CHAPTER 13

EXAMPLES OF INTEGRATED CONTROL PROGRAMS - AFRICA

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13.1 INTRODUCTION

The entomological work in East and West Africa on the sorghum crop has been concerned with the range of pest species present, assessment of losses and occasionally insecticidal control. There has been little work on integrated control of sorghum insects in Africa. In general, there is a dearth of published information on the actual losses caused to sorghum by pests in Africa. Harris and Harris (1967) have given an overview of loss estimates caused by a range of pests and diseases. Many of the standard reference papers cover a range of pests and cereal hosts, not only sorghum.

Sorghum is an extremely important crop since it is grown essentially as a small farmer subsistence crop in Africa and is particularly useful in view of its comparative drought tolerance. Yields, however, are low; statistics indicate 600-800 kg/ha. Part of the reason for these low yields are undoubtedly pests. The low yields obtained mean that insecticidal control in small farmer situations in uneconomic and only marginally economic at higher levels of production (Swaine 1957, Ingram 1960, Davies and Jowett 1970, Barry 1972). There are indications that in certain circumstances increases in pest incidence can arise from use of insecticides (Davies and Jowett 1966). For these reasons, therefore, the crop is one which is particularly well suited to an integrated control approach.

13.2 PEST SPECIES

Sorghum in Africa is subject to attack by a range of pest species. The main pests are the sorghum shoot fly, *Atherigona soccata* Rond., the stem borers, *Chilo partellus* Swin. and *Busseola fusca* (Full.) and the sorghum midge *Contarinia sorghicola* (Coq.). The exact status of the many head bug species as pests is not clear, but Bowden (1965) considers them to have been underestimated as sources of loss. Several sporadic pests, e.g. African armyworm, *Spodoptera exempta* (Walk) can be locally or seasonally devastating (Brown et al. 1969). The biology of these species has been described earlier in this document (Chapter 4). The more important references with regard to the biology and distribution of these pests in East and West Africa are: Lefevre (1935), Geering (1953), Swaine and Wyatt (1954), Bowden (1956), Ingram (1958), Nye (1960), Harris (1961), Harris (1962), Barry (1972) (a) and (b), Brown and Dewhurst (1975), and Ogwaru (1978) (a) and (b).

13.2.1 Insecticidal Control of Pest Species

There is little evidence that insecticidal control of sorghum insect pests on farmers' fields is economic in Africa. However, assessments of the effect of pests on plant population have seldom been made and these populations are demonstrably sub-optimal. Even on research stations with much higher yield levels and improved cultivars the responses are marginal (Swaine 1957, Ingram 1960, Davies and Jowett 1970). Insecticides are, however, frequently recommended (Wheatley 1961, Coutin 1970).

Given the difficulties of controlling many of the borers with insecticides and the high cost and difficulty of ready access to insecticides and the low cost of the produce, there is clearly a need for the application of integrated pest control methods.

13.3 INTEGRATED APPROACH TO CONTROL

There are many agronmic factors which can be used when formulating a strategy for control of sorghum insect pests. Some of these have already been recommended piece meal to farmers, but as far as can be ascertained, nowhere in Africa is the available range of practices applied.

Biological and agronomic factors which could be utilized in an integrated control strategy include:

1. Good seed bed preparation
2. Early sowing
3. Destruction of crop residues
4. Close season
5. Parasites and predators
6. Use of resistant cultivars

13.3.1 Seed Bed Preparation

In most sorghum growing situations in East and West Africa for at least part of the year, severe climatic conditions involving a hot droughty season of three or more months are experienced. Many of the more important sorghum pests insects have to be able to 'carry-over' as aestivating larvae or pupae in this period. A good early ploughing of land to be used for sowing sorghum is useful in exposing or burying pupae and larvae present in stubble and residues. A rough ploughing of land at the end of the crop season enables very early ploughing just after the break of the rains to be carried out, thus ensuring timely sowing. The preparation of a fine tilth seed bed enables seed to germinate well and establish quickly and minimizes the period of seedling vulnerability to unfavourable environmental factors.

13.3.2 Early sowing

Timely sowing is usually an important factor in reducing pest attack in most crops and this is certainly so in the instance of sorghum. In Africa, shootfly attack is considerably reduced by early sowing (Nye 1960, Davies and Jowett 1066). It has been observed also that delayed sowing results in more damage to sorghum from borer (Harris 1962) and midge than earlier sowing. The main reason for this is that the initial pest densities are low and build up to serious proportions only occurs within the crop or on volunteer plants which germinate in old sorghum fields with the arrival of rain. This is particularly so in the instance of dipteran and lepidopteran borers. In the instance of shootfly and midge, however, increases to very high densities can be rapid and damage can become severe with only slight delays in sowing.

It is of considerable advantage to attempt to get some synchronisation of sowing dates on a regional scale and in the interests of reduction of midge attack to attempt to sow cultivars which flower at approximately the same time. Migration of midge from early maturing cultivars to late maturing cultivars is a well-known and damaging phenomenon. Midge does not normally migrate over long distances (Harris 1976).

13.3.3 Destruction of Crop Residues

In general, alternative hosts of the main sorghum pests in Africa appear to play a relatively minor role in carryover. In many areas, their importance is further reduced by the fact that dry season buring is often carried out as part of the normal agricultural practice, killing the resting pupae and larvae present in field stubble and old grass stems. Crop residues are, however, usually important in carryover (Ingram 1958, Harris 1962). In Africa, this presents problems, as stalks of sorghum are used as a convenient means of preventing soil erosion (Nye 1960, Soheltes 1978), as fodder for animals and as thatching and housing material (Harris 1962). The crop also is ratooned. Sorghum stalks and stubble left standing in the fields are an important source of initial populations of several stems borer species and stored heads or threshed panicles and residues are a source of resting larvae of midge (Harris 1961). Several workers, including Ingram (1958), have commented on the close relationship between the distribution of Busseola fusca and areas of relatively high population density and hence agricultural production.

In spite of these problems, there is no doubt that efforts should be made to encourage the utilization of stalks prior to sowing of new season's crop and to use only stalks from early sown fields for housing purposes, since these contain fewer aestivating pupae and larvae. Residues left after threshing should be burnt.

13.3.4 Parasites and Predators

Extensive lists of parasites and predators are available for most of the pest species present on sorghum in Africa. Eastern and Western Africa have been well surveyed for parasites (Nye 1960, Milner 1967, Mohyuddin and Greathead 1970). However, their overall importance is such that it appears that little would be gained by artifical rearing and release. In the instance of shootfly and midge, the very short life cycles of the pests and high biotic potential mitigate against successful biological control. There is no doubt that several parasites do exert an important regulating influence on lepidopterous borers, particularly in non-crop season "carryover" populations.

13.3.5 Resistant Cultivars

The success of breeding crops for resistance to pests has stimulated work on the subject on sorghum in Africa. Work has been largely focussed in Uganda in East Africa and Nigeria in West Africa (Doggett et al. 1970, Starks et al. 1970, Starks and Doggett 1970). Several mechanisms of resistance are unknown. With shootfly, one is nonpreference for oviposition in some cultivars. Particularly important in many African sorghums is the ability of cultivars to tiller rapidly after the main shoot is attacked and produce several synchronous tillers some of which escape subsequent damage and which manage to produce small heads. These in aggregrate produce a yield somewhat inferior to the main head if the rains do not cut off sharply. This type of resistance is termed 'recovery resistance' (Doggett

materials is being improved (Doggett et al. 1970). Methods have also been developed for determining resistance to Chilo stem borer (Starks and Doggett 1970). As materials come forward from breeding programs these will have an effect on the efficiency of integrated control. Material is currently being developed at ICRISAT incorporating pest resistance and is being extensively tested in multilocational pest nurseries in Africa.

13.4 INTEGRATED PEST CONTROL IN AFRICA - A HYPOTHETICAL SCHEME:

In the prevailing situation in Eastern and Western Africa, it is unlikely that treatment of the growing sorghum crops with insecticides will be either practical or economic on small farmer holdings and only marginally beneficial on larger holdings except where hybrids are grown or produced. Integrated control will not therefore involve use of insecticides, but will be concerned mainly with minimizing pest build up.

It is important to minimize carryover in the stalks from the previous season and to eliminate volunteer plants. Destruction of crop residues is also important.

It is recommended that the crops should be sown as soon as possible after the break of the rains in a seed bag roughly prepared at the end of the previous season and reploughed when sufficient rain falls. Ideally a seed rate in excess of the optimum should be sown to ensure a reasonable plant population and to allow for losses to soil insects. Thinning should be carried out 14 to 21 days after emergence of the crop and seedlings showing obvious "dead heart" symptoms eliminated at this time. This prevents a build up of shootfly within the crop. Synchronous sowing of areas should be actively encouraged to avoid pest shifts