SYNOPSIS OF STRUCTURE, LIFE HISTORY AND SEASONAL BEHAVIOUR OF SWEET BRIER

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Summary

The structural and behavioural aspects of sweet brier (*Rosa rubiginosa*) which are determined by its genetic constitution are briefly described. The information deals with the normal form of sweet brier encountered in New Zealand. Attention is drawn also to certain abnormal features which, as far as can be judged, are genetically determined. Unless stated otherwise, all measurements and observations relate to plants growing in the Waimakariri Catchment, North Canterbury, and at Lincoln College.

DESCRIPTION

Deciduous shrub reaching an extreme height of 5 m, but usually 1-3 m. Stems erect, heavily armed with stout, hooked prickles mixed with scattered aciculi and setae. Buds mainly red, terminal 5-10 mm long, axillary 2-5 mm long. Leaves alternate, 5-10 (-15) cm long, pinnate, with up to nine shortly petiolate, opposite leaflets, slightly pubescent, glandular, with fine pricklets on back of rachis, stipulate. Leaflets 1-2 (-4) cm long, sub-orbicular to oval-elliptic, doubly serrate, dull green, pubescent above and on main veins below, very glandular below. Flowers hermaphrodite 1-3 (-5), corymbose, bright pink, monoclinal, actinomorphic, 5-merous, perigynous. Stamens many, free. Carpels many, free, adnate to receptacle. Receptacle cup-shaped, hollowed, coloured, fleshy, glandular-hispid at base. Disk nectariferous. Sepals tardily deciduous. Fruit an achene about 5 mm long, cream coloured when ripe, with one seed.

The species is pentaploid with a chromosome number $2n=35$ (Tackholm, 1922). Aberrant forms and hybrids with the dog rose (*R. canina*) occur in New Zealand, though both are comparatively rare.

Introduced. Frequently planted as an introduction in many localities. An early colonizer of disturbed habitats in indigenous tussock grassland.

THE SEED AND EMBRYO

FLOWERING

Flower primordia are initiated after the shoots have begun to develop in the spring. Meiosis apparently occurs in the anthers when the buds appear between the stipules of the subtending scale leaves (Erlanson, 1930). Flowering begins in November, reaches a peak in December, and may cease altogether in early January. Usually one crop of flowers is produced each season, but a light second crop in March is not infrequent. The latter, however, rarely sets seed. Under experimental conditions plants will flower in their

third season, but in nature flowering begins on much older plants (5-10 years or more). The anthokinetic cycle is regular and hips visibly swell within ten days of anthesis. Although insect pollination does occur, selfing is common, and the species is facultatively self-fertilizing. Floral abnormalities (teretomata) are not uncommon, especially on late flowers.

Fig. 1: Fruit of sweet brier, a, hip; b, hip cut longitudinally, showing thickness of flesh and arrangement of achenes; c, achene (fruit) cut longitudinally, showing thick pericarp, bristles, and seed in central cavity; d, achene cut transversely showing two cotyledons of single seed; e, seed enclosed by the testa; f, seed with testa removed showing embryo and one cotyledon.

SEED DEVELOPMENT

The basic features of the fruiting structure are shown in Fig. 1. The seed is exalbuminous, consisting of two white cotyledons and a bud-like embryo. Split and extra cotyledons also arise, although the frequency of occurrence is low.

Hips and achenes cease to grow about mid-January, but the embryo and cotyledons continue growth for several more weeks. By mid-February the achene is cream coloured, the pericarp bony, and the embryo and cotyledons fill the entire central cavity. Hips gradually turn yellow then orange and, finally, red. The wall tissue breaks down in April and in May hips are wrinkled, soft, and jammy. Later they become blackened and dry. Though many fall within twelve months of formation it is common to find hips up to three years old still attached to plants.

SEED PRODUCTION

An average-sized plant of normal vigour can produce 1,000 hips in a season. Achene production, however, varies according to the age and vigour of fruiting shoots, and the number and position of hips in a cluster.

Achenes fall into three distinct classes: fully-developed, under-developed (degenerated), and undeveloped (non-fertilized primordia). Table 1 shows the average distribution of each class in "single" hips.

TABLE 1: DISTRIBUTION OF ACHENE CLASSES IN SWEET BRIER

N = 100 hips. Provenance = Lake Pearson 1961 crop

<i>Fully-developed Achenes</i>	<i>Underdeveloped Achenes</i>	<i>Undeveloped Achenes</i>	<i>Total Potential</i>
23.1±4.9	0.7±1.1	7.6±4.4	31.4±3.9

MOISTURE CONTENT OF RIPE SEED

In mid-February when hips are green and firm and the achene, embryo, and cotyledons have ceased growth, the moisture content of seed is about 32%. By the following December when hips are black and leathery, yet still attached to plants, the moisture content drops to about 18%. Seed stored air-dry at room temperature for two years has a moisture content of 6%. Such seed rapidly imbibes water (>30%) within 24 hours of soaking. It seems that neither the massive pericarp nor the testa prevent access of water in seed of some *Rosa* spp. (cf. Jackson and Blundell, 1963).

VIABILITY

The potential germinative capacity of freshly-harvested ripe seed — determined by the tetrazolium staining method — is high, often exceeding 80%. A fully-developed achene indicates that fertilization has taken place, but not all the fertilized products reach maturity, while some are consumed by larvae of the rose seed chalcid (*Megastigmus aculeatus*). A typical example is shown in Table 2.

TABLE 2: PERCENTAGE VIABILITY OF SWEET BRIER SEED
(TETRAZOLIUM TEST)

N = 400 fully-developed achenes. Provenance = Lake Pearson
1961 crop

<i>Aborted or Non-staining</i>	<i>Infested with Chalcid Larvae</i>	<i>Viable Seed</i>
8.5	9.0	82.5

GERMINATION

Under field conditions, seedlings will appear during a limited period in spring, commencing in early August. Germination of individual seed lots is erratic, extending over several years, and peak germination occurs in the second spring following seed production. Percentage viability is not expressed in the number of emergent seedlings.

TABLE 3: CUMULATIVE PERCENTAGE GERMINATION OF
SWEET BRIER SEED

N = 400 fully-developed achenes. Provenance = Lake
Pearson 1961 crop

<i>1961</i>	<i>1962</i>	<i>1963</i>
0.2	41.5	54.7

It appears that the variable dormancy characteristic of some *Rosa* spp. is not caused by immaturity of the embryo or impervious seed coats, but rather by the mechanical restriction imposed by the pericarp, and growth and germination inhibitors contained in the achene (Jackson and Blundell, 1963).

LONGEVITY

Degeneration of seed under conditions of artificial storage is very slow. However, under natural conditions viability may be signifi-

TABLE 4. FATE OF SEED AFTER TWO-YEARS' STORAGE AT
DIFFERENT DEPTHS IN SOIL

N = 500 seeds. Provenance = Lake Pearson 1961 crop.
Viability before treatment = 78%

<i>Depth of Burial</i>	<i>Cumulative Emergence %</i>		<i>Remaining Whole Seed %</i>	<i>Viability of Remaining whole seed (Tetrazolium test) %</i>
	<i>1st yr.</i>	<i>2nd yr.</i>		
1 in.	41.6	55.4	6.6	6.6
2 in.	5.4	6.0	32.2	6.2
4 in.	—	—	53.4	15.3
8 in.	—	—	40.4	22.2

cantly reduced and germination seriously retarded, especially if the seed is ineffectively buried or buried too deeply. Table 4 summarizes the fate of seed buried for two years in a soil of average organic matter content under low rainfall conditions.

THE SHOOT AND LEAVES

SEEDLING DEVELOPMENT

Germination and early seedling stages are shown in Fig. 2. At first the hypocotyl is fleshy, pink and glandular above the soil surface,

Fig. 2: Germination and early seedling stages of sweet brier grown in standard potting soil in an unheated greenhouse. All except a are drawn to the same scale.

and the cotyledons are photosynthetic and glandular below and on the margins. Later, the hypocotyl becomes brown and woody and the cotyledons yellow and fall. Seeds at stage *a* (Fig. 2) were planted in moist soil in an unheated greenhouse on November 26, 1962, and seedlings reached stage *e* on December 20.

Fig. 3: Diagrams showing parts of sweet brier plants. 1, Shoot system; 2, Types of bud; 3, Classification of buds on a foreshortened replacement shoot. MS, mature shoot; RS, replacement shoot; LB, lateral branch; SPS, spur shoot; SS, subterranean stem; SSS, subterranean stem sucker; PR, parent roots; TB, terminal bud; AB, axillary bud; SB, supernumerary bud; FB, fruit bud region; ADB, aerial dormant bud region (vegetative); BCB, basal crown bud region (vegetative); SDB, subterranean dormant bud (vegetative); LS, leaf scar. (Diagrammatic; not to scale.)

First-year seedlings grown in an unheated greenhouse develop leafy main shoots up to 40 cm long and side branches and basal shoots up to 20 cm long in their first season. Under natural conditions, plants of the same age remain monaxial, rarely exceeding 6 cm in length. By the end of their second season, greenhouse plants possess several vigorous basal shoots, a weaker, straggling, "juvenile" shoot system, and one or more underground shoots.

THE SHOOT SYSTEM

A mature plant consists of a long-lived stool or crown which supports a colony of woody perennial shoots or canes. Shoot growth is determinate and branching is definite or cymose. The wood is ring-porous.

Shoots arise in four different ways (Fig. 3, 1) — as stem suckers (replacement shoots) from dormant crown or basal trunk buds, as lateral branches from axillary buds well above ground level, as subterranean stem suckers from dormant buds of underground shoots or, more rarely, as root suckers from adventitious buds on major roots which have been exposed or injured.

New shoots arise annually, thus enlarging the colony and replacing old or injured shoots. Young shoots are at first succulent, pigmented and photosynthetic, but later they become lignified and thorny. Veteran plants are difficult to age because of their multiaxial growth habit, but individual shoots 15 to 25 years old are not uncommon.

THE LEAVES

The first leaf of seedlings is unifoliate, but successive leaves are more complex, and in cultivated plants the full complement of seven leaflets is attained at the twelfth node on main stems. On the other hand, leaves of suppressed seedlings may remain at the trifoliate stage for many years. In leaves grown in full sunlight there are two distinct layers of palisade parenchyma, and stomata are situated on the lower surface.

Most of the leaves are shed between March and May, and at abscission the leaves are usually pale green, except under droughty conditions, when they turn yellow, and fall early.

BUD ACTIVITY

The principal winter buds of aerial shoots are shown in Fig. 3, 2. Each possesses up to seven or more modified bud scales protecting several foliage leaf primordia (Fig. 4). Buds are classified also according to their function and activity (Fig. 3, 3).

Vegetative buds of seedlings and juvenile plants begin opening in early August, followed by the fruit buds of adult shoots in late August. When young flower buds become visible, basal crown or trunk buds swell, giving rise to vigorous replacement shoots and lateral branches. Buds which do not develop either vegetative shoots or inflorescences in the spring following their formation remain dormant unless the shoot above them dies, becomes senescent, or is decapitated. Apical dominance is pronounced in adult shoots, but is less closely observed in seedlings and juvenile shoot systems.

Winter buds are not fully dormant since they can be induced to grow at any time by exposure to high temperatures regardless of day length conditions, and without winter chilling.

SEASONAL GROWTH OF SHOOTS

The duration of growth in flowering shoots is largely determined by the number of initials already laid down in resting buds. From late August to late December the leaves present as primordia in the winter fruit bud unfold, the internodes elongate, and the apex produces one or more flowers. On the other hand, new replacement

Fig. 4: Buds, bud scales, leaf primordia, and developing leaves. 1, terminal bud of spur shoot; 2, terminal bud of immature replacement shoot; 3, axillary bud of replacement shoot. a, outer scales; b, inner scales; c, outermost leaf primordia; d, appearance of c after the bud has opened in spring. (Diagrammatic; not to scale.)

shoots, lateral branches, subterranean stem suckers and vigorous seedlings unfold more leaves than were present in winter buds, and may continue extension growth into April. In this case the overall period of growth is largely controlled by climatic conditions of which temperature is an overriding factor.

Growth in diameter is apparently dependent upon active extension growth. When the latter ceases, cambial activity also ceases shortly after.

ROOT SYSTEM

The first lateral roots of newly-germinated seedlings usually appear before the first foliage leaf unfolds (Fig. 2). First-year seedlings, grown in an unheated greenhouse and with four leaves unfolded, possess a freely-branched taproot system with a total root length of about 100 cm and an oven-dry weight of about 0.03 g. By the end of the summer, these seedlings had developed robust root systems consisting of many coarse (>0.5 mm diameter) and fine roots with a total oven-dry weight of about 1.4 to 2 g.

The root system of mature plants consists of long, radiating, coarse roots; shorter, finer, lateral roots emanating from coarse roots; and fine rootlets, mostly annual, concentrated near the soil surface. Underground shoots which root at the nodes are also regarded as functional roots. Root growth continues long after aerial shoots cease extension growth.

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