Paper 11
LUCERNE GRAZING MANAGEMENT RESEARCH

C.G. Janson
Winchmore Irrigation Research Station
M.A.F. Private Bag
Ashburton

INTRODUCTION

Lucerne is recognised as a very valuable legume in many parts of the world because of its high yield, forage quality and wide climatic and soil adaptation. Its drought resistance has permitted substantial increases in forage production in many areas. It can provide a dependable and economical supply of good quality protein, independent of soil nitrogen. Lucerne is also an excellent source of calcium, magnesium, phosphorus and vitamins A and D.

Lucerne reached New Zealand in about 1800 (Bolton 1962). Latest figures (1979) put the total area of lucerne in New Zealand at 180,000 hectares. Associated with the expansion in the area of the crop has been an increase in its use for grazing purposes.

Research has been conducted on harvesting this crop for many years and a large amount of information has accumulated. However until recently, this research was concerned almost entirely with harvesting by cutting.

CUTTING MANAGEMENT

Keoghan (1967) reviewed the effects of cutting frequency and height on lucerne for the last major review of the crop in New Zealand. This review, in common with others, showed that frequency of cutting was internationally accepted as an important determinant of lucerne production. He concluded that cutting at frequent intervals, or at immature stages of growth, will nearly always reduce yields significantly, compared with cutting less frequently or at mature stages of growth. He also concluded that height of cutting was, for all practical purposes unimportant unless the lucerne was being cut frequently. The relative insensitivity to cutting height has been associated with the very low efficiency of the old, mature leaves left behind by a high level cut (Brown *et al.*, 1966) and by the relative unimportance of tall stubble as regrowth sites (Keoghan, 1966). Keoghan (1967) concluded that "insofar as continued frequent cutting has been found to have deleterious effects, the need to leave a high stubble must be considered a reflection of poor management".

The clear message that has come out from the many hundreds of harvesting studies on lucerne, is that infrequent cutting at a relatively mature growth stage and at normal mower height, 2-4 cm above ground, should be the aim.

Climate complicates this general principal. In dry seasons and dry climates lucerne seems better able to withstand frequent harvesting than in wetter seasons and more humid climates (Turpin, 1931; Dawson *et al.*, 1940; Staten *et al*., 1945; Jackobs, 1950; Davies and Tyler, 1962). Keoghan (1967) stated that the physiological reason for this increased resilience of lucerne in dry seasons and climates was not clear.

GRAZING MANAGEMENT: POSITION AT 1967

It is against this background of information on cutting management that our thinking and notions on grazing management have developed. Thus the impression was cast of lucerne being essentially a hay type plant, and if it was to be harvested with animals, then their grazing activity would need to approximate that of a haying regime as closely as possible. Despite the difficulties in incorporating this into a practical farm scale situation, this impression was basically the consensus of the scientific community on lucerne grazing management when Iversen (1967) reviewed the subject. His succinct summary of grazing policy read as follows. "Lucerne must be grazed boldly and heavily at the early flower stage with from 50 to 200 sheep per acre. The best interval we have found is four days grazing with 36 days spelling. This requires 10 fields and is very easily managed".

In addition to his own work there was a wealth of information from a number of different countries supporting this policy of Iversen's. Fuelleman *et al.* (1944; 1948), Pratt and Davis (1956), Arny and Schmid (1958), Seath *et al.* (1962), in the U.S.A., Wilson and Clark (1961), Cooke *et al.* (1965), in Canada, Davis (1947), Barker *et al.*

(1957) in England, and Moore *et al.* (1946) in Australia, all showed the absolute need for adequate spelling to a mature growth stage between grazings, and the invariably severe and generally disastrous effect on lucerne production and survival of set-stocking or frequent grazing at immature growth stages.

MORE ROTATIONAL GRAZING STUDIES

Since 1967 there have been a number of lucerne grazing management studies done, particularly in Australia. These have invariably demonstrated again the absolute essentiality of rotational grazing with adequate spelling, provided a stocking rate was imposed which reasonably matched herbage production. These studies have generally involved a set-stocked or continuously grazed treatment and a number of rotationally grazed treatments based on different numbers of paddocks in the rotation (Peart, 1968; Smith, 1970a; 1970b; Brownlee, 1973).

It is important to note that the studies of Smith (*loc. cit.)* and Southwood and Robards (1975) have shown, in common with studies on grass/clover pastures, that the stocking rate imposed strongly influences the importance of the grazing system. At very low stocking rates the grazing system was relatively unimportant, such that in a favourable season animal performance and lucerne persistence could be maintained even under set-stocking. However it only took a small deterioration in climatic conditions for the obviously fragile balance that existed under set-stocking to be tipped against the lucerne and widespread plant mortality resulted (Southwood and Robards, 1975). As stocking rate increased the necessity for rotational grazing with an adequate number of paddocks in the cycle rapidly increased. Indeed Smith (1970a) showed that at his highest stocking rates, lucerne plant survival could be maintained only on his most intensively subdivided treatment, which was also the treatment providing the longest spell between grazings.

THE PRACTICAL PROBLEM

Predictably enough, these studies have encouraged subdivision with quick grazing and long spells. Others, with much less published evidence, have made similar recommendations (Clinton, 1968; Clare, 1971). However, implementation of these recommendations by the farming community has been tardy and, under extensive farming conditions, negligible. This is not surprising in view of the considerable costs involved, combined possibly with a lack of conviction of worthwhile returns.

In reviewing this situation, Cameron (1973) states that, "recent developments in the management of lucerne-based grazing systems have revolved around the use of more and smaller paddocks and shorter grazing periods. However, because of the extensive nature of many livestock industries, these techniques are not widely applicable. What is required, rather, is a system using few paddocks and involving minimum handling of livestock".

THE IMPORTANCE OF GRAZING DURATION

Clearly, the demonstrated need for a relatively long spell between most grazings to allow the plant to reach a semi-mature growth stage, does not of itself require intensive subdivision and frequent shifting of stock. The spelling requirements of lucerne can be met with two paddocks. Thus the necessity for increased subdivision and frequency of stock movement rests on the importance of grazing duration (GD). GD is defined as the length of time stock graze an area of lucerne at any one grazing before being moved on to allow uninterrupted regrowth. GD is of course the other half to spelling duration in any rotational grazing cycle.

In the last decade or so while there have been a number of lucerne grazing management studies involving different grazing durations (GDs) many have given very little insight into the importance of GD because the basis of comparison has confounded grazing and spelling durations,and the latter has dominated the result (Smith, 1970a; 1970b; Brownlee, 1973; Fitzgerald, 1974; McKinney, 1974). Gradually however, the relative importance of GD in lucerne management is being clarified.

FIELD STUDIES ON GRAZING DURATION

In New South Wales, Peart (1968, 1970) compared two rotational grazing systems: 5 days on/35 days off (eight paddocks), with 12 on/36 off (four paddocks). While little agronomic data was collected, he did show that both the survival of the lucerne plants and the average liveweight of the wethers on the plots were higher on the system with the shorter GD.

In Canterbury O'Connor (1970) showed that GDs, varying from three to 18 days through the spring and summer, had no residual effect on lucerne yield or density six months later in the following spring. However, he also showed that herbage yield at the end of a 36 day regrowth period was considerably lower following an 18 or 24 day GD than a 12 day GD and stated that, "severe basal shoot grazing" on the 18 and 24 day treatments was the cause of this. No indication was given of the maturity stage of the lucerne when grazing commenced, or the severity of grazing when it ceased on the different treatments. The author simply noted herbage yield after 36 days following the different GDs.

SIMULATED GRAZING DURATION STUDIES

The general pattern of lucerne herbage consumption by the grazing animal has been described by Arnold (1960) and McKinney *et al.,* (1970). A number of workers (Monson, 1966; Othman, 1972; Janson, 1975a; Constable *et al.,* 1977) have attempted to simulate this defoliatory effect of the grazing animal by progressively removing the herbage in small 'bites' with hand shears, working down from the top of the stems. Othman (1972) and Janson (1975a) were able to show that the removal of the apices and top third of the mature stems stimulated the development of new shoots at the base of the sward. In addition, if the progressive defoliation period was prolonged, the new shoots growing up from the base of the stems could be decapitated in the final 'bites' when the last of the mature herbage was removed. Surprisingly, Monson (1966) chose to leave these new shoots completely untouched, and thus generated a quite unrealistic grazing simulation. Janson (1975a) noted that herbage yield after 1-2 weeks regrowth was lower after both a very short and a long defoliation duration (the time taken to progressively remove the herbage) than after an intermediate defoliation duration (DD). Othman (1972) recorded the same effect, while Constable *et al* (1977) recorded a depression in herbage regrowth following a long DD only.

Thus four reports (O'Connor, 1970; Othman, 1972; Janson, 1975a; Constable *et al.*, 1977) independently have demonstrated a depression in regrowth following a long grazing or DD, and the first three have also indicated a lag in immediate regrowth following a very short or instantaneous DD. Janson (1975a) suggested a lack of development of the new shoot population caused the lag following a very short DD, but was less certain as to the reason for the effect of the long DD. Constable *et al* (1977) linked the reduced top weight increases, following a long DD, with reduced root weight and root total non-structural carbohydrate concentration. However, the design of their project, in common with that of O'Connor and Othman confounded maturity stage and DD, thus making it very difficult to pinpoint the effect of DD *per se*.

QUANTIFYING THE EFFECT

Janson (1978) examined GD effects on Wairau lucerne both in the field and controlled environment chambers. All grazing treatments commenced at the 1% flower/basal shoot appearance stage. For eight months through the spring, summer and autumn at Palmerston North, sheep were used to graze off the lucerne down to a mature stem stubble height of 10-12cm at each grazing in either 2-4, 15 or 30 days. The stocking density required to do this (determined on adjacent sacrifice areas) was, for the first grazing, 1400, 180 and 80 hoggets per hectare respectively for the 2-4, 15 and 30 days GDs. Once again differences were recorded between the three GD treatments in herbage growth rates through the first half of the regrowth period,with highest growth rates following the 15 day GD treatment. However, the total production of lucerne herbage over the full eight month period of this trial was highest under the 2-4 day GD system, 14% lower under the 15 day GD system and 29% lower under the 30 day GD system. This study was the first to accurately quantify the effects of GD on lucerne herbage production over a sustained period. It was noted also that the differences in total lucerne herbage production were generated almost entirely by differences in stem yield for there were no significant differences between the three treatments in the total production of non-stem (i.e. leaf and new shoot) material.

PRACTICAL IMPLICATIONS

It could be concluded from the work of Janson (1978) that the morphology of the plant and the grazing pattern of stock preclude high lucerne growth rates during grazing. Thus maximum herbage production will be achieved only under systems of very quick grazing, i.e. 2-4 days GDs. However the impact of the 15 day GD, in particular, on total lucerne production, was sufficiently small to make the adoption of longer GDs, than the 2-4 days which have been recommended, an attractive proposition in many circumstances. A 14% reduction in total lucerne yield may well be considered a reasonable price to pay for a less intensive system involving 15 day GSs rather than the idealistic one involving 2-4 days GDs. In addition some practical implications could be drawn from the fact that the treatment effects on total yield measured by Janson (1978) were generated entirely by differences in stem yield. While the stem is undoubtedly the least digestible fraction of the herbage (Christian *et al.*, 1970), mature animals can use most of it. However, to young stock especially lambs, much of the stem is virtually indigestible and as a consequence, they graze principally just the leaf and new shoot material (Jagusch *et al.*, 1970; 1971). Therefore extending the grazing duration even up to 30 days is unlikely to signficantly affect the capacity of the lucerne to feed young stock, but will reduce its production of feed utilisable by mature animals. Fortunately, it is the mature animals which adapt most readily to the high stock concentrations and frequent shifting associated with short grazing durations, and young stock, for example weaned lambs, which benefit most from the low stocking density and infrequent shifting of long grazing periods.

It is important to realise that in this project Janson (1978) did not measure effects on the sheep. He imposed the grazing treatments and measured the detailed effects on the different components of the lucerne crop. Thus the statements above on animal response to GD are extrapolatory, and need verification. It is also important to note that the defoliation pattern of each GD in this study reflected the situation in which a predetermined number of stock enter a paddock, graze the lucerne down to the required stubble height and are removed, with no alteration to mob size during grazing. It would be most unwise to conclude that the findings of this project on the relative effects of different GDs would apply to GDs of a similar length, but a vastly different defoliation pattern. Thus a situation in which lucerne was kept closely grazed for much of a 30 day GD could be expected to generate considerably more severe effects than the 30 day GDs in this project. Conversely if the lucerne was only lightly 'topped' for much of the GD and then quickly defoliated, right at the end of the grazing period, this could be expected to generate a smaller effect than a GD of similar length defoliated in the manner adopted for this project.

Smith, M.V. 1970b. The effect of stocking rate and grazing management on the liveweight and wool production of wethers grazing dryland lucerne pastures. *Proceedings Australian Society of Animal Production 8:* 460-465.

Southwood, O.R., Robards, G.D. 1975. Lucerne persistence and the productivity of ewes and lambs grazed at two stocking rates within different management systems. *Australian Journal of Experimental Agriculture and Animal Husbandry 15:* 747-752.

Staten, G., Stroud, R.S., Carter, J. 1945. New Mexico Agriculture Experimental Station Bulletin 323.

Taylor, T.H., Templeton, W.C., Taylor, N.L. 1967. Response of creeping and non creeping alfalfa clones to harvesting regimes. *Agronomy Journal 59:* 234-237.

Turpin, H.W. 1931. Effect of stage of cutting on yield and quality of lucerne. *Farming in South Africa 6:* 388.

Wilson, D.B., Clark, R.D. 1961. Performance of four irrigated pasture mixtures under grazing by sheep. *Canadian Journal of Plant Science 41:* 533-543.

DISCUSSION

White: At high stocking densities and grazing for 2 weeks, the animals are going to have high quality feed on offer initially, but later, lower quality and lesser dry matter on offer. Surely this means they are going to have longer time on low quality rations than shorter grazing periods.

Janson: Weaned lambs eat apicies and leaves over the first 10 days, and basal shoots over the second 10 day period. The feed quality therefore doesn't decline.

Gould: Surely the essence of good grazing management is that these basal shoots should not be grazed.

Janson: In the limited length of the trial there was no difference in leaf and new shoot production, although total production was lower and regrowth slower.