THE SPRAYING OF ESTABLISHING PASTURES

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SUMMARY

MAXIMUM production of palatable pasture herbage occurs where soil fertility is high. Few New Zealand soils are naturally of high fertility and the most important nutrient deficiency is that of nitrogen. The fixation of nitrogen in the clover nodule by rhizobium species can correct this deficiency.

It is difficult to maintain productive grasses and clovers together in the proportions which will permit maximum production. Any damage to clovers should be avoided, particularly in young pastures. MCPB and 2,4-DB have been reported to kill many common pasture weeds without spray damage to red and white clovers. Work at Grasslands Division, Department of Scientific and Industrial Research, with these materials on red and white clovers and on establishing pastures is presented in the summary.

It is concluded that with care taken to prevent MCPB reaching the soil establishing pastures can be sprayed effectively within 6 weeks of emergence with 1lb. acid equivalent per acre of sodium salt of MCPB.

Pasture management aims at maximum production of palatable pasture herbage. The common problem which arises is deficiency in plant nutrition, the most important deficiency in New Zealand being that of nitrogen. It is fortunate that our climate permits us to make wide use of "legume" or "clover" nitrogen, but nitrogen supplied in this way may be less dependable than applications of "fertiliser" nitrogen. Changes in the environment which damage clovers must necessarily reduce the quantity of nitrogen fixed in the nodule by rhizobium species. Further, it is not clear that underground transfer of "clover" nitrogen can in fact take place at all times. (1) Indeed it is possible that during the summer "clover" nitrogen may be fully utilised by the clovers themselves. (2) But for reasons of economy "fertiliser" nitrogen is seldom used, and we are required to persist in using clovers for the supply of nitrogen to our pastures.

By and large, high fertility and low fertility are synonymous with high and low supply of available nitrogen, and it is usual for high-fertility pastures to contain more grass than low-fertility pastures. (3) Clovers do not produce a bulk of herbage, whereas the grasses, notably the ryegrasses, are capable of producing large quantities of herbage. At Grasslands Division, Palmerston North, it has been found that maximum production can come from a pasture which contains about 70 per cent. of ryegrass and 30 per cent. of clover. (4) More or less ryegrass implies reduced production; the former condition because there is insufficient "clover" nitrogen to **sustain** maximum growth and the latter condition because there is insufficient "clover" nitrogen to **promote** maximum growth.

Pastures are grown to be grazed, and grazing itself damages the pasture plants. One aim of pasture management is to reduce this damage as much as possible. It is relatively easy to alter the composition of a sward by grazing, clover being encouraged by hard grazing and grasses by light grazing. Within 2 or 3 months pasture composition may be changed radically by faulty grazing. (5) Thus it is that unceasing vigilance and care are needed to maintain the desired 70:30 ratio of grass to clover. The point is that clover growth **can** be encouraged by grazing management. In practice the clover damage resulting from grazing can be reduced to a low level so that normal growth may soon be resumed. The damage to clovers caused by the hormone weedkillers MCPA and 2,4-D has been

likened to this effect. It is my experience that this spray damage is much more severe than grazing and that the effect can persist for some weeks after spraying, thus delaying the resumption of normal growth.

Once the weeds have been reduced by hormone spraying it is essential to encourage the fast-growing grasses and clovers but, as is obvious, clover damage is directly contrary to this. Consequently, bare patches remain, resistant weeds increase, and ryegrass vigour diminishes. There is little information regarding the effect, if any, of weeds on pasture productivity. Thus it seems impossible to advocate the use of MCPA and 2,4-D for the control of weeds in pastures, except where the weeds are very numerous or for other special reasons. In my opinion the clover damage caused by MCPA and 2,4-D, even at low rates, has been so severe as to seriously limit their value as weedkillers in pasture.

The particular subject of this paper is establishing pasture, and the well-known extreme sensitivity of young clover plants to MCPA and 2,4-D has precluded their use on such pastures. It has been a common if questionable practice to spray with MCPA at low rates 5 to 6 months after emergence, when the pasture is well nigh established, and with 2,4-D at later times. This situation has permitted weeds to grow to large size, thus offering intense competition to sown grasses and clovers for nutrient (nitrogen particularly) and space. As stated earlier New Zealand soils are naturally deficient in nitrogen, which makes it essential to reduce any period without vigorous clover growth. Put in another way, clover growth should be encouraged from the earliest emergence. A vigorous pasture should then form rapidly. It is clear that weeds should be removed either before emergence or very soon after.

At Grasslands Division, Palmerston North, 2,4-D mixed into the soil before sowing has been effective in preventing all but hard weed seeds from emerging. If the soil is moist and warm, this can be achieved within 3 weeks, but the quantities of 2,4-D involved remove this measure from the sphere of pasture management. For various reasons other pre-emergence treatments have proved to be undesirable. At an earlier Conference (1955) I spoke of a selective placement machine which sprayed tall-growing weeds without damage to low-growing clovers. This approach has little place in the spraying of establishing pastures. Until recently it has appeared to be almost impossible to control weeds in establishing pastures. Grazing has been the only relatively safe measure and it was often ineffective. With Wain's development of MCPB and 2,4-DB it may well be that this situation no longer exists.(7) The claim has been made that these selectively activated materials affect many common pasture weeds and have no effect on red and white clovers. For the first time the problem appears to be near solution.

At Grasslands Division, Palmerston North, work with sodium salt of MCPB commenced in October 1955. The results are summarised here.

Effects on clovers: The most important clover plants in New Zealand are white and red clover (*Trifolium repens* and *T. pratense*). Single plants of these species were sprayed in the winter, when 6 to 10 trifoliate leaves were present, with the sodium salts of MCPB and 2,4-DB at 1lb. acid equivalent per acre. Ten weeks later the plants were harvested. Neither material affected red clover yield, but white clover yield was reduced whenever MCPB reached the soil (see Table 1).

TABLE 1—THE EFFECT OF MCPB ON WHITE CLOVER. DRY WEIGHT PER PLANT IN GMS.

No treatment	1.53
Soil only sprayed	1.10
Foliage only sprayed	1.71
Soil and foliage sprayed	1.06
Detectable difference at 5 per cent. level of probability	0.35

These reduced yields were associated with reductions in leaf number. Distorted leaves appeared on both white and red clovers wherever MCPB was used, but with 2,4-DB they appeared only where the material was applied to the foliage. It appeared that with 2,4-DB any effect through the soil was negligible. The presence of distorted leaves did not appear to be connected with reduced yields. The importance of these leaves in younger plants is not yet known. It appeared that clover plants as mature as those used here could be sprayed safely with 2,4-DB and MCPB provided the latter did not reach the soil.

Clover growth after spraying with 1lb. acid equivalent per acre of each of sodium MCPA and sodium MCPB may be seen in Fig. 1.

FIG. 1. THE EFFECT OF MCPB AND MCPA ON RED AND WHITE CLOVER

MCPB had less effect on both white and red clovers than did MCPA, but the difference was large for white clover. MCPA retarded the resumption of normal white clover growth and, in a pasture, this could have been critical. MCPB was markedly superior in this respect.

From the foregoing it seemed reasonable to suppose that establishing pastures could be sprayed safely at a very early age, always provided that the action of MCPB through the soil was borne in mind. Commencing in the autumn, an establishing short-rotation ryegrass-clover pasture was sprayed with 1lb. acid equivalent of sodium salt of MCPB on successive dates. As a result of rapid establishment the soil surface was covered by herbage within 4 weeks of emergence. Spraying 2 weeks after emergence eliminated white clover and reduced the vigour of short-rotation ryegrass. Later sprayings had little effect on the clovers, but clover vigour had been reduced by increasing weed competition.

Three establishing pastures in various parts of the Manawatu were sprayed, in the autumn-winter period, with sodium salt of MCPB at different rates on successive dates. Again there was no damage to clovers except where MCPB reached the soil, either because the pasture was sparse at spraying or because rain fell soon after spraying. Again clover deaths and damage to ryegrass occurred together. Where MCPB was wholly retained by the herbage increasing rates did not cause increased damage. If the pasture was sparse at spraying the 3lb. acid equivalent rate was drastic in action; indeed the effect of one such treatment is still reflected by reduced clover population in one experimental pasture 12 months after spraying.

Effects on weeds: Observations confirmed reports that MCPB was not effective on some common weeds, for example dandelion (*Taraxacum officinale*), but most of the pasture weeds common in the Manawatu appeared to be susceptible. As in the past, stage of growth appeared to be important. In one pasture, regrowth docks (*Rumex* species notably *R. obtusifolius*) were not reduced by less than 2lb. acid equivalent MCPB, whereas seedlings (2 to 4 leaves) were eliminated by 1lb. acid equivalent. Twelve months later it is clear that 3lb. acid equivalent was the most effective on regrowth docks.

The weeds listed below were affected by MCPB.

<i>Amaranthus retroflexus</i>	Redroot
<i>Capsella bursa-pastoris</i>	Shepherd's purse.
<i>Chenopodium album</i>	Fat-hen
<i>Chenopodium murale</i>	Nettle-leaved goosefoot
<i>Cirsium arvense</i>	Californian or creeping thistle
<i>Cirsium lanceolatum</i>	Scotch or spear thistle
<i>Coronopus didymus</i>	Hog cress
<i>Plantago lanceolata</i>	Rib grass
<i>Plantago major</i>	Broad-leaved plantain
<i>Polygonum aviculare</i>	Wireweed
<i>Polygonum persicaria</i>	Lady's thumb
<i>Ranunculus</i> sp	Buttercups
<i>Rumex crispus</i>	Curled dock
<i>Rumex obtusifolius</i>	Broad-leaved dock
<i>Silybum marianum</i>	Variegated thistle
<i>Sisymbrium officinale</i>	Hedge mustard
<i>Solanum nigrum</i>	Black nightshade
<i>Sonchus oleraceus</i>	Sow thistle

With the exception of the docks and Californian thistle all these plants were present in the establishing pastures in the seedling stage. One pound acid equivalent MCPB proved to be sufficient to kill all these weeds up to the eighth or ninth week after emergence. Indeed, other observations suggested that most would be killed, at this time, by about $\frac{1}{2}$ lb. acid equivalent. Catchfly (*Silene gallica*), Spurrey (*Spergula arvensis*), hemlock (*Conium maculatum*), and the mayweeds (*Matricaria* spp) did not appear to be activators of MCPB and were thus not susceptible to it.

MCPB was slow in its action on weeds and thus gave a first impression that it was less effective than MCPA. Within 6 or 7 weeks it was clear that MCPB was in fact at least as effective as MCPA and with the passage of time I have formed the opinion that it is more effective than MCPA. The environment, as dictated by soil, climate, and season, can influence the speed of effect, but it does appear that MCPB is translocated more efficiently than is MCPA. However, it is still desirable to achieve complete coverage of the plant. It is noteworthy that the reduction in weeds, following the use of MCPB, is still clearly visible in all the experimental pastures 12 months after spraying.

DISCUSSION AND CONCLUSION

It is a truism that nitrogen is supplied by the rhizobium species in the clover nodule and it should be clear that vigorous clover growth can mean productive pasture. Further, it should be clear that clover seedlings must be encouraged from the moment they emerge. Light foliage applications of MCPB on very young pastures can facilitate this by eliminating weeds without causing clover death. But, because the action of MCPB is slow, it is possible that weed competition will still influence young establishing pastures to a limited extent. Obviously it is essential to spray with MCPB as soon after emergence as possible. The evidence I have, and my interpretation of it, leads me to believe that soil micro-organisms are capable of converting MCPB into a plant growth regulator which by passing into

the root systems will damage all plants, but clovers in particular. Young clovers can be killed.

Every care should be taken to avoid placing MCPB on the soil. One way of doing this is to spray at low gallonage and low pressure when herbage cover of the soil is complete, even though complete coverage of every plant becomes impossible. This course of action may be hampered by practical difficulties. When the concentration of MCPB is high clover leaves may be scorched, the action being that of a light defoliation, or nozzles may become blocked by a crystalline deposit. This latter point should be of concern only to large-scale operators.

It is difficult to explain the presence of the distorted leaves which appear following spraying, and it is difficult to estimate their importance in the plant's physiology. It seems possible that their influence in a very young plant may be large, but their effect on plants with 5 or 6 trifoliate leaves does not appear to be of much moment, and many clover plants will be as mature as this when spraying is delayed until herbage covers the soil.

Despite these points it appears that for the first time it is possible to spray weeds in pasture when they are most susceptible without damaging the associated clovers. It is now possible to weed spray young establishing pastures safely. It appears that 2,4-DB may be at least as effective as MCPB in this situation. The problem of resistant weeds remains.

I conclude that with care taken to prevent MCPB reaching the soil establishing pastures can be sprayed effectively within 6 weeks of emergence with 1lb. acid equivalent per acre of sodium salt of MCPB.

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DISCUSSION

Q.—Has any work been done on broad-leaved docks in established pastures with 2,4-DB or MCPB.

A.—No trial has been laid down, but I would say that 2lb. of MCPB would kill half the docks present.

Q.—What is the length of residual effect of MCPB and 2,4-DB in soil?

A.—There is no direct evidence, but damage has been noted 4 weeks after spraying.

Q.—Weeds resistant to MCPB were mentioned. Are any of these of major importance in pastures and which ones?

A.—Catchfly (*Silene gallica*), spurrey (*Spergula arvensis*), and hemlock (*Conium maculatum*).

Q.—With high sowing rates and dense, established sward would it be possible to spray within 1 month after germination?

A.—Yes.

Q.—Would higher rates than 1lb. of MCPB be better on Californian thistle?

A.—Rates of up to 3lb. were used in trials. There is no evidence that they were better than 1lb.