

PROJECT COMPLETION SUMMARY SHEET

DATE sheet completed: 25 August 2000

Project Title: Management of *Cyperus* in small-holder farming systems on Vertisols and vertic clay soils

DFID Project Reference No: R6737
Programme: Crop Protection Programme
Programme Manager (Institution): Dr Simon Eden-Green (NRIL)
Sub-Contractor (Project Leader's Institution): P J Terry (IACR-Long Ashton Research Station, Bristol, UK)

Production System: High Potential
Programme Purpose: Livelihoods of poor people improved through sustainably enhanced production and productivity of RNR systems
Commodity Base: Maize, cowpea, vegetables
Beneficiaries: ☐ Small-scale farmers with perennial sedge and grass weeds
☐ Extension service
☐ Companies marketing weed control products
Target Institutions: ☐ University of Ghana Agricultural Research Station, Kpong
☐ Crops Research Institute, Kumasi
Geographic Focus: Ghana (but research is relevant to many developing countries)

	Planned	Actual
Start Date:	01-Sep-96	01-Sep-96
Finish Date:	31-Aug-00	31-Aug-00 (includes 1-year extension)
Total Cost:	£250,746	£250,746

1. Project purpose (box 15a of PMF):

Methods of managing *Cyperus rotundus* that integrate cultural, biological and cultivation techniques will be developed to allow small-scale farmers in Ghana to utilise Vertisols and other clay soils to their full potential. Management of the weed complex associated with *C. rotundus* on these soils, particularly *Imperata cylindrica*, will also be addressed.

This was primarily an adaptive research project where known technology (particularly the control of *Cyperus rotundus* by glyphosate herbicide) was tested in a system previously developed by the ODA/IBSRAM project, 'Management of Vertisols for sustained rainfed smallholder crop production in Ghana (T0336)'. Not only were technical solutions to the *Cyperus* problem sought, but work was also done on the economics, acceptability to farmers and promotion of this technology. A separate study, within the project framework, was done by CABI Bioscience to find pathogens of *C. rotundus* in Ghana that would have the potential for being developed as biological control agents for this weed.

2. Outputs:

- Within five cropping seasons, over a period of three years, populations of tubers (the sole means of propagation) in the soil of *Cyperus rotundus* were reduced by over 99% (from approximately 811 tubers/m² to about 2 tubers/m²) in a long-term trial on the research station. In up to 24 on-farm trials (the numbers varied from one season to another), the percentage ground covers of *Cyperus* shoots were reduced by approximately 77% over three cropping seasons.
- Glyphosate controlled many annual weeds present at the time of application, replacing one of the two hand-weedings required during a season. Control of annual grasses and broadleaved weeds was enhanced when residual herbicides were used (Lasso/atrazine in maize and Dual in cowpea).
- Crop yields on glyphosate-treated plots were always significantly greater than on hand-weeded plots. This was undoubtedly due to the suppression of weed growth when the crop was most vulnerable to competition. It is not possible to say what proportion of the increase

was due to the control of *C. rotundus* but the result is consistent with the findings of other researchers who have observed yield increases after control of this weed.

- Relative yields on flat and camber beds were not consistent. During 1999 at ARS Kpong, camber beds gave significantly higher yields than flat plots but, in 1998, the reverse was true. The difference can be attributed to rainfall; high and average rainfall favours camber beds whilst low rainfall (38% below average) favours flat plots. In the normal rainfall year of 1999, 10m-wide camber beds gave yields that were 55% higher than flat plots whilst yields on 5m-wide camber beds were only 27% higher.
- The combination of camber beds and glyphosate for weed control produced maize grain yields of 3.5 t/ha, a significant increase over the typical yields of about 1.0 t/ha with traditional methods of hoe weeding on flat land.
- A cost-benefit model developed by the project showed that the economics of using glyphosate compared very favourably to hand weeding. Gross margins for glyphosate treatments were higher than for hand weeding because of the greater yields and reduced labour costs for weed control. For glyphosate treatments on camber beds, they can be £345/ha, compared with £81/ha for low-input farmers using hand weeding on flat plots.
- Many farmers participating in the research programme have been very satisfied with the results and will continue using glyphosate and camber beds. Hence, there is reasonable cause for optimism that farmers around Kpong and in other areas will adopt the technology demonstrated in this research for improved use of Vertisols.
- In a survey of *Cyperus rotundus* in Ghana in May-October 1997, 18 actual or potential pathogens were collected. The mycobiota proved to be unexpectedly rich and a number of isolates are taxonomically unknown at the generic or species level.
- On disease observation plots, it was shown that indigenous pathogens are slow to build-up within the weed population and fail to suppress weed outbreaks. A significant proportion of co-evolved pathogens was shown to be already present in Ghana, thus negating the need for a classical biological control strategy.

3. Contribution of Outputs (box 18a of PMF) to Project Goal (box 7 of PMF):

- “An understanding of farmers’ perceptions of weeds and their capacity to manage them on Vertisols and vertic clay soils.” This was achieved in a socio-economic survey in the first year of the project and through working with farmers and by an open day.
- “Researcher-managed and farmer-participatory trials will produce results on various weed management options.” On-farm trials were done in six seasons with up to 24 participating farmers. Complementary studies were done on the research station over seven seasons. A practical method for controlling *Cyperus rotundus* was demonstrated, based on the integration of glyphosate herbicide into traditional farming systems and in systems based on camber bed land forms.
- “Recommendations for the management of *Cyperus*, on Vertisols and vertic clay soils.” A guide book for farmers and the extension service will be completed within 2000.
- “Dissemination of recommendations through publications, the extension service, student training and open days for farmers.” Posters and papers were presented at two international weed conferences. One paper has been submitted to an international journal and at least two more are planned. The extension service has been involved with on-farm trials and an open day. An open day for farmers was broadcast twice to an audience of three million TV viewers in Ghana. Post-graduate students have been employed on the project to gain work experience and to contribute to the research.
- “Necrotrophic pathogens of *C. rotundus* isolated and identified, together with preliminary assessments of their pathogenicity.” Eighteen pathogens were isolated and tested for their pathogenicity. More time was needed for this research but additional funding was not approved.
- “An assessment of the potential of Ghanaian farmers and extension workers to manipulate or incorporate a biocontrol agent within the local farming system.” This was not possible in the absence of an identified pathogen.

- “Long-term feasibility of exploiting indigenous and/or exotic fungi for the control of *C. rotundus*.” It was not possible to achieve this during the 18-month lifetime of this aspect of the project.

The project goal was, “To identify methods for the control of *Cyperus rotundus* which enable more effective utilisation of Vertisols and similar clay soils by smallholder farmers”. This was achieved by:

- Developing techniques, based on glyphosate herbicide, to give over 99% control of *Cyperus rotundus* within three years.
- Demonstrating the yield benefits of using camber beds in seasons of normal and above average rainfall.
- Using technologies that farmers are already using and/or for which they have affordable access.
- Demonstrating methods in on-farm trials that farmers have indicated they are willing to adopt.

4. Publications

DARKWA, E.O., JOHNSON, B.K., NYALEMEGBE, K., TERRY, P.J. and WILLCOCKS, T.J. (1999) Control of *Cyperus rotundus* on Vertisols and vertic clays in Ghana. pp. 373-378. In: *Proceedings of the 1999 Brighton Conference*. (Edited proceedings and poster)

TERRY, P.J., DARKWA, E.O., JOHNSON, B.K., YANGYUORO, M. and WILLCOCKS, T.J. (2000) Weed management on Vertisols for small-scale farmers in Ghana. pp192-193. In: *Abstracts, Third International Weed Science Congress*, Foz do Iguassu, Brazil. (Abstract and poster)

TERRY, P.J. (Ed.) (1999) International Crop Protection: Achievements and Ambitions. *Proceedings 1999 BCPC Symposium No. 73*, Brighton. 150 pp. (Edited proceedings)

WILLCOCKS, T.J., DARKWA E.O., JOHNSON, B.K., NYALEMEGBE, K., TERRY, P.J. and YANGYUORU, M. (1999) How can the production potential of Vertisols and vertic clays contribute to the demand for more food? Presentation at Tropical Agriculture Association Biennial Residential Seminar, *Can sustainable agriculture feed the population of tropical countries for the next 25 Years?* Edinburgh, 25 – 26 September 1999. *TAA Newsletter*, **20** (1): 29-30. (Peer reviewed paper)

Paper submitted to peer-reviewed journal:

DARKWA, E.O., JOHNSON, B.K., YANGYUORO, M., WILLCOCKS, T.J. and TERRY, P.J. Weed management on Vertisols for small-scale farmers in Ghana.

5. Internal Reports

(a) Back-to-Office reports following visits to Ghana (* bold = outputs in last financial quarter)

1996	October	P J Terry & T J Willcocks
1997	Feb/March	T J Willcocks
	“ May	P J Terry & T J Willcocks
	“ November	T J Willcocks
1998	March	P J Terry
	“ March	T J Willcocks
	“ October	P J Terry & T J Willcocks
1999	March	P J Terry
	“ March	T J Willcocks
	“ July	P J Terry & T J Willcocks
2000	February	P J Terry
	“ March	T J Willcocks
	“ August*	T J Willcocks
	“ Aug/Sept*	P J Terry

(b) Annual and quarterly reports

1996-1999 - Four annual reports
 1996-2000 - 12 quarterly reports

(c) Other internal reports

ELLENBROEK, W.E.T., KWADZO, G.T-M. and EGYIR, I.S. (1997) Smallholders' arable farming systems on Vertisols and vertic clay soils in Ghana, October 1997. Report of Natural Resources Institute, Chatham. 57 pp.

EVANS, H.C. (1998) Final report of the IIBC component of NRIL project ZA0055. Report of CABI Bioscience, Ascot. 7 pp.

6. Other Dissemination of Results

DARKWA, E.O., OTENG, J., JOHNSON, B.K., NYALEMEGBE, K., OTI-BOATENG, C., TERRY, P.J. and WILLCOCKS, T.J. (1999) Management of the perennial weed *Cyperus rotundus* on Vertisols and vertic clay soils. Agricultural Research Station, Kpong and Block Farms, Somanya, Ghana. 22 July. [Field day for 70 farmers, extension workers and academics from the University of Ghana]

DARKWA, E.O., OTENG, J., OTI-BOATENG, C., TERRY, P.J. and WILLCOCKS, T.J. (1999) Control of *Cyperus rotundus* on Vertisols. "Agrolink" Ghana Television. 2 August (18:30) 15 minutes. Ghana (national). Twi and English. (Television, audience of 3 million)

7. Follow-up Indicated/Planned:

Further publications are planned. These include a guide to the management of *Cyperus rotundus* on Vertisols for farmers and extension officers (in preparation) and at least two publications in peer-reviewed journals. A project proposal on the management of water and weeds on Vertisols is being considered for submission to the NRSP after encouraging comments from the programme manager, Dr M Quin. It is anticipated that a new project will be compatible with the Agricultural Services Improvement Program (AGSIP) in Ghana. Mrs Christiana Amoatey from the University of Ghana has secured a Commonwealth Academic Staff Scholarship to do a PhD on some aspect of *Cyperus rotundus* at the University of Reading from 2000.

1. Equipment purchased during the project and recommendations for its transfer/disposal

List all equipment (with purchase value of >£500) purchased during the quarter.

	Item	Make and Model	Serial No. (or vehicle reg.)	Date purchased	Purchase price (in £)	Location (where held)
1	Landrover ①	Estate	Chassis no. 299529	Feb-97 ②	5,115 ③	ARS Kpong
2	Moisture meter	Digital Grain-master, 560-020	MA 8035093	Feb-97	630	ARS, Kpong
3	Computer	Compaq Deskpro	243070-093	Mar-97	1,300	ARS Kpong
4	Printer	Hewlett Packard HP 5L	NUN352434	Mar-97	553	ARS Kpong
5	Statistics software	Genstat	T5WND3CNAN	Oct-97	750	ARS Kpong
6	Airconditioner	Westinghouse	Not known	Apr-98	542	ARS Kpong
7	Gearbox	Landrover	Not known ④	Oct-98	1,900	ARS Kpong
8	Steering box	Landrover	Not known ④	Oct-98	1,165	ARS Kpong

① Second hand vehicle (first registered in 1987) from previous DFID project in Egypt that had been stored at NRI
 ② Date of export from the UK
 ③ Vehicle was not purchased. Its value for insurance purposes was £5,115
 ④ Serial numbers not known. Items were procured and fitted to project Landrover by vehicle maintenance staff at the BHC, Accra

Transfer recommendation: For each equipment item you wish to recommend transfer, please specify:

- Who do you recommend it is transferred to (organisation, department and name of person responsible for the equipment)

All items should be transferred to University of Ghana Agricultural Research Station, Kpong. Dr E O Darkwa, Director of the Station, will be responsible for it.

- When do you recommend it is transferred
Immediately after the project ends on 31 August 2000
- Justification for recommendations to transfer
 1. Landrover – too old and unreliable for use on another DFID project but suitable for local running by ARS Kpong.
 2. Moisture meter – Probe broke during use. No value to any other project but could be used by ARS Kpong if they wish to repair it.
 3. Computer – the 486 processor is rather obsolete. ARS Kpong is poorly resourced for computers and would like to keep it.
 4. Printer – black and white model. Little second-hand value but useful to ARS Kpong.
 5. Genstat - licensed to project. No second-hand value but useful to ARS Kpong.
 6. Airconditioner – installed into project office. Little second-hand value but useful to ARS Kpong.
 7. Gearbox – leave with Landrover (item 1).
 8. Steering box - leave with Landrover (item 1).

Disposal recommendation: For each equipment item you wish to recommend disposal, please specify:

No items are recommended for disposal.

9. Name and signature of this report:

P J Terry