9. **Yokoyama, V.Y. and J. Pritchard. 1984. Effect of pesticides on mortality, fecundity, and egg viability of Geocoris pallens (Hemiptera: Lygaeidae). Journal of Economic Entomology 77: 876-879.**

Sublethal doses of the insecticides carbaryl, methidathion and methomyl, the acarides dicofol and propargite, the herbicide glyphosate, the defoliant DEF (s,s,s-tributyl phosphorotrithioate) and the fungicide sulfur were tested as cotton leaf residues on Geocortis pallens, a major predator in Californian cotton. No pesticide except propargite significantly increased adult mortality 25-192 hours after a 24-hour acute exposure; neither did they have any detrimental effect on female mortality, fecundity or egg viability. This suggests that deleterious long-term effects in predator populations would not occur if insects survived initial treatments. Males were more susceptible to methidathion and methomyl and females were more susceptible to propargite. Females exposed to DEF laid more eggs. Potential beneficial effects of chemicals on predator populations should be considered in the selection of pesticides for pest management programs.

10. **Zaitseva, V.K. 1981. Specific behavioral reactions of forest red ants to glyphosate treatment. Ekol. Zashch. Lesa 6: 71-75. (Soviet Union)**

Broad-leaf tree control exposes the beneficial forest red ant (Formica rufa) to the arboricide glyphosate. Spraying anthills at 2-6 kg I/ha did not affect ant behavior or the expansion of anthills.

TITLES

11. Hoy, J.B., D.L. Dahlsten and P.J. Shea. 1982. The effects of 2,4-D and an alternative material (glyphosate) used for brushfield rehabilitation on soil arthropod community and litter decomposition rate, Final Report USA-UCB, Research Agreement No. PSW-81-0026, 34 p.

12. Leslie, G.W. 1977. The toxicity of some agrochemicals to Pheidol sp. (Hymenoptera: Formicidae) a common ant in natal cane fields. Proceedings of the Annual Congress of South African Sugar Technology Association 51: 21-23.

13. Martin, N.A. 1982. The effects of herbicides used on asparagus on the growth rate of the earthworm Allolobophora caliginosa, Proceedings of the 35th New Zealand Weed and Pest Control Conference, pp. 328-331.

14. Robinson, A.F., C.C. Orr and J.R. Abernathy. 1977. Influence of Nothanguina phyllobia on silverleaf nightshade. Proceedings of the 30th Annual Meeting of the Southern Weed Science Society, p. 142.

VI. MICROFLORA

1. **Bogdanovic, V.V. 1975. Study of the herbicide effects upon some soil microorganisms. Mikrobiologija 12: 121-125. (Yugoslavia)**

Spraying the soil of an apple orchard with 10 kg simazine/ha did not affect the soil microorganisms. Caragard increased the total numbers of microorganisms, and especially those of fungi and actinomycetes. Roundup increased the total microorganisms and aerobic ammonifiers, but inhibited fungi and actinomycetes.

2. **Carlisle, S.M. and J.T. Trevors. 1986. Effect of the herbicide glyphosate on nitrification denitrification and acetylene reduction in soil. Water, Air, and Soil Pollution 29: 189-204.**

The effect of glyphosate on soil respiration and H_2 oxidation in an agricultural soil was investigated. The effects of the pure herbicide and commercial formulation, Roundup[R] (Monsanto Company), were compared in soil under both aerobic and anaerobic conditions. Both formulations stimulated O_2 uptake as well as aerobic and anaerobic CO_2 evolution. Roundup caused more stimulation than glyphosate under aerobic incubation conditions; the formulations had an equal effect on anaerobic CO_2 evolution. Hydrogen oxidation was inhibited by both formulations in aerobic and anaerobic soil. Aerobic oxidation was inhibited to the same extent by both formulations; Roundup had a stronger inhibitory effect on anaerobic H_2 oxidation than did glyphosate. No toxicity to any of these activities should be seen at recommended field application rates of the herbicide.

3. **Chan, K. and S.C. Leung. 1986. Effects of paraquat and glyphosate on growth, respiration, and enzyme activity of aquatic bacteria. Bulletin of Environmental Contamination and Toxicology 36: 52-59. (Hong Kong)**

(*) The present paper reports the results of a study on the effects of paraquat and glyphosate on growth, respiration and enzyme activity of aquatic bacteria. Experimental pools A, B and C were located at the Lam Tseun River in Hong Kong. All these pools were gravel pits with surface areas of 25, 23 and 21 m^2, and mean depths of 0.8, 0.6 and 0.54 m, respectively. Paraquat (Gramoxone[R], 1,1'-dimethyl-4,4'-bipyridinium dichloride) was applied to pool B so a concentration of 20 ppm was obtained. Glyphosate (Roundup[R], isopropylamine salt of N-phosphonomethyl glycine containing 356 g/l glyphosate) was applied to pool C so that a concentration of 200 ppm was achieved. Pool A was used as the control. Viable cell counts of the pool water were determined at 2-day intervals by using the spread plate method with Nutrient Agar for a total of 30 days after application of the herbicides. All agar plates were incubated at 25°C for 48 hours before the number of bacterial colony forming unit (CFU) was counted. Two bacteria of most frequent occurrence were identified as Aeromonas hydrophila C-1 which was a facultative anaerobic strain, and Pseudomonas chlororaphis L-1 which was a strictly aerobic strain. These two bacteria were used in subsequent experiments. The present results indicate that aquatic bacteria in general are more susceptible to paraquat than the soil microflora and human bacteria in terms of paraquat concentration applied to the aquatic environment. Since in situ study confirms the inhibitory effects of these two herbicides on aquatic bacterial populations and it is conceivable that communities of higher trophic level in the aquatic environment might also be affected. Consequently, consideration must be given to the possibility of contamination of non-target environment such as streams, ponds and lakes when applying paraquat and glyphosate in the field.

4. **Fletcher, K. and B. Freedman. 1985. Effects of the herbicides glyphosate, 2,4,5-trichlorophenoxyacetic acid, and 2,4-dichlorophenoxyacetic acid on forest litter decomposition. Canadian Journal of Forest Research 16: 6-9.**

Laboratory studies with two leaf litter and one forest floor substrate showed that the herbicides 2,4-dichlorophenoxyacetic acid (2,4-D),2,4,5-trichlorophenoxyacetic acid(2,4,5-T), a 50:50 mixture of these, and glyphosate all had toxic thresholds at which they reduced decomposition. However, in all cases, the thresholds were >50 times higher than residue concentrations that occur in the field after silvicultural herbicide treatments. In a field study at one site, no measurable 1-year postspray effects on litter decomposition were found among treatment plots sprayed at 0.0, 3.4 or 6.7 kg 2,4,5-T/ha.

5. **Ghassemi, M., S. Quinlivan, and M. Dellarco. 1982. Environmental effects of new herbicides for vegetation control in forestry. Environment International 7: 389-402.**

Environmental fate of and toxicity data for ammonium ethyl carbamoylphosphonate [fosamine ammonium], N-(phosphonomethyl)-glycine [glyphosate], and 3-cyclohexyl-6-(dimethylamino)-1-methyl-1,3,5-triazine-2,4(1H,3H)-dione[hexazinone] which appear promising for vegetation control in forestry are reviewed. None of the three herbicides is very persistent in soil, with half-lives reported of about 7-10 days for fosamine ammonium, 8-19 weeks for glyphosate, and 1-6 months for hexazinone, depending on soil type and climatic conditions. Degradation in soil is primarily via microbial routes. Whereas hexazinone is a very mobile herbicide (with mobility dependent on soil type), fosamine ammonium and glyphosate are strongly adsorbed and not readily leached in many soil types. Based on bioassay results, the three herbicides exhibit "very low" to "low" toxicity. Fosamine ammonium is not mutagenic and was not teratogenic when fed to pregnant rats at 10,000 ppm. Data on hexazinone indicate no carcinogenic effect in rats, negative in bacterial and mammalian point mutation assays, and not embryotoxic or teratogenic at up to 5000 ppm in diet of rats. The three herbicides have minimum-to- nil effect on soil microorganisms and exhibit little or no potential for bioaccumulation. Limitations of the available data are discussed and suggestions are made for future studies.

6. **Gomez, M.A. and M.A. Sagardoy. 1985. Influence of glyphosate herbicide on the microflora and mesofauna of a sandy soil in a semiarid region. Revista Latinoamericana de Microbiologia 27: 351-358. (Argentina)**

Refer to Terrestrial Invertebrates Section (page 27).

7. **Gomez, M.A. and M.A. Sagardoy. 1985. The effect of glyphosate on aerobic bacteria that colonize a sandy soil. Anales de Edafologia y Agrobiologia 44: 119-130. (Argentina)**

From a sandy soil of the semiarid zone of the province of Buenos Aires, Argentina, 519 bacterial strains were isolated and their genera were identified. Furthermore, the effect of the herbicide on the principal microbial groups was also studied. The results indicate that within the gram positive bacteria, coryneform bacteria and *Bacillus* spp. were predominant microorganisms. In the gram negative bacteria the *Acinetobacter* was found to be the dominant genus. The herbicide, at different doses, had little effect on the bacteria that colonize the soil. There was no deleterious effect detected on the potential of these bacterial strains as participants in the nitrogen cycle. The application of the herbicide to sterilized soil at the dose of 40 L/ha did not produce any deleterious effect on eurythermic bacteria of the types coryneform, *Bacillus* spp. or *Acetobacter* 307. However, after 10 days of incubation, the number of *Acinetobacter* 218 was found to decrease. The imperceptible effect produced by glyphosate on the bacteria which normally colonize such soil suggests that the use of the herbicide would not produce any significant alteration in that biological component of the ecosystem soil.

8. **Grossbard, E. 1985. Effects of glyphosate on the microflora: with reference to the decomposition of treated vegetation and interaction with some plant pathogens. In: The Herbicide Glyphosate. Edited by E. Grossbard and D. Atkinson. Butterworths, London. (United Kingdom)**

(*) Although more research is required to clarify the interactions of glyphosate with the microflora a few common threads lead through the labyrinth of observations. In pure culture, many microbial species are inhibited by glyphosate. This effect is selective, variable in magnitude and frequently dose related. In terms of agricultural practice, inhibitory effects, especially of the celluloytic fungi, occur at concentrations well above those normally used in agriculture. Moreover, the amount of herbicide which reaches the soil is smaller than that applied, because a certain proportion of glyphosate, which is foliar applied, is retained by the vegetation. Also glyphosate is adsorbed and degraded in soil; one reason why the microorganisms examined tolerate generally the glyphosate in soil much better than in pure culture in laboratory media. Furthermore, the numbers of propagules of all microbial groups in soil increased following glyphosate treatment. Despite the shortcomings of techniques for enumerating microbial propagules in soil, this observation implies utilization by soil microflora of either glyphosate itself or its degradation products. A reassuring aspect of the behaviour of glyphosate is that it does not curtail nitrification in the soil, an activity affected adversely by some other herbicides. Mineralization of nitrogen, even at high concentrations of glyphosate, is enhanced, as is another important function-cellulose decomposition. On present evidence, however, it may be concluded that soil fertility per se is unlikely to be impaired by the agricultural use of glyphosate.

9. **Grossbard, E. and S.L. Cooper. 1974. The decay of cereal straw after spraying with paraquat and glyphosate. Proceedings of the British Weed Control Conference 12: 337-343. (United Kingdom)**

The effect of paraquat (1.7 kg/ha) and glyphosate (3.4 kg/ha) on the decay of C^{14}-labeled rye leaves incubating on the soil surface and of unlabeled barley straw, covered by a shallow layer of soil, was studied in the lab. Paraquat and glyphosate had no effect on the decay of rye leaves on the surface and glyphosate did not affect degradation of barley straw. However, paraquat significantly suppressed the decay of buried barley straw as measured by weight loss, which was, after 16 weeks, between 40 and 55% of the initial weight for control and only between 18 and 26% with paraquat. The addition of NH_4NO_3 increased the extent of decay of barley straw treated with paraquat by about 17% but at the end of the experiment the weight loss was still smaller than for control straw.

10. **Grossbard, E. and H.A. Davies. 1976. Specific microbial responses to herbicides. Weed Research 16: 163-169. (United Kingdom)**

Herbicides can exert adverse effects on the soil microflora, depending on concentration, though often at higher rates than the herbicidal dose. Examples refer to changes in microbial growth (asulam, linuron, paraquat) and equilibrium (metoxuron), respiration and nitrification in samples from field experiments (linuron, simazine) and laboratory experiments (bentazone, glyphosate, barban, etc), enzyme activities (urease, phosphatase, barban, chlorpropham, linuron) and the decay of sprayed vegetation (glyphosate, paraquat).

11. **Grossbard, E. and D. Harris. 1981. Effects on straw decay of the herbicides paraquat and glyphosate in combination with nitrogen amendments. Annals of Applied Biology 98: 277-288. (United Kingdom)**

The effects of paraquat were studied at 4-7 kg a.i./ha and of glyphosate at 9.4 kg a.i./ha on the weight loss and rate of O_2 uptake by stems of barley straw, incubated on the soil surface for various periods of time, and stems and leaves of wheat straw on the soil surface or covered with a shallow layer of soil. In general, paraquat reduced weight loss and frequently O_2 uptake. Glyphosate normally had no effect but occasionally it was stimulatory. However, in isolated instances, paraquat was inactive and glyphosate slightly inhibitory. Leaves decayed faster than stems. Burial as well as the addition to straw of leaf protein, nitrochalk, urea and clover plants increased decomposition in all treatments, but nitrogen amendments were less effective in those with paraquat. For example, urea enhanced weight loss after 21 weeks from 19 to 34% of the initial weight in unsprayed wheat straw, from 12 to 24% in paraquat-treated and from 20 to 37% in glyphosate-treated straw, indicating that conditions stimulating decomposition may attenuate but not entirely eliminate the inhibitory effects of paraquat. A repeated addition of nitrogen to straw in various stages of decay increased O_2 uptake in all treatments but least in the paraquat-treated straw, implying that a complete recovery from the initial curtailment of microbial activity, brought about by this herbicide, did not occur. Although the concentration of paraquat used was 9 times greater than the minimum recommended for field application, the degree of inhibition observed in these laboratory experiments was probably not sufficiently great to be of marked economic importance.

12. **Grossbard, E. and G. Wingfield. 1978. Effects of paraquat, aminotriazole and glyphosate on cellulose decomposition. Weed Research 18: 347-353. (United Kingdom)**

Effects of paraquat, activated aminotriazol and glyphosate on cellulose decomposition were studied in laboratory experiments. Herbicides were either incorporated in soil or sprayed onto cellulosic substrates which were incubated either on the surface of soil or buried. Paraquat applied directly to the substrates inhibited their decay, but not when applied to the soil. Aminotriazole incorporated in soil at 500 ppm strongly suppressed decomposition of buried calico, but effects varied with surface incubation. The only effects observed at 150 ppm were occasional stimulation of the decay of surface-incubated calico. Glyphosate applied either to soil or substrate usually stimulated cellulose decay. Numbers of ropagules of cellulolytic fungi were decreased by aminotriazole and glyphosate applied to the soil and by glyphosate and paraquat applied to cellulose, but increased in soil treated with paraquat. In pure culture paraquat was the most, and aminotriazole the least, toxic to the 5 test fungi. Numbers of cellulolytic bacteria were decreased in soil treated with paraquat but the other 2 herbicides either did not affect or stimulated this group.

13. **Harris, D. and E. Grossbard. 1979. Effects of the herbicides Gramoxone W and Roundup on _Septoria nodorum_. Transactions of the British Mycological Society 73: 27-33. (United Kingdom)**

The action of Gramoxone W (a.i. paraquat) and Roundup (a.i. glyphosate) on vegetative growth, spore formation, germination and pathogenicity of spores of _Septoria nodorum_ Berk. to detached wheat leaf segments, was examined. Both herbicides had inhibitory effects, but Roundup was the more active. At 80 ppm it reduced the growth rates of four isolates by 50-55%, whilst Gramoxone W at 80 ppm produced a 25-40% reduction. Roundup at 80 ppm reduced spore formation by 90% but Gramoxone W was ineffective. Pre-treatment with Roundup reduced spore germination by 60% even when the herbicide was absent from the germination medium. However, with Gramoxone W this inhibition occurred only when the herbicide was incorporated in the germination medium. A potential carry-over of the active ingredient of Gramoxone W was indicated by the presence of C^{14} in washed spore suspensions prepared from cultures grown on media containing C^{14}-labelled paraquat, and by the greater severity of lesions on detached leaves infected by spores from cultures grown with Gramoxone W, when compared to lesions produced by untreated spores. Roundup pre-treated spores produced lesions less severe than control, except at high inoculum density, where in some experiments lesion severity was enhanced late in the incubation period.

14. **Heinonen-Tanski, H., L. Montonen, L.R. Ervio, S. Junnila and B. Pessala. 1985. The effects of chlorsulfuron, glyphosate, metribuzin and TCA on soil nitrification capacity and dehydrogenase activity. In: Comportement et Effects Secondaires des Pesticides dans le Sol, Versailles, France. June 4-8, 1984. Pp. 183-189. (Finland)**

In field trials at Jokioinen and Ruukki, Finland, potatoes were treated with glyphosate, metribuzin or TCA and barley with chlorsulfuron all applied at the normal rate or 3 times this rate. The effects of the herbicides on soil dehydrogenase and nitrification activity were studied. Chlorsulfuron and glyphosate had little effect on soil dehydrogenase and nitrification, but metribuzin and TCA reduced both activities especially in clay soils. The effects of TCA were still evident 1 year after application.

15. **Heinonen-Tanski, H., C. Rosenberg, H. Siltanen, S. Kilpi and P. Simojoki. 1985. The effect of the annual use of pesticides on soil microorganisms, pesticide residues in the soil and barley yields. Pesticide Science 16: 341-348. (Finland)**

A study has been made of the influence of pesticides used annually on soil microorganisms and crop yields (Finland). The persistence of these pesticides in the soil was also investigated. The herbicides MCPA, glyphosate, maleic hydrazide and tri-allate, and the insecticide parathion, were applied on experimental plots on which barley was grown during the years 1973-1981. The fungicide 2-methoxyethylmercury chloride was used every year for dressing the seeds grown in pesticide-treated plots. The pesticide treatments did not affect significantly the numbers of several groups of soil microorganisms. A slight increase was, however, observed in the nitrification activity in the soil. The barley yields were on average higher on pesticide-treated plots than on controls because of successful weed control. Pesticide residues in the soil were generally very low; for example, for parathion they were below 0.02 mg/kg within 11 days, and for MCPA 0.06 mg/kg within 7 days. However, the glyphosate residue was 1.6 mg/kg in the autumn 2 days after the treatment, and the residue settled to a level of 0.2 mg/kg during the following summer. No clear dependence was observed between the residue level and the time between treatment and sampling.

16. Heinonen-Tanski, H., H. Siltanen, S. Kilpi, P. Simojoki, C. Rosenberg and S. Makenen. 1986. The effect of the annual use of some pesticides on soil microorganisms, pesticide residues in soil and carrot (Daucus carota) yields. Pesticide Science 17: 135-142. (Finland)

The study deals with the effect of common, annually-used pesticides on soil microorganisms, pesticide residues in soil, and carrot (Daucus carota) yields in central Finland. Linuron residues in carrot roots were also analyzed. Thiram + lindane and dimethoate were applied from 1973-1981 at the commercially recommended doses on experimental plots of carrots, linuron was applied at twice the recommended rate from 1973-1979 and at the normal rate thereafter and in addition TCA was applied in 1978. Maleic hydrazide was used in the years 1973-1976, and glyphosate after 1977. The numbers of different soil microorganisms, their activities and the pesticide residues were studied from autumn 1978 to 1981. The pesticide treatments reduced the growth of soil algae but increased the total number of microorganisms and the number of aerobic spore-forming bacteria. Linuron residues in the soil were 0.9-2.8 mg/kg in the growing season and 1.2-1.7 mg/kg in the autumn, 3 months after application. The residues of glyphosate in the soil were 0.7 mg/kg in the autumn, 41 days after the treatment, and had declined to a level of about 0.2 mg/kg by the following summer. In the pesticide-treated plots the carrot yield was only 20-60% of the yield in the hand-weeded plots. The herbicide program controlled most of the annual weeds but not couchgrass Elymus repens and milk sow-thistle Sonchus arvensis.

17. **Hendrix, P.F. and R.W. Parmelee. 1985. Decomposition nutrient loss and microarthropod densities in herbicide-treated grass litter in a Georgia piedmont USA agroecosystem. Soil Biology and Biochemistry 17: 421-428.**

A litterbag experiment was made to investigate the influence of the herbicides atrazine, paraquat and glyphosate on several aspects of the decomposition of grass litter in a fallow field. Litterbags containing dried Johnson grass (Sorghum halepense) leaves were dipped in herbicide solutions at recommended and 10 times recommended field application rates, placed in the field, and randomly collected every 3 weeks from July-November, 1982. At the highest treatment levels of paraquat and glyphosate, the leaves showed slower weight loss, faster losses of P, Ca and Mg, and higher densities of microfloral-grazing microarthropods than untreated controls. Using a conceptual model of the decomposition subsystem, it is hypothesized that herbicide treatment altered the system by promoting microbial utilization of the herbicide or additive as a carbon source; increasing the importance of microarthropod grazing relative to comminution; eliminating or reducing the importance of the predatory microarthropods; and increasing the rate of nutrient loss from the litter via microbial and microarthropod activity. The system thus became simplified with fewer recycling loops, accelerated soluble nutrient loss, and slower decay of carbon from the leaf tissue.

18. **Levesque, C.A., J.E. Rahe and D.M. Eaves. 1987. Effects of glyphosate on Fusarium spp.: its influence on root colonization of weeds, propagule density in the soil, and crop emergence. Canadian Journal of Microbiology 33: 354-360.**

Glyphosate is a broad spectrum herbicide that can lead to root rot like damage on crops. This study was undertaken to investigate the effect of glyphosate on the root-colonizing Fusarium spp. The research was conducted at two sites. Site one was densely covered with perennial weeds, and site two with annuals. At site one, spraying the weed cover with glyphosate increased ($p < 0.05$) the level of colonization by Fusarium spp. in Ranunculus repens and Holcus lanatus, but not in Stellaria media and Plantago lanceolata. At site two, glyphosaste enhanced colonization in Spergula arvensis, Stellaria media, Echinochloa crusgalli, and Chenopodium album, but not in Capsella bursa-pastoris and Polygonum persicaria. At both sites, the number of colony-forming units of Fusarium spp. per gram of dried soil was increased by the application of glyphosate. Nevertheless, crops subsequently sown in the field containing the annual weeds were not detrimentally affected by glyphosate treatment of these weeds.

19. **Mallik, M.A.B. and K. Tesfai. 1985. Pesticidal effect on soybean and Rhizobia symbiosis. Plant and Soil 85: 33-42.**

Relative compatibility of selected pesticides at 2 levels of application: recommended rate and 5 times or 10 times with soybean-rhizobia symbiosis was tested in pot culture experiments using a prepared peat inoculant. PCNB (pentachloronitro benzene), carboxin and carboxin + captan at recommended level were innocuous to growth, nodulation, N_2-fixation and total nitrogen content of shoot. Carboxin and carboxin + captan but not PCNB at 10 times recommended level proved detrimental to nodulation and N_2-fixation. Carbaryl and malthion at recommended level had no adverse effect but at 10 times recommended level severely reduced N_2-fixation but not other parameters. Acephate, diazinon and toxaphene at both levels reduced N_2-fixation and total nitrogen content but not growth and nodulation. All five herbicides used at recommended and 5 times recommended level adversely affected nodulation and N_2-fixation. Glyphosate proved least toxic to all parameters. 2,4-D at recommended level was less harmful to nodulation and N_2-fixation than trifluralin, alachlor and metribuzin.

20. **Marsh, J.A.P., H.A. Davies and E. Grossbard. 1977. The effect of herbicides on respiration and transformation of nitrogen in 2 soils. Part 1 metribuzin and glyphosate. Weed Research 17: 77-82. (United Kingdom)**

The effects of metribuzin and glyphosate at 100 ppm on microbial CO_2 evolution and nitrogen transformation in 2 soils were investigated in the laboratory. Both herbicides reduced CO_2 evolution from Boddington Barn soil (organic carbon content 1.5%, pH 6.6) at some dates, but neither gave any consistent effects on Triangle soil (organic carbon content 4.0%, pH 5.1). Both metribuzin and glyphosate stimulated mineralization of nitrogen for at least 9 weeks. Only metribuzin on Triangle soil gave any indication of inhibition of nitrification. Metribuzin degraded more rapidly in Triangle soil than in Boddington Barn.

21. **Mueller, M.M., C. Rosenberg, H. Siltanen and T. Wartiovaara. 1981. Fate of glyphosate and its influence on nitrogen cycling in two Finnish agriculture soils. Bulletin of Environmental Contamination and Toxicology 27: 724-730. (Finland)**

(*) During an energy forest experiment in Suomusjarvi, Kettula (located in Southern Finland) glyphosate was used to destroy indigenous flora, mainly quackgrass, before replanting. Since the degradation rate of glyphosate and its biological impact are known to vary and field data were largely unavailable, it was decided that both the persistence of glyphosate and its effects on the nitrogen cycling processes fundamental to the energy forest experiment should be investigated. Both fields, SK-1 (loam soil) and SK-2 (fine silt soil), were treated on the 14th of September, 1978 with glyphosate 2.6 kg/ha. Two sites of ca. 100 m^2 were chosen at each field and sampled immediately after the application of glyphosate, 1 month and eight months later. Control samples were collected before glyphosate was applied. It is concluded that glyphosate degraded even at low temperature conditions, and it is not to be expected, that the application of glyphosate will affect directly nitrogen fixation, nitrification or denitrification activity in these soils.

22. **Pipke, R., A. Schulz and N. Amrhein. 1987. Uptake of glyphosate by an Arthrobacter sp. Applied Environmental Microbiology 53: 974-978. (Federal Republic of Germany)**

The uptake of glyphosate (N-[phosphonomethyl]glycine) by an Arthrobacter sp. which can utilize this herbicide as its sole source of phosphorus was investigated. Orthophosphate suppressed the expression of the uptake system for glyphosate and also compared with glyphosate for uptake. The K_m for glyphosate uptake was 125 uM, and the K_i for orthophosphate was 24 uM.

Organophosphonates as well as organophosphates inhibited glyphosate uptake, but only organophosphates and orthophosphate suppressed the uptake system. Glyphosate uptake was energy dependent, had a pH optimum of 6 to 7, and was differentially affected by divalent cations.

23. **Powell, C.L. and D.J. Bagyaraj. 1985. Effects of some herbicides and fungicides on the in-vitro growth of the endomycorrhizal fungus *Pezizella ericae*. New Zealand Journal of Agricultural Research 27: 581-586. (New Zealand)**

The endomycorrhizal fungus, *P. ericae* (Read), was grown in modified Norkran's broth amended with several rates of 2 herbicides (hexazinone and glyphosate) and 3 fungicides (etridiazole, vinclozolin and benomyl). At equivalent rates to those used in the field, there was no significant effect of hexazinone, glyphosate or etridiazole on fungal dry matter (DM) yields after 30 days incubation at 20 degrees Celcius. However, vinclozolin and benomyl reduced fungal DM production by 48% and 82%, respectively, although it is likely that *P. ericae* would be able to tolerate the low rates at which these fungicides would be present in plant roots under field conditions.

24. **Preston, C.M. and J.A. Trofymow. 1987. Effects of glyphosate on biological activity of two forest soils. Proceedings of the Carnation Creek Herbicide Workshop, Nanaimo, B.C. December 8-10, (In press).**

The results from laboratory and field trials are presented. To examine possible effects of glyphosate on carbon dioxide evolution and nitrogen transformations, forest floor and mineral soil from a Douglas-fir site at Shawnigan Lake (Vancouver Island) were incubated with glyphosate (10 and 50 ug/g) with or without N^{15}-labelled urea (200 ug/g N). No significant effects of glyphosate were found on carbon dioxide evolution, urea hydrolysis, immobilization or ammonium or nutrification, for either soil depth or level of glyphosate application. In field studies, soil fauna and microflora populations were monitored in surface organic layers prior to and following glyphosate application on alder covered sites at Carnation Creek (Vancouver Island). In a six month study, glyphosate had no significant long-term effects on either soil fauna or microflora populations. Soil microflora populations in herbicide treated plots fluctuated and then returned to control levels during an intensive one month field sampling trial.

25. **Roslycky, E.B. 1982. Glyphosate and the response of the soil microbiota. Soil Biology and Biochemistry 14: 87-92.**

Limited information on the effect of glyphosate (N-phosphonomethylglycine) on soil microorganisms justified an inquiry into the response of soil actinomycetes, bacteria and fungi in terms of their respiration, and sensitivity of isolates. Low concentrations of glyphosate had little effect on total populations of these organisms during the 214-day experiment, while high concentrations initially increased actinomycete and bacterial numbers by 2 and 1 1/2 logs, respectively. The stimulation was followed by a decline and fluctuation showing a gradual increase in numbers. The respiration rates of the soil microbiota in soil suspensions, showed some irregular stimulation and retardation with up to 10 mu.g glyphosate/ml. In contrast high doses suppressed O_2 uptake by the microbiota. Fungi were the least affected. Pronounced inhibition of actinomycete and bacterial respiration was in agreement with the results from isolate replication. The results indicated both stimulation and inhibition of O_2 uptake by some organisms within these groups. In contrast to some reports of limited, short-term inquiries these results showed considerable effects of glyphosate on soil microorganisms.

26. **Torstensson, N.T.L. and A. Aamisepp. 1977. Detoxification of glyphosate in soil. Weed Research 17: 209-212. (Sweden)**

Detoxification of glyphosate [N-(phosphonomethyl)-glycine] in nonsterile and autoclaved soils was followed by bioassay with wheat. Comparisons were made with detoxification of MCPA [2-methyl-4-chlorophenoxyacetic acid] under similar conditions followed by bioassay with spring rape. The well known pattern for microbial metabolism of MCPA with a lag phase preceeding the rapid degradation was shown. The initial rapid inactivation of glyphosate is by adsorption, but the results also clearly indicate that the further disappearance of activity depends mainly on microbial degradation. Glyphosate does not seem to sustain microbial growth, which indicates that it is degraded by co-metabolism. In autoclaved soil the possibility of a slight chemical degradation or an adsorption that becomes stronger with time could not be excluded.

27. **Vasilev, K. 1982. Glyphosate effect on test microorganisms under laboratory conditions. Khigiena I Zuraveopazvane 25: 346-351. (Bulgaria)**

The effect of the herbicide glyphosate was studied on some representative species of water saprophilic microflora and of some sanitary-indicative and pathogenic intestinal microorganisms. Strains from the following species were used:

Pseudomonas aeruginosa, Escherichia coli and Salmonella typhimurium. The experiments were carried out under laboratory conditions with and without aeration, with 3 concentrations of glyphosate (10, 100 and 300 mg/dm^3). The quantitative changes in the microorganisms were studied by inoculations on solid nutritive media. Glyphosate effect on test microorganisms was concentration-dependent. At a concentration of 10 mg/dm^3, glyphosate induced an increase in the quantity of the test microorganisms, at a concentration of 300 mg/dm^3, an inhibitory effect was established, manifested by a reduction of the number of microorganisms. All tested glyphosate concentrations, in combination with aeration, induced a sharp decrease in the quantity of the test microorganisms.

TITLES

28. Ana'yeva, N.D., B.P. Strekozov and O.K. Tyuryukanova. 1987. Change in the microbial biomass of soils caused by pesticides. Soviet Soil Science 18: 56-62.

29. Bliev, Y.K. and A.N. Martynov. 1981. The influence of glyphosate on the fertility of a sodpodsolic soil. Khimiya v Sel'skom Khozyaistive 19: 51-54.

30. Grossbard, E. and D. Harris. 1977. Selective action of Gramoxone W and Roundup on Chaetomium globosum in relation to straw decay. Transactions of the British Mycological Society 69: 141-146.

31. Helweg, A. 1986. Side effects caused by pesticide combinations. In FEMS (Federation of European Microbiological Societies) Symposium, No. 33. Microbial Communities in soil. Edited by V. Jensen, A. Kjoller and L.H. Sorensen. Copenhagen, Denmark, August 4-8, 1985.

32. Kruglov, Y.V., N.B. Gersh and M. Shtal'berg. 1980. The influence of glyphosate on the soil microflora. Khimiya v Sel'skom Khozayisteve 18: 42-44.

33. Lonsjo, H. J. Stark, L. Torstensson and B. Wessen. 1980. Glyphosate: decomposition and effects on biological processes in soil. Weeds and Weed Control, 21st Swedish Weed Conference. Vol. 1/2, pp. 140-146.

34. Mercer, P.C. and T.W. Fraser. 1986. Microorganisms associated with the retting of flax treated with the herbicide glyphosate. Annals of Applied Biology 109: 509-521.

35. Quilty, S.P. and M.J. Geoghegan. 1975. Effects of glyphosate on fungi. Proceedings of the Society for General Microbiology II: 87. 36. Quilty, S.P. and M.J. Geoghegan. 1976. Effects of 'Roundup' on microbial populations in cultivated peat, Proceedings of the Society for General Microbiology III, 128.

37. Torstensson, L. 1978. Glyphosate degradation and effects on soil micoorganisms. Weeds and Weed Control 19: 7-8.

38. Tropea, M., G. Fisichella and A. Longo. 1979. Influence of glyphosate on CO_2 evolution in some typical soils of eastern Sicily. Tecnica Agricola 31 (1-3), 11 p.

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