PRELIMINARY RESULTS OF TRIALS USING POTASSIUM CARBONATE TO ACCELERATE LUCERNE HAY DRYING (1) LINCOLN

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ABSTRACT

Preliminary trials at both Lincoln and Palmerston North using potassium carbonate to accelerate drying of lucerne gave positive but variable responses. At Lincoln, potassium carbonate applied at 10 kg/ha immediately before cutting was tested on seven occasions under differing weather conditions on lucerne of different maturity and yield. On all occasions potassium carbonate enhanced drying but the effect was not always statistically or practically significant. Responses ranged from a two-day advantage over a three-day period, to no advantage over five days. The results from trials near Palmerston North are presented in Part 2. Further research is required before this spraying technique could be confidently recommended.

INTRODUCTION

Lucerne has long been a popular hay crop but slow field drying, especially of the stem, is often a problem. Faster drying increases the amount of leaf in the baled product and increases the probability of rain-free drying.

Tullberg and Angus (1972) first reported the use of potassium carbonate as an accelerant of lucerne drying. Subsequently Tullberg and others have reported refinements to the technique (Tullberg and Angus, 1978; Tullberg and Minson, 1978) and it is now used successfully by farmers in Australia and the U.S.A. Reports from Australia suggest that potassium carbonate applied at cutting at up to 10 kg/ha in up to 400*l* of water reduces drying time by one to two days (Table 1).

Farmers have claimed that, in addition to hastening drying, potassium carbonate produces less leaf shatter and better colour (Minson and Tullberg, 1981).

To test the technique under New Zealand conditions, field trials were conducted both at Lincoln and Palmerston North (Clothier and Slack, 1982). The Lincoln trials are reported here.

TABLE 1: Effectiveness of potassium carbonate in trials in Australia.

Days to Baler-fit K_2CO_3	K_2CO_3 + *C	*C	Control	Reference
2	—	3	4	Tullberg and Angus, 1978
2	—	2	3	Tullberg and Angus, 1978
2	—	>2	>2	Tullberg and Angus, 1978
—	1	2	>2	Crocker and Lodge, 1981

*C = Mechanically conditioned

MATERIALS AND METHODS

Over the 1981-82 summer, the effectiveness of potassium carbonate was tested on seven occasions in replicated randomised block field trials. Details of each run are given in Table 2. In separate operations, crops were sprayed and immediately cut with a sickle-bar mower. The

TABLE 2: Details of trials at Lincoln in 1981/82.

Run	Date and time of cutting	Maturity	Approx. yield (t/ha)	Treatments	No. reps
1	29/10; 1500	Early flower	4	K,C,K+C,0	4
2	15/12; 1500	Early flower	2.5	K,C,K+C	4
3	5/2; 0830	Full flower	3.5	K low,0	3
4	8/2; 0900	Full flower	3.5	K low,0	3
5	8/2; 1400	Full flower	3.5	K low,0	3
6	15/2; 1030	Vegetative	1.0	K,2K,0	6
7	21/4; 1030	Early seed pod	2.5	K,0	6
		Early bud	1.2		

K = K_2CO_3 at 10 kg/ha in 225 litres water (conventional sprayer)
2K = K_2CO_3 at 20 kg/ha in 450 litres water (conventional sprayer)
K low = K_2CO_3 at 10 kg/ha in 30 litres water (CDA)
C = conditioned with fluted rollers.
0 = untreated.

TABLE 3: Selected meteorological data from cutting until treated plots were baler-fit.

Run	Days*	Advantage**	Solar radiation (MJ/m^2)	Temperature max (°C)	Temperature min (°C)	Vapour press. def. (kPa)	Wind run at 6 m (km)	Rainfall (mm)
1	6	-2	18.0	13.4	2.8	3.8	422	2.4
2	5	0	17.4	14.9	8.2	4.7	488	1.8
3	3	-1	19.2	20.3	2.3	7.9	389	2.3
4	2	-1	18.2	23.0	6.2	9.9	474	0.0
5	3	0	18.2	23.0	6.2	9.9	474	0.0
6	1	-2	21.2	32.8	5.1	16.7	390	0.0
7	16***	0	6.6	13.1	1.5	2.2	319	15.6

* Number of days from cutting until sprayed plots baler-fit (0.33 gm/gm)
** Advantage = days sprayed — days unsprayed
*** Still not baleable after 16 days

spray nozzles were directed forwards so that, with the aid of a push-bar (Minson and Tullberg, 1981), the solution was directed towards both the lucerne stems and the leaves. Controlled droplet application (CDA) to improve spray coverage and to reduce water volume was used on 3 occasions. With CDA, the droplet size was approximately 250 microns. In runs 1 and 2, conditioning with fluted rollers was used as a treatment. A wetting agent was used with the potassium carbonate on all runs after the first.

Samples for dry matter determination were taken after cutting and thereafter at 1500-1800 hours each day, except during or following significant rainfall. Samples of the standing crop were not taken. At least one 30 cm section from the full swath width was taken from each plot. Samples were weighed, oven-dried and re-weighed, and the moisture content was calculated on a dry matter basis. Hay yield was estimated from the total weight of the samples and the material remaining at the end of each run. The swathes were turned by hand with a pitch-fork during runs 1, 2 and 7 at the times indicated in the figures.

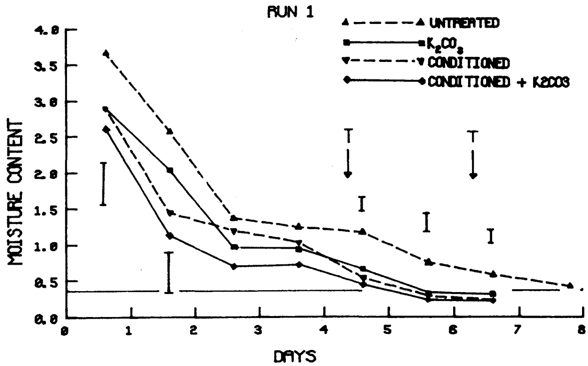

Figure 1: Moisture content during Run 1 (with L.S.D. (5%) when a significant F test occurred). T = Turned, R = Rain.

RESULTS AND DISCUSSION

Potassium carbonate increased the drying rate on all occasions. However, the effect was not always statistically or practically significant.

In runs 1 and 2, potassium carbonate tended to enhance drying but the effect of conditioning, with or without potassium carbonate, was greater (Fig. 1). In run 1, conditioning and potassium carbonate with conditioning were baler-fit after five days, potassium carbonate alone took six days and the untreated control was still not fit after seven days. Baler-fit was taken as 0.33 gms water per gm dry weight. In run 2, conditioning and potassium carbonate with conditioning were fit after four days and both potassium carbonate alone and the untreated control were fit after five days (Fig. 2). In run 3, the potassium carbonate treatment was fit after three days and the untreated control was probably fit after four days (Fig. 3). In run 4, plots treated with potassium carbonate were fit after two days and the control plots after three days, but in

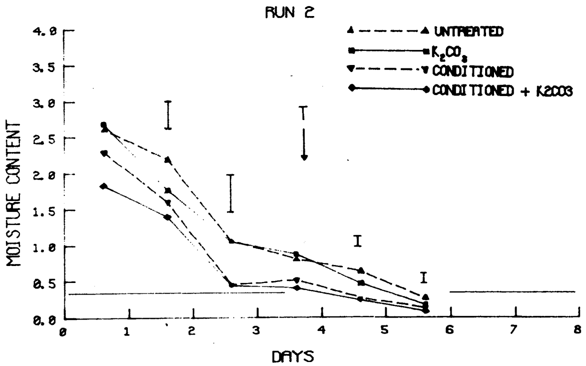

Figure 2: Moisture content during Run 2

run 5, which was sprayed and cut only five hours after run 4, there was no treatment effect and the hay was fit after three days (Fig. 3).

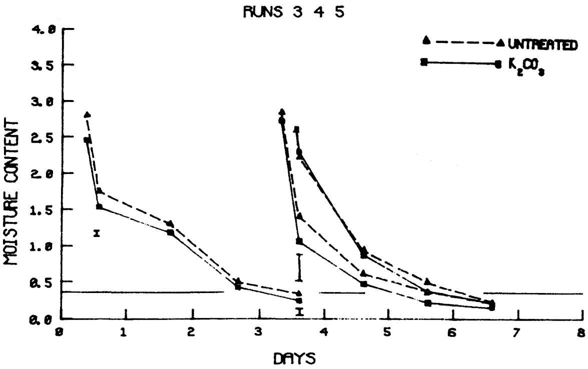

Figure 3: Moisture content during Runs 3, 4, and 5.

Treated plots in run 6 were cut on an exceptionally hot day and became fit (0.28 g/g) during the first day. Although the untreated plots had dried considerably (0.37 g/g) by 1800 hours that day, they did not become baler-fit until two days later (Fig. 4). This emphasises the major effect that even small differences in drying rate can have on hay-making. Although this difference was not statistically significant on the first day, it was later.

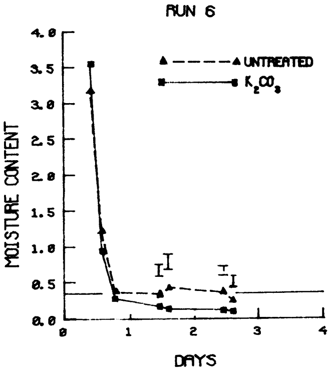

Figure 4: Moisture content during Run 6.

Poor drying conditions occurred during run 7 and it was abandoned after 16 days. An early response to potassium carbonate treatment disappeared after two periods of light rain (Fig. 5). In most of the previous runs, differences persisted which meant that the drier sprayed material continued to dry at the same rate as the untreated material. This did not occur in run 7.

Excluding run 7, the time until sprayed material was fit to bale was correlated with mean solar radiation (r = 0.81*) but not with wind run. This is to be expected from physical principles. Surrogate correlations such as with maximum temperature (r = 0.98**) and vapour pressure deficit (r = 95**) were found because of their primary relationship with solar radiation.

Maturity and yield are invariably confounded. The spectacular drying of treated lucerne in run 6 might lead one to suggest that potassium carbonate is especially useful on immature and/or light crops. Small-scale laboratory experiments with stem internodes of red clover have also shown that the spray is most effective on young, high water content tissue (C.B. Tanner and B.E. Clothier pers. comm.) However, run 7 showed no maturity (yield) x spray interaction. Immature material dried more slowly (Fig. 6) probably because its swathe lay flatter than that of the very stalky mature material. However these field results showed that potassium carbonate had the same effect (statistically) on mature and immature material.

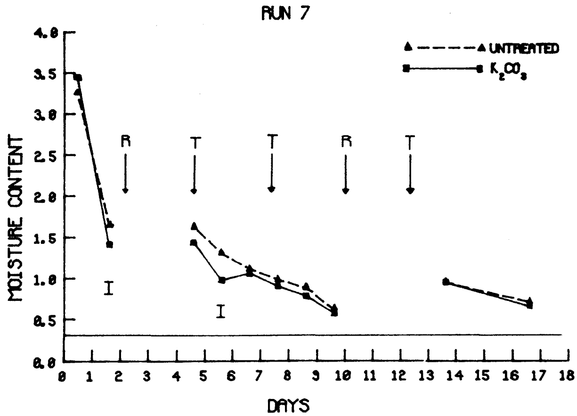

Figure 5: Moisture content during Run 7.

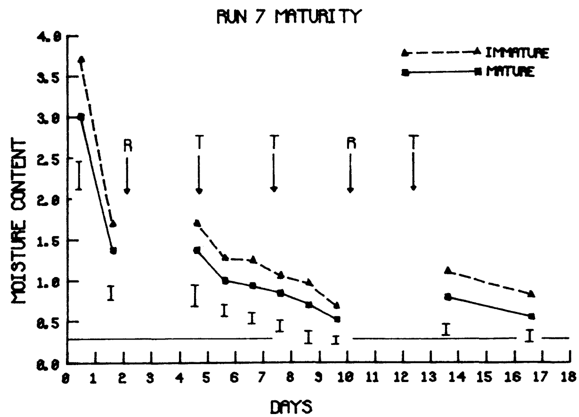

Figure 6: Moisture content during Run 7: Immature and Mature lucerne.

Applying potassium carbonate with a hand-held controlled droplet applicator gave a small positive response to potassium carbonate but further work will be necessary to determine if this method of application is worthwhile.

No clear indication of the best time of day to cut was apparent from these experiments, although the difference between runs 4 and 5, cut five hours apart, indicate that further work on timing might be useful. Doubling the rate of potassium carbonate and water had no added effect on drying on the one occasion it was tried.

CONCLUSION

Potassium carbonate had a positive effect on lucerne hay drying but further work will be required to determine whether its effect is sufficiently consistent for it to be useful commerically. Contrary to Australian results, these experiments and those of Clothier and Slack (1982) may indicate that potassium carbonate may be most effective under good drying conditions when the need for accelerated drying is least.

ACKNOWLEDGMENT

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