NEMATOLOGICAL REVIEWS - RESENAS NEMATOLOGICAS

ORGANIC AMENDMENTS IN NEMATODE CONTROL. AN EXAMINATION OF THE LITERATURE.

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ABSTRACT

Muller, R. and P.S. Gooch. 1982. Organic amendments in nematode control. An examination of the literature. Nematropica 12:319-326.

An on-line search of the literature on organic amendments from 1971-81 revealed 125 papers in which they were used to reduce nematode populations in order to increase yields. Oil cakes have been the most popular type of organic amendment used while sawdust, compost, green manure and chicken manure have also shown promise. The types of amendment used and the crops and nematodes involved have been analysed and tables and figures show current areas of research and possible future lines of investigation into this promising means of nematode control for the farmer and smallholder.

Additional key words: biological control, cultural practices, crop rotations, waste management, waste products.

RESUMEN

Muller, R., y P.S. Gooch. 1982. Enmiendas orgánicas para combatir nematodos fitoparásitos. Examen de la literatura. Nematópica 12:319-326.

Un reconocimiento con ordenadora de la literatura aparecida entre 1971 y 1981 reveló que habían 125 artículosobre el uso de enmiendas orgánicas para aumentar la producción de cultivos y reducir poblaciones de nematodos. Las tortas de aceites han sido las enmiendas más populares aunque el aserrín, estiércoles, y abonos vegetales y de gallina también resultaron prometedores. El trabajo presenta un análisis sobre los tipos de enmiendas utilizados así como listas de los cultivos y nematodos. También, por medio de gráficas y cuadros el trabajo señala las lineas actuales de investigación sobre el tema así como las posibilidades para la investigación futura sobre este método de combate de nematodos tan prometedor para el pequeño agricultor.

Palabras claves adicionales: control biológico, fertilización, manejo de desperdicios, prácticas de cultivo, manejo de plagas.

From time immemorial, it has been the habit of landholders to add any conveniently available waste of crop, animal or human origin to the soil in the hope that crop yields will be increased. In many cases yields are increased and the beneficial effect of the wastes is assumed to have been due to the provision of extra nutriment of some sort to the crop.

More recently, it has been realized that in some cases the benefits of adding organic material or residues to the soil is mainly due to a decrease in the levels of soil pathogens. This is caused by an alteration in soil structure and ecology, and/or by the action of waste-derived chemicals on the soil fauna and flora. Very often, when there is a decrease in the soil pathogen population, there is a consequent increase in crop yield. However, a reduction in pathogen population is by no means always followed by increased yields. It is also not unusal for the use of an organic amendment to be followed by an increase of pathogen populations and a decrease in yield. Relationships between pathogenic nematodes, soil ecology, organic amendments and plant host health are obviously complex and present a rich field for research.

In 1973, Singh & Sitaramaiah (9) published an excellent summary of the work on use of organic amendments in nematode control, most of the work having been done in India. The purpose of the present paper is to investigate the work that has been done in this area since the report of Singh & Sitaramaiah, and to underline the potentiality of this form of nematode control for farmers in the tropics. By using the abstracts in *Helminthological Abstracts, Series B, Plant Nematology*, a search of the literature covering the period 1973-82 revealed 125 papers in which organic amendments had been used in attempts to reduce nematode populations in order to increase crop yields.

For the purposes of this evaluation, organic amendments are considered to be any material of organic origin added to the soil, including manures, composts, oil cake, crop wastes and agro-industrial waste. It is recognized that no clear division exists between the use of manures, compost and other amendments as general fertilizers and their use specifically against nematodes and this sometimes makes evaluation of their efficiency difficult.

Table 1 demonstrates that most of the work continues to be done in India and that most of it relates to horticulture rather than to field crops. This masks the fact that in India nearly all work has been on vegetables, while most of the work in the USA and Europe has been on field crops. Except for India there has been little work on this method of nematode control in the tropics, although some of the North American work has been on semi-tropical crops. In Latin America there has been comparatively little work published in this field (4,11), although the variety of crops tested - tomato, okra, celery, pepper, beans, coffee, sugar cane - indicates an awareness of the broad potential of organic amendments as control agents.

The high proportion of papers on the genus *Meloidogyne* (Table 2) reflects the preponderance of work on vegetables, but other phytopathogenic nematodes are well represented. It is also not uncommon for authors to be imprecise about the identity of the nematodes that they are attempting to control.

Table 1. Organic amendments - Papers in the literature (1971-1981)

Origins of Papers		Crops Protected	
India	58	Tomato	28
USA	20	Vegetables	36
Europe	13	Field crops	17
Africa	10	Plantation crops	5
Latin America	8	[x]Others	10
Asia	11	Soil and *in vitro*	29
Australasia	1		
General reviews	4		
	125		125

[x] Includes flowers and forestry nurseries

Table 2. Nematode tested using organic amendments - Trials in the literature (1971-81)

Nematodes	No. of Trials		Nematodes	No. of Trials	
Meloidogyne spp.	10		*Hoplolaimus* spp.	1	
M. incognita	38		*H. indicus*	10	
M. javanica	11		*H. pseudorobustus*	1	
M. hapla	3				12
H. graminicola	2				
M. arenaria	1		*Helicotylenchus* spp.	4	
M. exigua	1		*H. erythrinae*	6	
		66			10
Pratylenchus spp.	2		*Tylenchus* spp.	8	
P. penetrans	12		*Aphelenchus* spp.	5	
P. brachyurus	2		*Rotylenchus* sp.	4	
		16	Tylenchids *sensu lato*	20	
					37
Tylenchorhynchus spp.	4				
T. brassicae	9		Nematodes, unspecified		16
		13			

Table 3. Organic amendments - Number of trials in the literature (1971-81)

Organic amendments used:	
Oil cakes	151
Crop waste/green manure	32
Compost/organic manure	14
Manure	18
Poultry manure	12
Processed crop waste/extracts	11
Agro-industrial waste	17
Sawdust	12

In many studies, more than one organic amendment has been tested, sometimes in parallel trials and sometimes in mixtures with other organic or inorganic amendments or with chemical nematicides. However, as Table 3 shows, the majority of the work has been with oil cake; another instance of the influence of Indian workers. Apart from oil cake, a large number of organic amendments have been tested and these are listed in Table 4. Sawdust, compost, green manure, and chicken manure appear to have been consistently useful in reducing nematode populations, although their efficacy may not be the same against different nematode genera and the reduction in population levels may not last long. Workers at the International Rice Research Centre (1) demonstrated that pre-plant treatment with chicken manure at 1 kg/ m^2 reduced *Meloidogyne* population levels in the soil by 50%, over three tomato cropping periods. Other, more rarely used, materials such as decaffeinated tea waste, gelatin, hardwood bark, cocoa pods or powdered *Tagetes* flowers have been highly effective. In Nigeria, Egunjobe & Larinde (3) treated soil with cocoa pods or cassava peelings in pot trials with maize infected with *Pratylenchus brachyurus* and demonstrated a reduction in nematode populations of 58 and 75%, respectively, with increase in yields of 124% and 22% over 14 weeks. Other amendments have not been so effective or have shown host related phytotoxicity.

Table 5 illustrates use of oil cake either as cakes mixed into the soil, or more rarely, as aqueous extracts watered into the soil. Most of the work has been done with Margosa (= neem), groundnut, mustard, castor bean and mahua and an approximate idea of their efficacy, either against nematodes or as promoters of crop yield, is indicated by the number of pluses. It must be emphasized that this scoring has had to be subjective to some extent, since authors are often imprecise as to the actual percent increase or decrease. The scorings ± or - refer to results which were negative or equivocal due to: increase in pathogen populations; diminution of efficacy of nematicides when used in conjunction with oil cake; phytotoxicity. A 'marked' reduction in

Table 4. Materials used as organic amendments, excluding oil cakes

Crop Residues	Green Manures
Flax	Rice Husks
Wheat	Cocoa Pods
Lucerne	Cassava Peelings
Grass	
Oat	

Agro-industrial Wastes	
Plant -	Sugar cane molasses
	Sugar cane bagasse
	Cassava flour waste
	Tea waste (decaffeinated)
	Organic acids
	Cellulose waste (paper making)
	Mycelial residue (antibiotic manufacture)
	Vinegar
Animal -	Bone meal
	Chicken manure
	Urea
	Fish guts
	Gelatin
	Chitin
Urban -	Compost
	Sewage
Others -	Chopped marigold[x]
	Chopped *Crotalaria*[x]
	Powdered tree bark

[x] known to have nematicidal action

nematode population can sometimes be associated with phytotoxicity to the crop. A typical result (9) showed that with margosa cake at 2500 kg/ha, the number of *Meloidogyne* galls per okra plant was reduced by about 70% and yield increased by about 40%. With standard DD chemical treatment, yields of okra were also increased by about 40%, but with DD plus margosa cake, yields were increased by 62%. Other oilcakes have not been used as much as those given scorings in Table 4 but some, such as cotton seed, soya and sesame, show promise.

Table 5. Number of Trials using Oil Cakes as Organic Amendments in the literature 1971-1981

Margosa/Neem	4 +++	33	Mahua		
(Azadirachta indica)	14 ++		*(Madhuca butyracea)*	3 ++	15
	8 +			6 +	
	1 ±			1 ±	
	2 -			3 -	
Groundnut	3 +++	29	Sesame	5	
(Arachis hypogaea)	13 ++		*(Sesamum indicum)*		
	8 +		Linseed	4	
	2 ±		*(Linum* sp.)		
Mustard	2 +++	21	Taramira	4	
(Brassica campestris)	7 ++		*(Eruca sativa)*		
	9 +		Cotton seed	3	
	2 -		*(Gossypium* sp.)		
			Honge	3	
Castor			Karanje	3	
(Ricinus communis)	9 ++	21	*Pongamia pinanata)*		
	9 +		Marotti	1	
	3 ±		*(Hydnocarpus lauri-folia)*		
			Soya	1	
			(Glycine max)		

+++ 'excellent' results
++ 'good' results
+ 'significant' results
± 'doubtful' results
- 'negative' results or phytotoxicity

At least 10 of the papers surveyed refer specifically to the mode of action of organic amendments and many others speculate briefly on the subject, but it is clear that much more work remains to be done. A distinction may be made between those amendments that: (1) introduce nutrients into the soil and encourage the growth of fungi and other organisms that compete with or destroy nematodes, while also contributing to the basic vigour of the host plant; (2) introduce chemicals that are nematicidal, nematostatic or that prevent egg hatching. Many of the oil cakes fall into the second category and their nematicidal properties can be enhanced by using aqueous or alcoholic extracts.

In summary, it can be stated that organic amendments have proved efficaceous against nematodes and as agents of increased crop yield. Efficacy is not generally as great or as long lasting as that of chemical nematicides,

although in many cases amendments seem to enhance or prolong the effect of nematicides. The lower efficacy of amendments is outweighed by their cheapness and relative availability when compared to conventional nematicides. However, amendments are usually bulky and need to be applied in large quantities. All these properties indicate that the maximum benefit of the use of organic amendments will be by small farmers or horticulturalists who have limited financial resources, but do have access to locally produced wastes of one sort or another. Thus this form of control must be seen as having a greater potential for Latin America than has been realized up to now. Organic amendments may be seen as a very real addition to the armoury of the small farmer, through whom must come any basic advances in agricultural production in the tropics.

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A copy of the full bibliography which served as the basis for this examination of the literature is available from the Commonwealth Institute of Parasitology.

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