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# RESEARCH REPORT

# A WEED SURVEY OF ARABLE LANDS OF THE SMALL-SCALE FARMING SECTOR OF ZIMBABWE

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There has been no national weed survey of weeds of arable lands in the small-scale non-commercial (SSNC) farming sector of Zimbabwe. All previous surveys done in the country covered the large-scale commercial (LSC) farming sector (Rattray and Wild, 1955; Soane and Waister, 1963; Thomas, 1970; Budd, 1975; Chivinge, 1983). However, periodic weed surveys are necessary as weed populations, compositions and intensity of infestations change with climatic variations and agricultural practices (Chancellor and Froud-Williams, 1984). As there has been no previous weed survey it was decided to conduct a national weed survey of the SSNC farming sector with the following objectives:

- (i) to find out which weeds are the most aggressive and difficult to control in the different administrative and ecological regions;
- (ii) to determine if there are any differences in the weed spectra in the five ecological regions;
- (iii) to find out which weeds need urgent detailed studies; and
- (iv) to establish a base for future weed surveys at national, provincial, district and regional level so as to monitor weed pressure or population changes every few years.

# MATERIALS AND METHODS

The survey was done in two stages. During the first stage a total of 600 questionnaires were sent to the Department of Agricultural, Technical and Extension Services (Agritex) and agro-chemical personnel from September 1983. The same exercise was repeated during 1983 to 1984. This period was chosen so as to cover both the summer and winter crop-growing seasons. The technical officers were asked to report on weeds specifically found in the SSNC farming areas of that part of the province in which they were working. Those completing the questionnaires were asked to list the weed species on the basis of aggressiveness of weeds and the difficulty in controlling them, noting any new weeds that had become problematic in the past five years.

Aggressiveness refers to fast and vigorous growth in the early stages of the weed so as to adversely affect the growth and development of the crop in its young stages. Difficult to control refers to situations in which weed control by hand pulling, hoeing or use of ox-drawn cultivators is not easily accomplished or to weeds which quickly produced subsequent generations soon after the removal of the same weed by the above-mentioned methods.

The second stage was done from 1983 to 1985 covering both the summer and

winter crop-growing seasons. This stage of the survey was considered necessary to verify the information from the first stage of the survey. The period 1983 to 1985 covered relatively dry and wet years. During this period the author went to two areas in each province and recorded weeds found in the fields.

For the selection of farmers whose fields were sampled, stratified random sampling was used. Agritex officers were asked to divide each province into eight equal parts by area. Each area was further sub-divided into sixteen smaller areas. Of the sixteen smaller portions each was sub-divided again into sixty-four villages. From each village the names of one hundred above-average and one hundred below-average farmers were submitted. The eight and sixteen smaller areas were numbered. By use of random number tables the first number to appear was chosen. The same process was repeated for the sixty-four villages. Then ten farmers were randomly chosen from the one hundred above-average and another ten chosen from the below-average farmers. Their fields of maize, cotton, sorghum and pearl millet were sampled.

For the actual sampling spot of the field systematic sampling was used. The land was divided diagonally and sampling was done every 20 metres following the diagonal lines. A total of six quadrats were taken in each field and the quadrats were  $1m \times 1m$ . Weeds in each quadrat were identified and classified as 'aggressive' or 'difficult to control'.

Each area was visited eight times in the period 1983/4-1984/5. The first visit was at the beginning of each growing season and the second at the end of each season. The author also had personal interviews with some of the farmers whose fields were visited.

# RESULTS

The administrative provinces and ecological regions are shown in Figure 1. From information from the survey the weeds were grouped into 'aggressive' and 'difficult to control' weeds on a provincial basis. Weeds were listed in order of frequency of occurrence.

## The most aggressive weeds

Acanthospermum hispidum was the most aggressive weed in six out of the eight provinces (Table I). The same weed was second in Mashonaland West and third in Mashonaland East. During the field survey this weed was found to infest most fields irrespective of crop or soil type, although it was more associated with sandy, poor soils. In both Mashonaland East and Mashonaland West *Eleusine indica* was the most aggressive weed. In lands which had been fertilized with either cattle manure or inorganic fertilizers the weed grew very fast to the extent that most cereal crops were easily choked, though all types suffered when infestations were heavy. In Manicaland and Masvingo *E. indica* was the second most aggressive weed.

Other weeds which were particularly aggressive in all the provinces were Commelina benghalensis, Striga asiatica, Striga spp., Tagetes minuta, Bidens pilosa, Rottboellia cochinchinensis, Amaranthus hybridus, Cynodon daciylon,





# Table I

THE MOST AGGRESSIVE WEEDS IN EACH PROVINCE\*

Manicaland		Mashonaland Central		Mashonaland East		Mashonaland West		
Acanthospermum hispidum	18	Acanthospermum hispidum	29	Eleusine indica	25	Eleusine indica	24	
Eleusine indica	ii	Siriga aslarica	27	Commelina bengalensis	20	Acanthospermum hispidum	22	
Bidens pilosa	10	Striga spp.	21	Acanthospermum hispidum	18	Commelina benghalensis	18	
Commelina benghalensis	8	A maranthus hybridus	18	Richardia scabra	17	Richardia scabra	15	
Cynodon dactylon	8	Tagetes minuta	15	Striga asiatica	15	Ipomoea plebia	12	
Ámaranthus hybridus	5	Eleusine indica	13	Striga spp.	15	Cyperus esculentus	- 11	
Striga asiatica	5	Commelina benghalensis	13	Rottboellia cochinchinensis	6	Tageses minuta	6	
Striga spp.	5	Rhynchelytrum repens	12	Tagetes minuta	6	Amaranthus hybridus	Ś	
Tagetes minuta	4	Cyperus esculentus	9	Amaranthus hybridus	4	Rottboellia cochinchinensis	- 5	
Eragrostis aspera	3	Panicum maximum	9	Nicandra physalodes	4	Striva asiatica	Ś	
Nicandra physalodes	ŝ	Nicandra physalodes	8	Cyperus esculentus	3	Striga SOD.	5	
Cleome monophylla	3	Rottboellia conchinchinensis	8	Bidens pilosa	2	Cyperus rotundus	4	
Richardia scabra	3	Bidens pilosa	4	Boerhavia diffusa	2	Nicandra physalodes	4	
Ceratotheca sesamoides	3	Cyperus rotundus	4	Galinsoga parvillora	2	Portulaca oleracea	4	
Cyperus esculentus	2	Éragrostis aspera	3	Rhynchelytrum repens	2	Physallis angulata	4	
Évperus rotundus	2	Hibiscus meeusi	3	Sida cordifolia	2	Urochloa nanicoides	3	
Hibisus meeusei	2	Galinsoga parvillora	3	Urochlog panicoides	2	Eragrostis aspera	3	
Vernonia cinerea	2	Celosia trigyna	2	Vernonia cinerea	2	Bidens pilosa	3	
Vernonia poskeana	ž	Convza floribunda	2	Vernonia poskeana	2	Celosia trigvna	2	
Urochloa panicoides	2	Donvza sumatrensis	2	Hibiscus trionum	ž	Euphorbia heterophylla	2	
Ocimum canum	2	Xanthium strumarium	2	Hibiscus meeusei	ī	Ocimum canum	2	
Euphorbia heterophylla	2	Digitaria spp.	2	Ocimum canum	ī	Sida alba	2	
Gisekia africana	2	Ocimum canum	2	Divitaria snp.	i	Oxygonum sinuatum	ī	
Crotolaria laburnifolia	Ż	Sida alba	2	Trichodesma zevlanicum	ĩ		-	
·····,		Trichodesma zevlanicum	Ī	Croiolaria laburnifolia	i			
		Gisekia africana	1	Gisekia africana	ī			
		Aergemone mexicana	i	Aereemone mexicana	Î			
			•	Oxygonum sinuatum	i			

WEED SURVEY

170

Midlands		Matabeleland North and South	•	Masvingo	
Acanthospermum hispidum	29	Acanthospermum hispidum	21	Acanthospermum hispidum	25
Striga asianca	24	Amaranthus hybridus	18	Eleusine indica	22
Striga spp.	22	Bidens pilosa	15	Striga asiatica	20
Eleusine indica	21	Commelina benghalensis	13	Striga spp.	18
Commelina benghalensis	16	Cyperus esculentus	12	Commelina benghalensis	17
Tagetes minuta	11	Tagetes minuta	12	Ipomoea plebia	10
Amaranthus hybridus	8	Eleusine indica	11	lpomoea spp.	8
Cyperus esculentus	8	Portulaca oleracea	11	Portulaca oleracea	8
Bidens pilosa	Ś	Strigg asiaticg	6	Bidens pilosa	7
Nicandra physalodes	4	Strieg soo.	6	Tagetes minuta	7
Cyperus rotundus	4	Nicandra physalodes	ŝ	Cyperus rotundus	5
Galinsoea narviflora	2	Rottboellia cochinchinensis	Š	Boerhavia diffusa	5
Portulaça oleraçea	2	Cyperus rotundus	4	Tribulus terrestris	4
Rhyncheltrum repens	2	Galinsoga parviflora	3	Amaranthus hybridus	4
Rotthoellia conchinchinensis	ī	Ocimum canum	3	Cleame monophylla	4
Ipomoea plebia	ī	Jacauemontia tamnifolia	ĩ	Celosia trigyna	4
Aereemone mexicana	ī	·,·································	-	Hibiscus meeusei	4
Hibiscus meeusei	- î			Gisekia africana	3
Gisekia africana	- í			Oxalis latifolia	3
Ixveonum sinuatum	i			Ceratotheca sesmoides	2
Etaerostis aspera	i			Commelina forskaolaei	Ī
	•			Eragrostis aspera	i

• The most aggressive weeds are at the top of the list and the least aggressive at the bottom of each list. The numbers indicate the number of times the weed was reported and observed to be an aggressive weed.

#### WEED SURVEY

Cyperus rotundus, Cyperus esculentus, Richardia scabra and Ipomoea plebeia. However, the aggressiveness of each weed species varied slightly from one province to another. B. pilosa was the third most aggressive weed in Manicaland, Matabeleland North and Matabeleland South. This weed was found growing luxuriantly wherever there were heavy infestations. Well-fertilized fields seemed to encourage the weed to grow well, even under heavy shading from crops such as maize and cotton. R. scabra was the fourth most aggressive weed in Mashonaland East and Mashonaland West. Information gathered during the field survey revealed that this weed has been on the increase in all the provinces since about ten years ago.

C. esculentus and I. plebeia were particularly aggressive in Mashonaland West. Farmers interviewed revealed that the main method of controlling C. esculentus was hoeing which only removed the shoot portion. This leaves the tuber underground which would produce another shoot. In fact, removal of one shoot stimulates dormant buds in the tuber, resulting in more shoots sprouting. I. plebeia and other *Ipomoea* species. were a big problem in Masvingo where they were reported and observed to climb on almost every other plant, crop or weed growing close to them. *Ipomoea* spp. were not easily distinguished from many crops, particularly broadleaf crops in the early stages, because they were found to be growing under heavy shading from crops. During that stage they formed long, thin vines which entangled the crop and would only emerge above the crop canopy towards flowering.

In Manicaland C. dactylon was the fifth most aggressive weed. However, in all other provinces its frequency was quite low. Most farmers interviewed in other provinces reported that once the land is ploughed and the weed is exposed to the dry weather it easily succumbs to the hot temperatures. Manicaland is a rather wet province compared to all the others. Another weed which was rather restricted to one province was R. cochinchinensis. It was reported to be among the most aggressive weeds in Mashonaland Central but was less aggressive in other provinces and was not even listed in Masvingo and Manicaland. In all areas where it was observed during the field survey it was found only in heavy soils and mostly associated with the maize crop. The growth habit and appearance of these two plants are so similar as to make distinction very difficult, particularly during the first few weeks of growth.

S. asiatica and other Striga species were reported and found to infest maize, sorghum and pearl millet in all the eight provinces. This weed was the second most aggressive weed in Mashonaland Central and the third most aggressive weed in the Midlands and Masvingo. Field observations revealed severe infestations and damage to late planted and poorly fertilized crops. Many plants wilted under adequate moisture even before the Striga emerged above ground. C. benghalensis was the second most aggressive weed in Mashonaland East and the third in Mashonaland West. In the other six remaining provinces, it had more or less the same frequency. This weed was found growing in all soil types and altitudes and seemed to tolerate shading from most crops.

Of the most aggressive weeds A. hybridus was the second most aggressive weed in both provinces of Matabeleland and the fourth most aggressive weed in Mashonaland Central. Least aggressive weeds varied considerably from one province to another with only Oxygonum sinuatum being the least aggressive in more than one province. Consequently, these weeds will not be discussed any further.

# The most difficult weeds to control

The most difficult weed to control in all the provinces, except in Mashonaland Central, was A. hispidum (Table II). Most farmers who were interviewed reported that the weed grew in dense stands and subsequent generations always came up soon after removal of one generation. In Mashonaland Central C. benghalensis was the most difficult weed to control, and it was the third most difficult weed to control in Mashonaland East. Other weeds with high frequencies included E. indica, S. asiatica, Striga spp., B. pilosa, C. esculentus, C. rotundus, A. hybridus, R. cochinchinensis and T. minuta. E. indica was the second most difficult weed to control in Manicaland, Mashonaland East and Masvingo.

S. asiatica and Striga spp. were considered difficult weeds to control in all the other provinces except in Mashonaland West. S. asiatica was the third most difficult weed to control in Manicaland and Masvingo. Large patches were found particularly in Masvingo with the heaviest infestations being on pearl millet. The only province where R. cochinchinensis was considered a difficult weed to control was Mashonaland East. During the field survey it was observed that this weed was restricted to heavy red and black soils only. In cases when the weed was left in the field and had attained a height of over 30 cm, it became very difficult to remove it by hand pulling, hoeing or use of ox-drawn cultivators, as the weed had developed strong brace roots. This weed was not even mentioned by the respondents in Manicaland and Masvingo provinces.

C. rotundus and C. esculentus were the only two sedges reported and observed to be difficult weeds to control; C. esculentus was the third most difficult weed to control in Mashonaland West and the fourth in Mashonaland East. This weed was mostly found in lighter soils. T. minuta was more of a problem in the Midlands while A. hybridus was difficult to control in Masvingo. The least difficult weeds to control were different in each province with the exception of *Hibiscus meeusei* which was at the bottom of the list in both Manicaland and Masvingo.

# DISCUSSION

The survey revealed that *R. scabra, Richardia brasiliensis* and *Trichodesma zeplanicum* were becoming problem weeds countrywide. *T. zeplanicum* germinates towards the end of the summer season when most crops are almost mature. Most farmers interviewed did not consider it necessary to weed it out as they were of the opinion that it had no chance to compete with the crop. Both species of *Richardia* were observed and reported to germinate throughout the summer and consequently those plants which grow towards the end of the summer season are never removed. *Tribulis terrestris* was observed and reported only in Masvingo where it is on the increase.

Another observation was that over 40 per cent of the farmers' fields visited had weeds and crops of the same size before the first weeding was done. This is too late to remove weeds as the detrimental effects of weeds on crop growth and final yield would have already occurred. Most farmers tended not to remove weeds

# Table II

# THE MOST DIFFICULT WEEDS TO CONTROL IN EACH PROVINCE\*

# WEED SURVEY

Midlands		Matabeleland North and South		Masvingo		
Acanthospermum hispidum	25	Acanthospermum hispidum	18	Acanthospermum hispidum	21	
Striga asiatica	23	Bidens pilosa	14	Eleusine indica	20	
Striga spp.	22	Eleusine indica	13	Striga asiatica	18	
Eleusine indica	21	Commelina benghalensis	12	Striga sop.	18	
Commetine benghalensis	20	Cyperus esculentus	IŌ	Commelina benghalensis	16	
Tagetes minuta	11	Tagetes minuta	7	Amaranthus hybridus	10	
Cyperus esculentus	10	Portulaca oleracea	5	Richardia scabra	8	
Portulaca oleracea	- 5	Amaranthus hybridus	4	Bidens vilosa	8	
Amaranthus hybridus	5	Euphorbia heterophylla	4	Tageles minuta	7	
Bidens pilosa	5	Nicandra physalodes	3	Cyperus esculentus	7	
Cyperus rotundus	3	Rottboellia cochinchinensis	2	Évperus rotundus	6	
<b>Cynodon</b> dactylon	3	Urochioa panicoides	2	Euphorbia heterophylla	5	
Rhynchelvirum repens	3	Cynodon dactylon	Ē	Tribulus terrestris	2	
Urochioa panicoides	1	-,	-	Hibiscus meeusei	2	
Galinsoga parviflora	ī				-	
Nicandra physalodes	Ĩ					

\* The most difficult weeds to control are at the top of the list and the least difficult at the bottom of each list. The numbers indicate the number of times when the weed was reported and observed to be a difficult weed to control.

1

### WEED SURVEY

once their crops had reached the flowering stage. The only exception was with the cotton crop where weeds would down-grade the crop if the lint was contaminated with trash from weeds.

Of the thirteen most aggressive and difficult to control weeds, eight were broadleaf and five were narrowleaf (Table III). From the five narrowleaf weeds three were grasses and two were sedges.

# Table III

# THE THIRTEEN MOST AGGRESSIVE AND DIFFICULT WEEDS TO CONTROL, CLASSIFIED ON FAMILY AND LEAF BASIS

Weed	Family	Narrowleaf	Broadleaf	
Acanthospermum hispidum	Asteraceae	No	Yes	
Amaranihus hybridus	Amaranthaceae	No	Yes	
Bidens pilosa	Asteraceae	No	Yes	
Commelina benghalensis	Commelinaceae	No	Yes	
Cynodon dactylon	Poaceae	Yes	No	
Évperus esculentus	<b>Cypera</b> ceae	Yes	No	
<b>Cyperus</b> rotundus	Cyperaceae	Yes	No	
Éleusine indica	Poaceae	Yes	No	
Ipomoea plebeia	Convolvulaceae	No	Yes	
Richardia scabra	Rubiaceae	No	Yes	
Rottboellia cochinchinensis	Poaceae	Yes	No	
Striga asiatica	Scophulariaceae	No	Yes	
Tagetes minuta	Asteraceae	No	Yes	

During the field survey it was noticed that most areas in the SSNC farming sector had sandy soils associated with *A. hispidum*. This observation agrees with Thomas (1970) and Drummond (1984). The weed was observed to have greater plasticity, i.e. it grew up to about 1 m tall, branched profusely and produced many seeds in moist, fertile soils, and in relatively dry, less fertile soils it grew to less than 30 cm tall and yet still produced at least small quantities of seeds. It spread easily by the attachment of its barbs to human clothes or animal fur (Drummond, 1984). This is probably why it has been found in all the eight provinces and all five regions of Zimbabwe. Although there have been no competition studies done on this weed, it does not seem to be competitive with most crops and is easily shaded in tall crops such as maize and cotton.

A. hispidum grew on almost all soil types and produced new generations irregularly. This is probably why most farmers regarded it as the most aggressive and difficult weed to control.

Thomas (1970), Budd (1975) and Chivinge (1983) reported A. hispidum to be among the top most aggressive and difficult weeds to control in the LSC farming sector. This clearly shows that this weed is a problem in all the arable

176

farming sectors of Zimbabwe, the problem being probably more pronounced in light soils.

*E. indica* produces numerous small seeds which germinate quite early in the crop-growing season and plants have a vigorous and extensive root system (Holm *et al.*, 1977). Field observation during the survey revealed that once the weed was more than one and a half months old from the time of emergence, it became very difficult to remove manually or mechanically. It is, therefore, not surprising to find this weed among the top most aggressive and difficult weeds to control in most provinces and ecological regions. Budd (1975) found it to be the most aggressive weed and the second most difficult weed to control in the LSC farming sector. This shows that *E. indica* grows in all ecological regions and soil types found in Zimbabwe. Consequently it is a problem in all the arable farming sectors of Zimbabwe.

C. benghalensis produces both aerial and subterranean seeds and also reproduces vegetatively. If the weed is removed by hand or mechanically, stems break off and root at the nodes, producing new plants. Thus, weeding may indirectly multiply the plant. Budd (1975) and Chivinge (1983) found C. benghalensis to be among the top seven most aggressive weeds in the LSC farming sector. Field observations by the author revealed that if C. benghalensis was allowed to grow in fertilized soils it grew quickly and luxuriantly and easily out-grew the crop plants. Control at that stage would be difficult except probably by the use of chemicals. This may explain why respondents reported it among the most aggressive and difficult weeds to control.

Other aggressive weeds such as S. asiatica, Striga spp., A. hybridus, T. minuta, B. pilosa and R. cochinchinensis are allowed to produce seed by the farmers as most SSNC farmers do not remove weeds once their crops have passed the flowering stage. The result is that these weeds come up in larger numbers in the subsequent seasons, as more seeds will have been added to those already in the seed bank. If more seed production is coupled with weed seed dormancy then the problem is worsened. For example, Striga spp. produces 400-500 seeds per capsule and seeds remain viable for 15-20 years (Ramaiah et al., 1983).

While *Striga* spp. were among the top most aggressive and difficult weeds to control in the SSNC farming sector, both Thomas (1970) and Budd (1975) do not even mention them in the LSC farming sector surveys. This clearly shows a difference in crop and weed management systems in the two farming sectors. The fact that *Striga* spp. were more troublesome only in certain provinces is a reflection of the extent to which they grow maize, pearl millet and sorghum crops. The Midlands, Masvingo and Mashonaland East had certain areas which grew large proportions of these crops. Sorghum and pearl millet were not fertilized with inorganic fertilizers which reduce *Striga* infestations (Drummond, 1984). *Striga* spp. were found growing in patches, and the plants were short and thin. They only became conspicuous after flowering. This makes their control before flowering difficult.

Budd (1975) and Chivinge (1983) reported *R. cochinchinensis* to be the second most aggressive and the second most difficult weed to control in the LSC farming sector. However, in this survey it was a problem only in Mashonaland East. The main reason why it is not a big problem in the SSNC farming sector is that it grows well in heavy soils (Thomas, 1970). There are less heavy soils in the

#### WEED SURVEY

SSNC and more in the LSC farming sector. The fact that it was not even mentioned in Masvingo and Manicaland is because of unfavourable low rainfall and low temperatures, respectively, as suggested by Thomas (1970). Weed management throughout the whole year, rather than weed control during the first half of the summer, would reduce the numbers of these weeds. The fact that the most aggressive weeds are similar to a certain extent in all the provinces and ecological regions suggests that the farming practices used by the SSNC farming sector are not very different, irrespective of the soil type, amount of rainfall or other climatic factors. Early germination and plasticity are attributes of highly competitive plants (Aldrich, 1984) and these characteristics are found in most of the weeds listed as aggressive and difficult to control in this survey. Some of these weeds, such as A. hispidum, have irregular germination which makes control difficult because they germinate throughout the whole year. Most SSNC farmers cannot weed when it is too wet because they either hand-hoe or cultivate with ox-drawn implements. The result is weeds with big root systems which are difficult to remove by these methods of weeding.

# CONCLUSIONS

The most aggressive and difficult-to-control weeds in the SSNC farming sector have been identified in all the administrative and ecological regions. The weeds were common across all the ecological regions and were mostly broadleaf weeds, three grasses and two sedges. Weeds which have started increasing over the past few years are now known and a base for future weed surveys has been established. It should be appreciated that some weeds might be very aggressive or difficult to control only in a particular limited locality.

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