Red clover seed production – research and practice

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ABSTRACT. National average certified seed yields (1972-76) of New Zealand's red clover cultivars are low, being 259 and 147 kg/ha, respectively, for Hamua and Turoa. Major factors considered important for improving these yields are: reduction in paddock size to improve pollination; preference for undersown pure sowings with the exception of well-managed Hamua/Manawa ryegrass mixtures; appropriate grazing management to promote a good level of individual plant development by closing; closing to be no earlier than the beginning of December; irrigation no later than closing date; harvesting dates brought forward 10 March for Hamua and early April for Turoa and Pawera by using a desiccant and direct heading when necessary.

Kay *words: Trifolium pratense,* seed production. pollination. cultivars.

INTRODUCTION

National average yields of machine-dressed seed (1972-76) are low for certified crops of New Zealand's red clover (*Trifolium pratense* L.) cultivars compared with their yield potential, being 259 kg/ha for early-flowering diploid, 'Grasslands **Hamua',** and 147 kg/ha for late-flowering diploid, 'Grasslands Turoa'. From 1976 data only, late-flowering tetraploid. 'Grasslands Pawera', yielded 176 kg/ha (MAF Certified Seed Production Statistics, 1977). These differences between cultivars may reflect genetic and paddock size effects, as well as those caused by variations in climate on plant and pollinator due to the areas in which each cultivar is grown. Hamua is grown predominantly in Blcnheim and the North Island, and Turoa on the downs and foothills from North Canterbury to Southland, while production of Pawera seed is spread throughout the South Island.

This paper discusses recent research findings and current farmer practice with a view to improving seed yields for all three cultivars.

RESEARCH

SEEDING RATE

Trials at lnvermay Research Centre, Otago, showed that the highest yields for Turoa red clover were gained from stands sown at 4 to 5 kg/ha in late January, either alone or with Ruanui ryegrass, and taken for seed in the following season. Manawa ryegrass as an alternative to Ruanui depressed seed yield. Spraying with paraquat in late October promoted plant development through removal of weed grasses, and improved seed yield at first and second harvests. Where the seed crop was not taken until the second productive season, seeding rate could be reduced to 3 kg/ha owing to the additional time available for better plant development (Cullen, 1968a, b, c).

Initial research on Pawera by Grasslands Division in the Mackenzie Basin, Canterbury, compared conventional 15 cm row spacings with inter-row cultivated 60 cm row spacings. Higher yields came from the latter, at a plant density of $17/m^2$ (seeding rate = 0.75 kg/ha), compared with the higher plant density of $67/m^2$ at 15 cm row spacings (3.0 kg/ha) (Clifford, 1974). This result emphasizes the importance of initial plant development and subsequent growth free from competition from other species.

FERTILIZER

Research at Invermay indicated no advantage in applying lime, potash, nitrogen or boron. However, sufficient superphosphate should be used with molybdenum to ensure good clover establishment (Cullen, 1968b).

CLOSING DATE

Research by Grasslands Division at Lincoln, Canterbury, indicated that closing the crop before the beginning of December (range 1 October — I November — 1 December) had no effect on total seed yields of Hamua and Turoa where limited irrigation was applied at closing (Table 1). However, for Pawera, December closings gave consistently higher yields due to increased numbers of flowering stems (Clifford, 1979). Another advantage of December closing was reduction of the vegetative bulk at harvest that can accutnulate in November, partiularly for second crops of Turoa and Pawera (Table 2). As wet seasons increased bulk and reduced flowering, irrigation after closing will not be advantageous in most situations for these two cultivars.

TABLE 1: THE EFFECT OF CLOSING DATE ON RELATIVE SEED YIELDS AT LINCOLN

Closing *Date*	*Cultivar* *Hamua*	*Turoa*	*Pawera*
October 1	100	100	100
November I	88	104	92
December I	98	107	130

TABLE 2: TOTAL SPRING PRODUCTION TO CLOSING FOR SECOND CROPS (kg/ha DM)

Closing Date	*Cultivar* *Hamua*	*Turoa*	*Pawera*
October 1	1 500	I 400	1700
November I *	3 600	2 700	3 800
December I	5 600	6 600	7 600

*Sig. difference.

December closings only delayed main flowering about a week but had no effect on harvest dates.

TIMING OF HARVEST

Average harvest times for the three seasons of the closing date experiment were mid-March for Hamua and early April for Turoa and Pawera. For all cultivars, major seed yield came from seedheads formed during early and main flowering. Early seedheads gave twice the seed weight of late-formed heads. Therefore farmers should be aiming to harvest at least the heads formed over the month of main flowering. These, expressed as a percentage of total flower-head production, were 84, 57 and 65% (mean of 3 closing dates × 3 seasons) for Hamua, Turoa and Pawera, respectively. The lower percentages for Turoa and Pawera were due to a wider range of flowering times within each cultivar. This was the only genetic attribute likely to affect potential harvestable seed yield. December compared with October closings increased the percentage of total seedheads harvested for Pawera only.

POLLINATION

Because honeybees can be transported to the crop they have proved to be the most reliable pollinators for Hamua and Turoa. Their main limitation is a higher temperature requirement than long-tongued bumblebees to maintain high working densities (Forster and Hadfield, 1958; Palmer-Jones *et al.*, 1966; Wratt, 1968). In warm seasons a considerable improvement to seed set could be achieved by maintaining a hive density of one per 3 ha close to the crop (Forster, 1974). We have observed that honeybees are ineffective pollinators of Pawera, with its longer corolla tube, where alternative food sources are available. However, a high seed yield (600 kg/ha) was gained with pollen-collecting honeybees in an intensive cropping area. Bumblebees arc the most efficient pollinators of red clover, but densities seldom exceed 500/ha on most crops, while large variations in numbers can occur season to season (Forster and Hadfield, 1958; Palmer-Jones et al., 1966; Gurr, 1974). A satisfactory alternative where honeybees have been shown to be ineffective is the increasing of bumblebee densities through annual spring supplementation of queens (Clifford, 1973). Our observations have shown that bumblebee density is directly related to the number of flower heads available for pollination. Thus the more intensive flowerings gained from December closings than from earlier closings would suffer no disadvantage in pollination.

PADDOCK SIZE

MAF Seed Certification statistics show distinct relationships between paddock size and seed yield for national averages. Seed yield decreased as paddock size increased.

Analysis of 30 first-harvest crops in the same season, from Blenheim and South Canterbury, showed that seed yields for Hamua and Turoa were reduced by 60 and 30% when paddock area increased above 5 ha (Table 3A).

TABLE 3: PADDOCK SIZE (ha) (A) AND NUMBERS OF CROPS (B) IN RELATION TO RED CLOVER SEED YIELDS (kg/ha)

A	Below 5.0 ha		Above 5.0 ha
Hamua	642	*	188
Turoa	391	*	242
B	*1st crop*		2nd *crop*
Hamua	592	*	275
Turoa	134		122

*Sig. difference.

This implies that seed yield/ha could bc much improved by sowing smaller areas and thus maximizing the pollination potential of the local bee population. A further advantage would be that the smaller area in crop allows more care to be taken at harvest, thereby reducing seed loss.

NUMBER OF CROPS

For 12 paddocks each of both cultivars, taken for two crops, the first harvest of Hamua produced more than double the seed yield of the second, but by contrast there was no difference in yield between first and second crops of Turoa (Table 3B).

GENERAL FARMER PRACTICE

HAMUA

Hamua is most commonly sown with 10 kg/ha Manawa ryegrass in March-April, or with rape, or spring undersown on a cereal. Seeding rates range from 4 to 8 kg/ha. When sown with Manawa, many Blenheim farmers lightly set-stock with ewes and lambs from mid-July to mid-October and then shut for a hay crop. The preclosing practice of taking a hay cut mid-December ensures that the numbers of earlier developing reproductive stems of this cultivar are not reduced through overgrazing (Gorman, 1955). Harvest dates range from March to the end of April. Harvest is by mowing, windrowing and picking up with header. Good yields average 500 kg/ha machine-dressed (MD) ,

TUROA

Turoa may be sown as a component of a general pasture after swedes or turnips, or undersown on a cereal, pea or linseed crop. As a consequence, sowing can vary from spring to autumn, with seeding rates varying from 3 to 7 kg/ha. Initially, light grazing is practised to aid consolidation and promote establishment and early development of the pasture. After October in the year the first crop is taken, grazing aims to reduce competition from weeds and companion grasses while fostering the development of flowering stems until the paddock is closed in late November to mid-December. In drier areas such as parts of North Otago, closing may be as early as mid-October. A preclosing hay cut is seldom taken, as in most areas it causes an undue delay in closing. Harvesting ranges from March to August, April to July being most common. In recent years there has been a trend to direct heading, with or without a desiccant for pure stands. Better yields average 200 kg/ha MD, usually taking two or more crops.

PAWERA

Pawera is spring undersown on a cereal crop or autumn sown with a Manawa or oat nurse crop. Sowing rates are 3 kg/ha in spring and 5 kg/ha in autumn. Although grazing management is similar to that for Turoa, earlier grazing is necessary to cope with Pawcra's better spring growth. Where climate allows. a hay cut may be taken prior to closing, particularly before the second and third crops, or alternatively the paddocks may be grazed until closing in late November to mid-December. Harvesting takes place from April to the end of June. Some farmers use desiccants to reduce vegetative bulk prior to harvest. Good crops should do better than 200 kg/ha MD. Most

farmers take two crops, but it is of note that one farmer in the Blenheim district has averaged 250 kg/ha MD off the same paddock over the last four seasons.

FERTILIZER

Farmers are aware of the requirement for a reasonable pH level to promote initial growth regardless of the cultivar grown, and apply lime within their rotation as required. Superphosphate is applied at sowing at a rate of 100 kg/ha, and at the same rate in the autumn prior to taking the crop. Some farmers apply superphosphate at closing, but this is a doubtful practice as it can promote a large increase in vegetative growth at the expense of flower heads, particularly in late-flowering cultivars.

SUMMARY

Paddock Size: No more than 4 to 6 ha (10 to 15 ac) to encourage a high seed set.

Compunion Grasses: 10 kg/ha Manawa with Hamua; none or 10 to 15 kg/ha Ruanui (no Manawa) for Turoa and Pawera.

Seeding Rate: 5 kg/ha for autumn, 3 kg/ha for spring sowings. Increase rate by 1 to 2 kg/ha if using a companion grass to overcome effect of grass competition on clover development depending on time from sowing to crop.

Fertilizer: Sufficient superphosphate to promote good establishment, followed by a dressing of 100 kg/ha in the autumn prior to taking seed crops. Lime, molybdenum and sulphur if necessary.

Management: Light grazing to promote establishment. Increase grazing as spring growth improves for Turoa and Pawera first crops. Preclosing hay cut for Hamua and possibly for second crops of Turoa and Pawera.

Closing Date: No earlier than the start of December when irrigation is available, particularly for Pawera; otherwise according to local climate patterns so as to allow sufficient time for recovery after closing and for seed fill.

Pollination: One honeybee hive per hectare (2 ac) , particularly in areas of intensive cropping.

Harvest: No later than the end of March for Hamua and the end of April for Turoa and Pawera. Use of a desiccant and direct heading may be needed to achieve this.

Numbers of *Crops:* For high average seed yields, no more than 1, 2 and 3 crops for Hamua, Turoa and Pawera, respectively.

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