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FINAL REPORT - NEEM PROJECT IN NIGER CONTRACT DAN-4142-C-00-5122-00

**INTEGRATED PEST MANAGEMENT
AND
ENVIRONMENTAL PROTECTION
PROJECT**

**Contract No.
DAN-4142-C-00-5122-00
Project No. 936-4142**

**FINAL REPORT - NEEM PROJECT IN NIGER
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Accomplishments Relative to the Scope of Work (SOW)

The practicality of using extracts of seed kernel from the neem tree, *Azadirachta indica*, as a locally-prepared pesticide for subsistence farmers in the Sahel to control grasshoppers and locusts on millet and sorghum was investigated in Niger, West Africa. This research was performed as a subcontract to an existing USAID centrally-funded contract to the Consortium for International Crop Protection (CICP). The University of Minnesota in turn subcontracted with the Agency to Facilitate the Growth of Rural Organizations (AFGRO) to conduct portions of this study.

Entomological trials to evaluate the efficacy of neem kernel extract (NKE) against grasshoppers were initiated in August-September, 1987, at the Sahelian research station of the International Crops Research Institute for the Semi-arid Tropics (ICRISAT), Sadore, Niger. For descriptions of these trials and their results see Dunkel et al. 1988 (5), and Radcliffe et al. 1990 (17).

Socio-economic studies concerning the feasibility of rural populations in Niger preparing and using NKE were undertaken in the arrondissement of Tera, in 1987-88. For descriptions of these studies and their results see AFGRO 1988 (2), 1989a (3), Ouedrago 1988 (7), Patten and Radcliffe 1988 (9), Radcliffe et al. 1989 (16), 1991 (18).

Further entomological trials on millet and sorghum were conducted in August-September, 1988, at the ICRISAT station, Sadore, and, in November 1988, on recession agricultural fields in south central Niger (village of Mozague). For descriptions of these trials and their results see Radcliffe and Strzok 1988 (13), 1990 (14), Radcliffe et al. 1989a (15), 1988b (16) and 1991 (18).

At the time studies were completed, copies of the scientific logs of both entomological and socio-economic studies (Supplements S1-S5) were left with in-country counterparts (i.e., A. Sani, Direction de la Protection des Végétaux du Ministère de l'Agriculture, Gouvernement du Niger, Kimba Idrissa, Université de Niamey). Copies of the socio-economic reports (AFGRO 1988 (2), AFGRO 1989 (3)) were provided in both English and French to host country officials in the Ministry of Agriculture.

The original scope of work called for on-farm trials of NKE on intercropped vegetable/cereal production. This requirement was suspended by Mr. C. Collier, AID S&T, who determined that such trials should not proceed until such time as an EPA license was granted for NKE formulations as food crop protectants (see below for discussion of current status of EPA registration).

In our trials, neem kernel extract provided significant protection to sorghum and millet seedlings against 9 of 11 species of Sahelian grasshoppers and locusts tested. NKE was effective against *Acrotylus blondeli*, *Diaboloatanops axillaris*, *Kraussaria angulifera*, *Oedaleus senegalensis*, *Pseudosphingonotus canariensis*, *Pyrgomorpha cognata*, *Ornithacris turbida cavoisi*, *Chrotogonus senegalensis*, and *Schistocerca gregaria*; NKE was ineffective against *Cryptocatanops haemorrhoidalis* - primarily a forb feeder and *Oedaleus nigriensis* - heavily parasitized. Locally-prepared NKE, from seed collected at 5 Nigerian locations (Niamey, Diagourou, Gotheye, Tsernawa and Mozague) proved as efficacious as alcoholic extracts (Beltsville neem provided by M. Jacobson, H. G. Larew, and J. D. Wharten, USDA, and Margosan-O provided by R. O. Larson, Vikwood, Ltd.).

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With respect to the socio-economic studies, we found that the settings in each village surveyed (Dargol, Bellekoira, Méhanna and Diagourou) were complex and markedly different, despite similar use patterns and crop selection and concluded that detailed knowledge of local conditions is essential to properly enter into arrangements to conduct farm trials which integrate exogenous technologies with local agricultural production schemes.

We concluded that applications of NKE as foliar sprays or as drenches were effective in protecting millet and sorghum seedlings from injury by most species of grasshoppers and locusts. As a readily available and easily prepared crop protectant NKE could be of great benefit to Sahelian farmers. However, the extensive scale on which these agronomic crops are planted appears to make this use of the technology impractical for the following reasons:

- a) the labor supply required to prepare, transport, and apply NKE would be inadequate,
- b) the availability of neem seed is too limited,
- c) water is often limited or must be transported considerable distances,
- d. in the villages surveyed, there existed a lack of equipment and tools for efficient transport and application of NKE on sorghum/millet fields.

Accordingly, while we conclude that the use this technology for the protection of millet and sorghum crops is probably not feasible, we believe that NKE could have great potential for the protection of smaller plots of fruits and vegetables and the intensively cultivated counter-season crops and for protection of stored products (AFGRO 1989b, 4).

Ancillary Research and Scientific Networking

USAID encouraged project personnel to network with other agencies doing similar research. Of particular benefit was our liaison and cooperative work with the University of Giessen/GTZ, which had mutual benefits in expanding both the magnitude and detail of the use of NKE as a crop protectant in the Sahel (Supplement S6). Liaison with the Ottawa University Group in Canada was also of benefit (Supplement S7).

First presentations of results of the entomological aspects of this research were at the Locust/Grasshopper Campaign Evaluation Workshop, in Harpers Ferry, W. Va., in January 1988 (Radcliffe and Strzok 1988, 13) and at the annual meeting of N. Central Branch Entomological Society of America (NCB-ESA) in Denver, Colo., in March 1988 (Dunkel et al. 1988, 5). We made an invited presentation on both entomological and socio-economic aspects of this project at a Conference on indigenous Knowledge Systems, in Washington, D.C., in December 1988 (Patten and Radcliffe 1988, 6). Our first report on the second series of entomological studies was presented at the annual meeting of NCB-ESA in Indianapolis, Ind., in March 1989 (Radcliffe, et al. 1989, 5). In April 1989, AFGRO, under USAID contract, designed a NKE Project for Crop Protection in Mali (AFGRO 1989, 4). This report should be consulted for recommended applications of NKE technology to Sahelian agriculture. In December 1989, we were invited participants in a neem seminar at International Chemical Congress of Pacific Basin Societies in Honolulu, Hawaii. Strzok presented an overview of both the entomological and socioeconomic aspects of this project (Radcliffe et al. 1989 (16). In January 1990, Radcliffe attended the 2nd CILSS IPM Conference of Sahelian crop protection specialists in Bamako, Mali. Here, we reported on the entomological aspects of this project and presented recommendations for future applications of

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NKE technology in Sahelian agriculture (Radcliffe and Strzok 1990, 14). In April, 1990, Radcliffe presented his Minnesota neem research at a USDA-sponsored workshop on the potential of neem in pest management programs (Radcliffe and Lagnaoui 1990, 11).

The entire project history and findings have been written as a chapter for publication in a book on indigenous knowledge systems edited by D. M. Warren and D. Brokensha and scheduled for publication in early 1991 (Radcliffe et al, 1991, 18).

Problems Encountered and Solutions Undertaken

The concept of this project (Schroeder 1987a, 19 and 1987b, 20) was first proposed by P. P. Strzok, President of AFGRO (Agency to Facilitate the Growth of Rural Organizations (AFGRO)). The final proposal was developed collaboratively by AFGRO, and scientists from the University of Minnesota, USAID (especially C. W. Castleton, and C. W. Collier) and the USDA (M. Jacobson and H. G. Larew). The project was undertaken as a cooperative venture between the University of Minnesota and AFGRO. This proved a very successful arrangement in that it maximized the capabilities of both agencies. We believe this cooperative arrangement is an excellent model for others engaged in applied research intended to bring together scientists and practitioners of rural development in less developed country settings. Such discrete efforts have almost immediate benefits at the local level where on-farm trials are conducted. We found that roles and functions of staff were not a problem; the division of tasks to the overall schemes became clear during the discussion and planning of each increment of the project to be executed. The interdisciplinary nature of this project fostered interdisciplinary interactions invaluable to our understanding and appreciation of both the opportunities and constraints in technology transfer.

Finding grasshoppers when the research teams needed to conduct efficacy tests added to the cost of this project. To accomplish our research it was sometimes necessary to dispatch collecting teams to areas where outbreaks of locusts and grasshoppers were occurring. These efforts were above budget, but we were fortunate in that the necessary insects could be collected in Niger. Please see Supplement S8 for a detailed discussion about accurate cost estimating and overruns with a project of this fluidity.

A problem with the designated point of contact with the local USAID was encountered; see Supplement S9 regarding its resolution.

Research Issues In Progress

The problem of obtaining an EPA license for NKE as a crop protectant is an active issue (see Supplement S10). At least four commercial firms in N. America, W. R. Grace, Natural Plants, Rohm and Haas, and Safer Canada, are conducting protocols with a view toward obtaining EPA registration for use of neem derivatives on food products. The USAID and USDA are cooperating in this effort as are various university researchers throughout the US. Obtaining food crop registration would permit USAID to sponsor on-farm research trials in the Sahel and other parts of tropical Africa. We have found strong interest in neem research in many West African countries, some of whom are already involved in NKE as a crop plant protectant.

We have been encouraged by the strong interest and support in this project from many sources: USAID, USDA, USEPA, the Sahelian countries, University of Giessen, GTZ, the University of Ottawa, M. Jacobson, the leading US expert on neem, as well as many other eminent scientists and practitioners of neem, e.g., Messrs. H. Schmutterer (U. Giessen), C. Hellpap (GTZ), H. Renschold (Max-Planck Institut), R. C. Saxena (IRRI), H. G. Larew (USAID), B. J. R. Philogene, Ottawa U., S. Ahmed (East-West Center), R. O. Larson, (Vikwood, Ltd.), etc.

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Radcliffe and phytopathologist M. Canteh, Department of Agricultural Services, The Gambia, recently (January 1990) submitted a proposal to the Program in Science and Technology Cooperation (PSTC) for application of neem technology to crop protection in that country.

Experience with NKE in Africa led Radcliffe to research the use of neem against Colorado potato beetle (Obst 1989 (6), 1990 (7) Radcliffe and Lagnaoui, 1990a (10), 1990b (11) and 1990c (12). This research has proven very promising and is now funded by the Greater Minnesota Corporation/Agricultural Utilization Research Institute (GMC/AURI), the Red River Valley Potato Growers Association (RRVPGA) (Ackerson 1990, 1) and Rohm and Haas.

Radcliffe has received support for continued research with neem-based insecticides from GMC/AURI, RRVPGA, Rohm and Haas, and W. R. Grace. Results against Colorado potato beetle have been spectacular and the suppliers of these products express optimism that food crop registration can be quickly obtained and their products commercialized. AFGRO has received support from Natural Plants, Inc., and Vikwood, Ltd. (Larson). There appears to be a rapidly emerging market for neem seeds and/or their extract, which could become an important cash crop to Sahelian countries.

Miscellaneous Matters

AFGRO managed the local administration of the project in Niger and was required to register with the Government of Niger and receive authority to work in that country. Considerable liaison and correspondence with other agencies in Niger was a continuing requirement to assure smooth progress on the various elements of the project. Copies of representative correspondence regarding such activities as well as the "Arrete" by the Government of Niger, allowing AFGRO to work in Niger, are presented in Supplement S11).

Publications, presentations relating to Univ. Minn./AFGRO Neem Project

1. **Ackerson, C. 1990.** RRVPGA receives research grant to study Colorado potato beetle. *Valley Potato Grower* 55(110): 12-14.
2. **AFGRO (Agency to Facilitate Growth of Rural Organizations). 1988.** Neem: Son utilisation par le paysan du Sahel comme un pesticide naturel pour la protection du mil et du sorgho contre l'invasion de sauterelles, rapport preliminaire. Mimeographed report, 97 pp. and 47 pp. appendices.
3. **AFGRO (Agency to Facilitate Growth of Rural Organizations). 1989a.** Neem: Its use by the Sahel farmer as a natural pesticide to protect millet and sorghum against grasshopper infestation. Mimeographed report, 95 pp. and 22 pp. appendices.
4. **AFGRO (Agency to Facilitate Growth of Rural Organizations). 1989b.** *Design of a Neem Kernel Extract Project for Crop Protection in Mali.* USAID Contract AFR-0000-0-00-9028-00, 39 pp, mimeographed.
5. **Dunkel, F. V., E. B. Radcliffe, and P. P. Strzok. 1988.** Antifeedant effect of neem kernel extract against a Sahelian grasshopper, *Kraussaria angulifera*. N. Centr. Branch Entomol. Soc. Amer., Denver, Colo., Mar. 20-23, 1988 (abstract).
6. **Obst, J. 1989.** Neem may be potato beetle's nemesis. *Minnesota Science* 44(1): 4-5. (reprinted in *Valley Potato Grower* 55(101): 66-67.

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7. **Obst, J. 1990.** Neem: Promise but frustration. *Minnesota Science* 45(2): 2.
8. **Ouedraogo, M. C. 1988.** Monographie du Village de Mozague, village situé à l'environ 30 km de Konni. Mimeographed report, 18 pp.
9. **Patten S. and E. B. Radcliffe. 1988.** Indigenous pest management: The case of neem. Conf. Indigenous Knowledge Systems: Implications for Agriculture and International Development, Washington, D.C., 15-16 Dec., 1988 (invited presentation).
10. **Radcliffe, E. B. and A. Lagnaoul. 1990a.** Colorado potato beetle control with neem. N. Centr. Branch Entomol. Soc. Amer., G. Rapids, Mich., 18-21 Mar. 1990 (submitted paper, abstract).
11. **Radcliffe, E. B. and A. Lagnaoul. 1990c.** Potential of neem for control of pyrethroid-resistant Colorado potato beetle. USDA Neem Workshop, *Neem's Potential in Pest Management Programs*, Beltsville, Md., 16-17 April, 1990 (book chapter, in press).
12. **Radcliffe, E. B. and A. Lagnaoul. 1990b.** Potential of neem for control of pyrethroid-resistant Colorado potato beetle. *Symposium on Ecology and Agriculture*, St. Paul, Minn., 28 Apr. 1990 (submitted paper, abstract)
13. **Radcliffe, E. B. and P. P. Strzok. 1988.** Sprays of neem kernel extract protect millet from grasshoppers in Niger. Presented at Locust/Grasshopper Campaign Evaluation Workshop, 18-21 Jan., 1988, Harpers Ferry, W. Virginia (invited presentation and poster).
14. **Radcliffe, E. B. and P. P. Strzok. 1990.** Possible use of crude extracts of neem as a locally-produced insecticide in the Sahel. *Deuxieme Seminaire sur la Lutte Integree Contre les Ennemis des Cultures Vivieres dans le Sahel*, Bamako, Mali, 4-9 Jan., 1990, CILSS Institut du Sahel (invited presentation, paper in press).
15. **Radcliffe, E. B., D. W. Ragsdale, A. Sanl, H. T. Khoury, and P. P. Strzok. 1989a.** Use of neem to control grasshoppers on millet and sorghum in Niger, Africa. N. Centr. Branch Entomol. Soc. Amer., Indianapolis, Ind., 12-15, 1989 (submitted paper, abstract).
16. **Radcliffe, E. B., P. P. Strzok, D. W. Ragsdale, A. Sanl, H. T. Khoury, and D. M. Noetzel. 1989b.** Use of neem to control grasshoppers/locusts on millet and sorghum in Niger, Africa. Pacificchem '89 (International Chemical Congress of Pacific Basin Societies), Honolulu, Hawaii, 17-21 Dec., 1989 (invited symposium presentation, abstract in press).
17. **Radcliffe, E. B., F. V. Dunkel, P. P. Strzok, and A. Sanl. 1990.** Antifeedant effect of neem, *Azadirachta indica* A. Juss., kernel extracts on *Kraussaria angulifera* (Krauss) (Orthoptera: Acrididae), a Sahelian grasshopper. *Tropical Agric.* (refereed paper, in press).
18. **Radcliffe, E. B., G. Ouedraogo, S. E. Patten, D. W. Ragsdale, and P. P. Strzok. 1991.** Neem in Niger: A new context for a system of indigenous knowledge. In *Indigenous Knowledge Systems: The Cultural Dimension of Development*, D. M. Warren, D. Brokensha, and L. J. Slikkerveer, eds., Kegan Paul International, London, England (book chapter, accepted).
19. **Schroeder, D. 1987a.** Survival in the Sahel: The lesson of the neem seed. *Humphrey Institute News* 10(2): 3-4, 6 and front cover.

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20. **Schroeder, D. 1987b. Battling locusts with a native tree. *Humphrey Institute News* 10(2): 5.**