AN INTEGRATED WEED CONTROL PROGRAMME

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Abstract

Principles governing the combination of hand labour, inexpensive herbicides and cultivation as a means of minimising the costs of a weed control programme are discussed. Other factors which are considered are reducing the peak labour requirement and minimising the adverse effects of the exodus of labourers at Christmas. The programme has been tried in trashed cane on the North Coast.

Introduction

The present economic situation dictates that if a farmer is to maintain a constant income, he will have to spend more time on management so that expenditure is limited and revenue is increased. Weed control is one of the major areas where this can be achieved since farmers tend to spend more money than is necessary on weed control.

Most industries in South Africa undertake projects to stabilize their labour force. The sugar industry should also formulate long term plans where the objective should be to reduce the labour force during periods of peak demand and minimise the discharge of labour during the off-crop and in winter. A reduction of the number of labourers during periods of peak demand also reduces housing requirements on the farm. This can probably be achieved by ensuring that there is work for employees who would normally be discharged during less busy periods. Because the labour required for weeding can be varied by varying the extent to which herbicide is used, it can play an important role in this regard.

Weed Control and Other Operations

Weed control cannot be studied in isolation because it competes with other operations for labour and equipment.

Weeding must take preference over topdressing because weeds use fertilizer which is then not available to the crop. A farmer must therefore not topdress a field unless weeds are under control. Similarly, weeding should take preference over planting as weeds should not be allowed to kill cane in one field while it is being planted in another.

If weeding is not carried out at the appropriate time, the labour required for the job increases, unlike in other operations. For example, if seven labourers are required to hand weed a hectare, and a farmer delays the operation for three weeks, the chances are that he will require 10 labourers per hectare when it is eventually done.

For a weed control programme to succeed it is essential that labour be productive and weeds be removed completely so that they do not grow again.

Cultivation should be shallower than 5 cm and the correct tines must be used to ensure complete removal of the weeds. Ripping to a depth of about 23 cm should be restricted to very young crops which do not have roots growing across the interrow. Cultivation must always be followed, some weeks later, by a hand weeding.

Herbicides must be selected carefully and applied accurately and timeously for them to be effective and must always be followed by a hand weeding after a few weeks.

No one of the above methods is more effective than the others; each has its advantages and disadvantages in achieving the most economical combinations. Examples of where each method can or cannot be used are given in Appendix 1.

Weed populations

Hand labour is the most efficient method of weed control when less than 10 labourers per hectare are required for the task. This is why herbicide applications and cultivation must be followed by hand weeding. The labour force cannot cope efficiently with denser populations of weeds so herbicides must be used to avoid this situation.

Cultivation of the interrow only is not advisable in very dense weed populations because weeds left in the cane row will present serious problems for hand labour and could result in increased labour requirements. Cultivation is often blamed for causing an increase in the germination of weeds but this cannot be so if it is restricted to fields where there are few weeds. This belief probably arose from the many weeds which are left in the cane row after interrow cultivation.

The density of a weed population does not affect the efficacy of herbicides and it is clear that where weed populations are dense, herbicides must be used if subsequent hand weeding is to be efficient.

Watergrass

Hand labour and cultivation are ineffective on watergrass (*Cyperus* spp) as they provide only temporary control and the operation requires more than 10 labourers per hectare. Cane can however, reach a full canopy stage without serious competition from this weed and thereafter it should not be a problem. Pre-emergence herbicide treatments can be used to kill watergrass but because of the patchy development of the weed and the expense of these herbicides, post-emergence treatments are more economic.

In plant crops, watergrass emerges before the cane, so phytotoxic herbicides can be used soon after the emergence of the watergrass and before the emergence of the cane. Many grasses and broadleaf weeds can also be killed at this stage but red watergrass (*Cyprus rotundus*) recovers within as little as two weeks after spraying.

If the first ratoon crop is burnt, watergrass should be sprayed but if the crop is trashed, cultivation followed by another inexpensive herbicide application and a hand weeding will probably be adequate to kill this weed.

In burnt ratoons, a post-emergence treatment is required to kill other grasses before the watergrass has developed sufficiently to be treated. If no more grasses germinate, watergrass can be left until it starts flowering before it is sprayed. If any more grass seedlings develop, herbicides will have to be used again before watergrass has developed sufficiently for the herbicide to be effective and the farmer will probably have to be satisfied with a suppression of, rather than complete control of the watergrass for the duration of that particular crop.

Stage of weed development

Herbicides are used for pre-emergence, early post-emergence and, under certain circumstances, late post-emergence control of weeds. Farmers should however plan to spray at the early post-emergence stage as this is when the inexpensive herbicides are most effective. Factors which result in flushes of weeds, e g spring rains, also improve the efficiency of herbicides and factors which cause staggered germination, e g cultivation of the interrow only, will have an adverse effect. Cultivation is most successful at the early post-emergence stage so it is possible to cultivate first and then hand weed some weeks later. In this

way weeds which have been buried by the cultivator can be seen and removed by hand.

Costs

Herbicides are expensive and should not be used unless the weed population justifies it. Except during the spring to early summer period, herbicides should not be used if 10 labourers or fewer per hectare are required to weed by hand.

When a farmer becomes familiar with using inexpensive herbicides, the expense of residual herbicides is rarely justified. Expensive herbicides give better results but the farmer must be sure that the improvement is adequate to cover the additional cost. As weed control on farms improves with the use of herbicides, it will become more economic to use the inexpensive products.

Effect of season

Winter weeds are predominantly broadleaf varieties which can be efficiently removed by hand, even at high populations. At this time, labour is plentiful, weeds grow slowly, there is more time for weeding and there are fewer operations competing for the labour. It could be beneficial to the sugar industry to employ as much labour as is economical at this time of the year, to provide some degree of permanence.

The peak period of germination of grass seedlings and therefore herbicide application, is in spring. Weed germination is less pronounced in summer, especially in trashed cane growing in heavy soils. When the mill closes, cutters are released for weeding, and, after Christmas, labourers return from planting their crops. During this period, it is more economical to use hand labour than herbicides.

Weed populations are substantially reduced by a trash cover. This makes labour under these conditions more economic than when cane is burnt. Cultivation in trashed fields is not possible.

Soil conditions

Although ridges adversely affect herbicide application, they cannot always be avoided. When planting in dry weather it is necessary to ridge deep to reach the moist soil and if tilth is not satisfactory, clods have to be left on the ridge in the interrow. These ridges have to be broken down for haulage and herbicide application.

Cultivation may be necessary to cover erosion rills. In some soils it is advisable to build up a ridge in the cane row, or to rip compacted crusts. These operations must be built into the weed control programme, e g if it is necessary to rip or cultivate, there is no point in using a long term residual herbicide or to hand weed before cultivating.

On heavy soils, residual effects of herbicide are usually disappointing partly because of fixation by clay particles and because of the weed spectrum which includes *Paspalum urvillei, Sorghum verticilliflorum, Cyperus rotundus* and *Rottboellia exaltata.* Inexpensive, early post-emergence applications of herbicides are therefore advantageous. Seasonal effects on heavy soils are more marked than on sandy soil.

Age of cane

The canopy of well-grown cane makes it unnecessary to use a herbicide with a residual effect. Inexpensive, phytotoxic herbicides can be directed away from green leaves making the use of herbicides economic.

Patchy weed development

Where weed development is patchy, spot or area spraying of herbicides can be justified even where tasks are light. This is not advisable during the spring months when labour should be used to eradicate those weeds which were not killed by the herbicides and those in areas which were not sprayed.

Programme Planning

An integrated, rather than a single programme of weed control should be implemented for each field; the method and/or products which would be most economical must be carefully considered.

Winter

During the winter, labour is abundant and the farmer's labour requirements are less because planting and topdressing are carried out in spring. Weeds grow more slowly and the germination of grasses is limited to only a few plant fields.

The germination of grass in heavy soils is suppressed in winter, but this is less marked on sandy soils. The most important method of controlling weeds at this time of the year is with hand labour and the farmer must decide how many of his seasonal workers can be productively employed to prevent losing control of weeds. The productivity of labourers can be increased by cultivating plant and burnt ratoon fields to kill weeds in the interrow.

Spring

At the onset of spring, there is a tendency for labourers to leave the farmer's employment to plant their own crops. At this time weeds germinate and the remaining labourers cannot effectively control them so herbicide application becomes the most important method of control.

Where seeding grasses occur or where grasses damage cane during the December/January period, the farmer must accept that he has failed to use herbicides correctly or that he employed too few labourers for hand weeding in spring. To prevent this, as many weeds as possible must be killed with a herbicide and the weeding programme must be followed strictly. The aim by the end of November should be to have a weeding task which will involve no more than five labourers per hectare.

In spring, the less expensive herbicides should be sprayed onto weeds and then the weeding gang can follow to eradicate those weeds which were not killed by the herbicide, before they get too big and before more than five labourers per hectare are required for the task.

If more than one swing of a hoe is required to remove grasses, they are too big and by that stage will have developed storage organs and a root system which retains a lot of soil. This increases the likelihood of them striking root again after weeding. It is advisable to carry the large clumps of grass out of the field into the road so that rooting again is eliminated. A farmer must be able to calculate when a particular field will need weeding and/or how many labourers will be needed to complete the task in a set time. An example of this is:

Field 1:	area 10 hectares, task 10 labourers/ha	= 100 labourers
Field 2:	area 12 hectares, task 5 labourers/ha	= 60 labourers
		160 labourers

Eight labourers will need 20 working days to complete the task. Alternatively, if the task is to be completed in 10 days, 16 labourers will be required.

Farmers will quickly learn to estimate the number of labourers required per hectare and this skill will greatly assist in obtaining good productivity from his farm labour. The timing of herbicide applications is critical and only the stage of weed development should determine when they are applied and then there should be no delay in doing so.

If more than 10 labourers per hectare are required in a field, the farmer must accept that his herbicide application has been incorrect and the cause must be investigated to prevent it recurring. The only way to rectify the mistake is with hand labour, regardless of the number of labourers required per hectare.

Cultivation can be used to increase labourer productivity but it should be restricted to fields which have few weeds. This can be very useful during periods of peak labour demand.

Summer

In fields where weeds are less of a problem, germination declines in summer, particularly under trashed conditions and in heavy soils. This is generally coupled with the imminent closure of the mill and moving cutters to the weeding gang. The objective of reducing the size of the labour force at the peak period should have been achieved and the use of herbicides can be reduced as the season progresses.

Farmers should not stop spraying too early in the season so that weeds are prevented from building up to unmanageable levels.

Choice of Herbicide

Once a farmer has acquired the necessary skill, inexpensive post-emergence herbicides can be used almost exclusively. Occasionally, some expensive herbicide may be needed to kill severe watergrass infestations or to deal with a weed population that gets out of control.

The products can be varied by applying phytotoxic products prior to the emergence of cane and to bigger cane where the chemical can be directed away from the leaves. An expensive herbicide which kills all weeds is not necessarily more economical than an inexpensive one which is nearly as effective (see Table 1).

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TABLE 1

Inexpensive herbicide recommendations

Weed problem	Treatment	Timing of application
1. Normal seedlings — warm weather	2,5 kg Diuron + 2ℓ 2,4-D + 0,2% Wetter (80%) (7,2 g ae/ℓ)	Very early post-emergence
2. Normal seedlings — heavy soils	2,5 kg Diuron + 2ℓ 2,4-D + 0,25ℓ Paraquat	Very early post-emergence
3. Normal seedlings — cold weather	4ℓ Ametryne + 2ℓ 2,4-D + 0,2% Wetter (50%)	Very early post-emergence
4. Normal seedlings with watergrass in plant cane prior to 3 leaves	2,5 kg Diuron + 1ℓ Paraquat	Before first cane shoots reach 3 leaf stage and early post-emergence of weeds
5. Medium sized weeds under large cane	2,5 kg Diuron + 1ℓ Paraquat	Weeds should not be too advanced and there must be no green cane leaves in the spray area
6. Broadleaf weeds below large cane	1ℓ Paraquat + 2ℓ 2,4-D	As for number 5

APPENDIX 1

Selection of weed control method

SITUATION	Herbicide*	Labour*	Cultivation*	REMARKS
1. Dense stand grass seedlings prior to tillering - All seasons	/	×	×	
2. Medium infestation grass seedlings prior to tillering - spring	/	×	?	
3. Light infestation grass seedlings prior to tillering - spring	/	?	/	Herbicide early, labour later
4. Medium infestation grass seedlings prior to tillering - after Xmas	?	?	?	Depends on availability of labour
5. Light infestation grass seedlings prior to tillering - after Xmas	?	/	/	Depends on availability of labour
6. Medium infestation grass seedlings prior to tillering - autumn, winter	×	/	/	
7. Light infestation grass seedlings prior to tillering - autumn, winter	×	/	/	
8. Medium size grasses - All seasons	×	/	/	Expensive herbicides delay weeding
9. Large grasses - All seasons	?	/	×	Expensive Herbicides delay weeding
10. Broadleaf weeds - spring	/	×	×	
11. Broadleaf weeds - summer	?	?	?	Depends on availability of labour.
12. Broadleaf weeds - winter, autumn	?	/	/	Depends on availability of labour
13. Dense stand watergrass and grasses prior to tillering - All seasons	/	×	×	
14. Dense stand watergrass and medium, large grasses - spring, summer	/	/	/	Herbicide for watergrass essential. Don't hand weed watergrass.
15. Dense stand watergrass and medium, large grasses - autumn, winter	?	/	/	Depends on availability of labour
16. Dense watergrass with few grasses - All seasons	/	?	?	Spot spray at 10% flowering
17. Interrow cultivation necessary in dense stand grass seedlings - spring	/	?	/	Herbicides before or after cultivation
18. Interrow cultivation necessary in dense stand grass seedlings - winter	?	/	/	Depends on availability of labour
19. Plant cane with heavy grass and watergrass problem prior to 3 leaf stage of cane - all seasons	/	×	×	
20. Plant cane with patchy watergrass problem only	/	?	/	Spot spray or cultivate and follow with labour

NOTE: Cultivation can only be used in plant cane and burnt ratoons.

* / = Acceptable

× = unacceptable

? = under some situations