established matagouri plants were suppressed, in many cases to the point of death, by a dense sward of grass and clover after one season of growth.

TABLE 4: COMPETITIVE SUPPRESSION OF MATAGOURI

Average dryweight per plant in grams and dead plants per cent

<i>Treatment</i>	<i>A</i>		<i>B</i>		<i>Soil C</i>		<i>D</i>		<i>E</i>	
	<i>Dry %</i>	<i>Wt. Dead</i>	<i>Dry %</i>	<i>Wt. Dead</i>	<i>Dry %</i>	<i>Wt. Dead</i>	<i>Dry %</i>	<i>Wt. Dead</i>	<i>Dry %</i>	<i>Wt. Dead</i>
At oversowing	0.5	0	1.1	0	1.6	0	1.6	0	1.2	0
9 months later, no competition	4.0	0	9.1	0	—	—	15.6	0	12.3	0
Light, competi- tion only	—	100	1.8	65	1.3	80	1.3	80	1.3	75
Partial light and root competi- tion	1.0	35	1.2	30	0.9	45	1.2	20	1.0	55
Full light and root competi- tion	—	100	1.1	65	—	100	1.1	60	0.4	50

In common with many plants prominent in early stages of plant successions, matagouri appears to have little tolerance for deep shade.

A combination of burning followed by periodic hard grazing and long spelling of topdressed and oversown 50 to 100 acre blocks may be the most effective approach to eradication of mature matagouri. There are herbicides effective in killing matagouri, but as yet spraying programmes could not be considered economic.

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