# Natural Pesticides and Synthesized Pesticides: Comparison and Their Impact on Soil Properties

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Our country mostly depends on our agricultural land, yield and farming. The conservation and quality management of soil is our need, without which any nation cannot survive. It is assumed that the natural pesticides are environmentally friendly and synthetic must have some harmful effect on soil. Di-thiocarbamates were discovered as a class of chemical compounds early in the history of Organosulpher chemistry. The strong metal binding properties of dithiocarbonic acid were recognized by Delepine [1], the pioneer worker in this field. Most of the metallic dithiocarbamates except these of alkali/alkaline earth metals, are water soluble. The chelating character of dithiocarbamates complexes are remarkable [2,3,]. The antimicrobial activities of these compounds are remarkable. At present they are produced in various countries in thousands of tones for use in agriculture to control plant diseases [4]. They are effective and some of their metal derivatives are also used as commercial pesticides. But as they are synthetic, they may have some harmful effect on soil as compared to natural pesticides [5,6,7,8,9]. Natural pesticides are environmental friendly [4] and have no harmful residues in soil and the food which grow in the soil. Present piece of work is based on the comparative studies of harmful effect of the chosen synthetic pesticides (the metal derivatives of dithiocarbamates Cu<sup>2+</sup>, Ni<sup>2+</sup>, Co<sup>2+</sup> etc.) and the natural pesticides like neem oil, Trichoderma and Beauena bassinar, on soil on the basis of the parameters selected such as pH, moisture oxidation-reduction potential, conductivity, total organic concentration, nitrogen, phosphorus, potash and fusarium count (in spores/ml). These selected parameters have been checked at different concentration (ppm) and regular time interval of both type of pesticides by standard methods.

**Keywords:** Organo-sulpher chemistry, Antimicrobial activities, Natural pesticides, neem oil, Trichoderma, Beauena bassinar.

# **1. INTRODUCTION**

Our country mainly depends on agricultural land, yield and farming, so the conservation of soil quality management is the need of the hour. The pesticides we use in our farms should be chosen in the way that they do not have any harmful effect on soil.

Natural and synthetic pesticides are used for this purpose. It is assumed that the natural pesticides are environmentally friendly whereas synthetic pesticides must have some harmful effects on soil.

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Present piece of work is based on the comparative studies of these two in vitro and in vivo conditions. For synthetic pesticide the metal complexes of (Cu<sup>2+</sup>, Ni<sup>2+</sup>) morpholine dithiocarbamates have been taken, and neem oil has been taken as natural pesticide for the study, Comparison has been made on some selected parameters of soil. All these parameters have been checked at different concentrations (ppm) and at regular time interval for both type of pesticides, by standard methods.

# 2. OBJECTIVES

The main objective of the work is to confirm the soil friendliness of synthesized pesticides with natural pesticides. Studies that were carried out are:

- Comparative study between natural pesticides and synthesized pesticides (Neem oil and Morpholine Dithiocarbamates of Cu<sup>2+</sup> and Ni<sup>2+</sup>)
- The impact of these two kinds of pesticides on some selected soil parameters. Special emphasis is given on the antimicrobial activity of these two at different concentrations and a regular time interval, before and after the treatment of these pesticides. All these chosen parameters of soil play vital role in soil fertility.

# 3. METHODOLOGY

Pesticidal activities of the prepared compounds were studied against pathogenic microbes 'Fusarium' in vitro condition by 'agar plate technique'. Solution of various concentration of the synthesized compounds (i.e., 10, 50, 100, 200, 500 & 1000 ppm) were prepared in appropriate solvents. These solutions were mixed with Czapeck's Dox agar medium with a little amount of antibiotic (to prevent the unwanted bacterial growth) and poured in a sterilized Petri dish. Control plate containing only 1 or 2 ml of solvent were also prepared for comparison, before transferring the Czepeck's Dox medium containing the known concentrations of 10, 50, 100, 500 & 1000 ppm of the synthesized compound under investigation, to the sterilized Petri dish and about 5ml of spore suspension of 'Fusarium' was also added. All these Petri dishes were kept in B.O.D. incubator at 28 +2°C for about 7 days with periodic observation.

After 7 days the Petri dish in which the test solutions were of 10 ppm concentration showed no inhibition. The inhibition started from the Petri dish in which the conc. was of 50 ppm. This showed that the MIC (minimum inhibition concentration) of the complexes is 50 ppm. Control plate also show no zone of inhibition which shows that solvent have no pesticidal activity.

Likewise, neem oil had also been tested for MIC.

### 4. RESULT AND DISCUSSION

The diameter of fungal growth is measured in mm and recorded in Table 1. The results showed that the synthesized compounds have remarkable antifungal activities.

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The comparison of biocidal activity and their effect on soil (some parameters have been selected and investigated by standard method) have been made at different concentration and time interval and tabulated in Tables 2a to 5d.

The parameters which have been studied and tabulated are: pH, moisture, oxidation reduction potential, conductivity, total organic concentration, nitrogen, phosphorus, potash & fusarium count (in spores/ml).

From the data of the Tables (3a to 5d) it can be inferred that in natural pesticide there were no changes upto 50 ppm concentration. The activity was found from the conc. 100 ppm & above. In case of neem oil (Tables 2a to 2d), all the parameters under investigation either did not deviate or deviated in a safe range.

So, we can say that the natural pesticide at lower concentration (i.e., 50 ppm) is not much effective, but soil friendly. At higher concentration (i.e., 100, 500 and 1000 ppm) it shows good pesticidal activity without altering soil parameters much.

In the study of the synthesized pesticides, it was found that the ligand i.e., Nadithiocarbamates have very limited pesticidal activity that too at higher concentration i.e., 500 & 1000 ppm (Tables 3a-3d) with very little changes in soil properties.

The metal complexes of the ligand, i.e., Cu-morpholine dithiocarbamates and Nimorpholine dithiocarbamates showed remarkable pesticidal activities at lower concentrations. Cu-morpholine dithiocarbamates (Tables 4a to 4d) and Ni-morpholine dithiocarbamates (Tables 5a to 5d) are very effective pesticides. Cu-morpholine dithiocarbamates showed antifungal activity at 50 ppm and also at higher concentration, with very little changes in soil properties; the altered properties were also in the safe range. In Ni-morpholine dithiocarbamates, it also showed remarkable antifungal properties at 50 ppm, but at higher concentration the soil properties such as pH & ORP were altered considerably, whereas conductivity, moisture & potash contents were altered slightly.

The soil properties in all the three cases were altered slightly, i.e., ORP, pH, moisture & potash. Otherwise, the remaining soil parameters were the same as they were before the treatment.

Conclusively, we can say that the synthesized pesticides are also environmentally friendly upto a limited use and concentration and more effective at lower concentrations than the natural pesticide, in the light of the parameters which were selected for the study.

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Fig. 1: (A) Control Plate and (B) Na-m-dithiocarbamates.



Fig. 2: 100ppm: (A) Neem oil, (B) Cu, (C) Ni.

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Fig. 3: 200ppm: (A) Cu, (B) Ni.



Fig. 4: 1000ppm: Neem oil.

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**Table 1:** Diameter Fungus colony in test plates in millimetres (mm) for morpholinedithiocarbomates and its metal derivatives.

S. No.	Compounds			
		200ppm	100ppm	50ppm
1.	Na-dithiocarbamates	12	15	17
2.	Cu-dithiocarbamates	5	8	10
3.	Ni-dithiocarbamates	8	10	13

Diameter of fungus colony in control plate = 21mm

Na-dithiocarbamates = Sodium Morpholine dithiocarbamates

Table 2a: Comparison of various parameters of Neem oil in soil at different
concentrations & time interval at 50 ppm.

S.No.	Test	Conc. (ppm)	Hq	Moisture (%)	ORP (mV)	Conductivity	TOC. (%)	Z	٩	Potash	F.C.
1.	Before Treatment	0	7	69	+190	2	0.2	0.04	0.04	0.04	23
2.	After Treatment (0 days)	50	7	69	+190	2	0.2	0.04	0.04	0.04	23
3.	After 8 days' Treatment	50	7	69	+180	3	0.2	0.04	0.04	0.04	23
4.	After 16 days' Treatment	50	7	70	+180	3	0.2	0.04	0.04	0.04	23
5.	After 24 days' Treatment	50	7	70	+180	3	0.2	0.04	0.04	0.04	23

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S.No.	Test	Conc. (ppm)	Hq	Moisture (%)	ORP (mV)	Conductivity	тос. (%)	z	٩	Potash	F.C.
1.	Before Treatment	0	7	69	+190	2	0.2	0.04	0.04	0.04	23
2.	After Treatment (0 days)	100	7	70	+190	3	0.2	0.04	0.04	0.04	23
3.	After 8 days' Treatment	100	7	71	+180	3	0.2	0.04	0.04	0.04	22
4.	After 16 days' Treatment	100	7	71	+180	3	0.2	0.04	0.04	0.04	22
5.	After 24 days' Treatment	100	7	71	+170	3	0.2	0.04	0.04	0.04	22

Natural Pesticides and Synthesized Pesticides: Comparison and Their Impact on Soil Properties **Table 2b:** Comparison of various parameters of Neem oil in soil at different concentration & time interval at 100ppm.

**Table 2c:** Comparison of various parameters of Neem oil in soil at different concentration & time interval at 500ppm.

S.No.	Test	Conc. (ppm)	Hq	Moisture (%)	ORP (mV)	Conductivity	тос. (%)	Z	٩	Potash	F.C.
1.	Before Treatment	0	7	69	+190	2	0.2	0.04	0.04	0.04	23
2.	After Treatment (0 days)	500	7	72	+190	3	0.2	0.04	0.04	0.04	23
3.	After 8 days' Treatment	500	7.5	73	+210	4	0.2	0.04	0.04	0.04	22

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4.	After 16 days' Treatment	500	7.5	73	+210	4	0.2	0.04	0.04	0.04	22
5.	After 24 days' Treatment	500	7.5	73	+210	4	0.2	0.04	0.04	0.04	22

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**Table 2d:** Comparison of various parameters of Neem oil in soil at different concentration & time interval at 1000ppm.

S.No.	Test	Conc. (ppm)	Hq	Moisture (%)	ORP (mV)	Conductivity	тос. (%)	z	٩	Potash	F.C.
1.	Before Treatment	0	6	67	+190	2	0.2	0.04	0.04	0.04	23
2.	After Treatment (0 days)	1000	7	70	+210	3	0.2	0.04	0.04	0.04	23
3.	After 8 days' Treatment	1000	7.5	72	+210	4	0.2	0.04	0.04	0.04	22
4.	After 16 days' Treatment	1000	7.5	73	+210	4	0.2	0.04	0.04	0.04	19
5.	After 24 days' Treatment	1000	7.5	73	+210	4	0.2	0.04	0.04	0.04	19

 Table 3a: Comparison of various parameters of Na-dithiocarbamates in soil at different concentration & time interval at 50ppm.

S.No.	Test	Conc. (ppm)	Hq	Moisture (%)	ORP (mV)	Conductivity	тос. (%)	Z	ď	Potash	F.C.
1.	Before Treatment	0	6	70	+190	2	0.2	0.05	0.03	0.05	24

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2.	After Treatment (0 days)	50	6	70	+190	2	0.2	0.05	0.03	0.05	24
3.	After 8 days' Treatment	50	6	70	+190	2	0.2	0.05	0.03	0.05	24
4.	After 16 days' Treatment	50	6	70	+190	2	0.2	0.05	0.03	0.05	24
5.	After 24 days' Treatment	50	6	70	+190	2	0.2	0.05	0.03	0.05	24

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**Table 3b:** Comparison of various parameters of Na-dithiocarbamates in soil at different concentration & time interval at 100ppm.

S.No.	Test	Conc. (ppm)	Hq	Moisture (%)	ORP (mV)	Conductivity	TOC. (%)	Z	٩	Potash	F.C.
1.	Before Treatment	0	6	70	+190	2	0.2	0.05	0.03	0.05	24
2.	After Treatment (0 days)	100	6	72	+190	2	0.2	0.05	0.03	0.05	24
3.	After 8 days' Treatment	100	6.5	73	+150	2	0.2	0.05	0.03	0.05	24
4.	After 16 days' Treatment	100	6.5	73	+150	2	0.2	0.05	0.03	0.05	24
5.	After 24 days' Treatment	100	6.5	73	+150	2	0.2	0.05	0.03	0.05	24

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S.No.	Test	Conc. (ppm)	Hq	Moisture (%)	ORP (mV)	Conductivity	TOC. (%)	Z	٩	Potash	F.C.
1.	Before Treatment	0	6	70	+190	2	0.2	0.05	0.03	0.05	24
2.	After Treatment (0 days)	500	6.5	72	+190	2	0.2	0.05	0.03	0.05	24
3.	After 8 days' Treatment	500	7	73	+170	3	0.2	0.06	0.03	0.06	23
4.	After 16 days' Treatment	500	7	73	+170	3	0.2	0.06	0.03	0.06	23
5.	After 24 days' Treatment	500	7	73	+170	3	0.2	0.06	0.03	0.06	23

 Table 3c: Comparison of various parameters of Na-dithiocarbamates in soil at different concentration & time interval at 500ppm.

**Table 3d:** Comparison of various parameters of Na-dithiocarbamates in soil at different concentration & time interval at 1000ppm.

S.No.	Test	Conc. (ppm)	Hq	Moisture (%)	ORP (mV)	Conductivity	тос. (%)	z	٩	Potash	F.C.
1.	Before Treatment	0	6	70	+190	2	0.2	0.05	0.03	0.05	24
2.	After Treatment (0 days)	1000	7	72	+190	2	0.2	0.05	0.03	0.05	24
3.	After 8 days' Treatment	1000	7.5	73	+190	3	0.2	0.06	0.03	0.06	23

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4.	After 16 days' Treatment	1000	7.5	74	+190	3	0.2	0.07	0.03	0.07	23
5.	After 24 days' Treatment	1000	7.5	74	+190	3	0.2	0.07	0.03	0.07	22

 Table 4a: Comparison of various parameters of Cu-dithiocarbamates in soil at different concentration & time interval at 50ppm.

S.No.	Test	Conc. (ppm)	Hd	Moisture (%)	ORP (mV)	Conductivity	тос. (%)	N	٩	Potash	F.C.
1.	Before Treatment	0	6.5	67	+100	2	0.2	0.04	0.03	0.04	24
2.	After Treatment (0 days)	50	6.5	68	+100	2	0.2	0.04	0.03	0.04	24
3.	After 8 days' Treatment	50	6.5	70	+100	2	0.2	0.04	0.03	0.04	23
4.	After 16 days' Treatment	50	6.5	71.2	+105	2	0.2	0.04	0.03	0.04	23
5.	After 24 days' Treatment	50	6.5	72	+110	2	0.2	0.04	0.03	0.04	23

**Table 4b**: Comparison of various parameters of Cu-dithiocarbamates in soil at different concentration & time interval at 100ppm.

S.No.	Test	Conc. (ppm)	Hd	Moisture (%)	ORP (mV)	Conductivity	тос. (%)	N	d	Potash	F.C.
1.	Before Treatment	0	6.5	67	+100	2	0.2	0.04	0.03	0.04	24

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2.	After Treatment (0 days)	100	6.5	71	+100	2	0.2	0.04	0.03	0.04	23
3.	After 8 days' Treatment	100	6.5	71	+105	2	0.2	0.04	0.03	0.04	23
4.	After 16 days' Treatment	100	6.5	72	+110	2	0.2	0.04	0.03	0.04	23
5.	After 24 days' Treatment	100	6.5	72	+110	2	0.2	0.04	0.03	0.04	23

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 Table 4c: Comparison of various parameters of Cu-dithiocarbamates in soil at different concentration & time interval at 500ppm.

S.No.	Test	Conc. (ppm)	Hq	Moisture (%)	ORP (mV)	Conductivity	TOC. (%)	z	٩	Potash	F.C.
1.	Before Treatment	0	6.5	67	+100	2	0.2	0.04	0.03	0.04	24
2.	After Treatment (0 days)	500	6.5	73	+115	2	0.2	0.04	0.03	0.04	24
3.	After 8 days' Treatment	500	7	73	+118	3	0.2	0.04	0.03	0.04	23
4.	After 16 days' Treatment	500	7	74	+130	3	0.2	0.04	0.03	0.04	23
5.	After 24 days' Treatment	500	7	74	+130	3	0.2	0.04	0.03	0.04	23

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S.No.	Test	Conc. (ppm)	Hq	Moisture (%)	ORP (mV)	Conductivity	тос. (%)	Z	٩	Potash	F.C.
1.	Before Treatment	0	6.5	67	+100	2	0.2	0.04	0.03	0.04	24
2.	After Treatment (0 days)	1000	6.5	73	+110	2	0.2	0.04	0.03	0.04	24
3.	After 8 days' Treatment	1000	7	73	+130	3	0.2	0.04	0.03	0.04	23
4.	After 16 days' Treatment	1000	7	75	+130	3	0.2	0.04	0.03	0.04	23
5.	After 24 days' Treatment	1000	7	75	+145	3	0.2	0.04	0.03	0.04	23

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 Table 4d: Comparison of various parameters of Cu-dithiocarbamates in soil at different concentration & time interval at 1000ppm.

# **Table 5a:** Comparison of various parameters of Ni-dithiocarbamates in soil at different concentration & time interval at 50ppm.

S.No.	Test	Conc. (ppm)	Hq	Moisture (%)	ORP (mV)	Conductivity	TOC. (%)	Z	٩	Potash	F.C.
1.	Before Treatment	0	6.5	62	+150	2	0.2	0.04	0.03	0.04	24
2.	After Treatment (0 days)	50	6.5	70	+150	2	0.2	0.04	0.03	0.04	23
3.	After 8 days' Treatment	50	6.5	70	+170	2	0.2	0.04	0.03	0.04	23

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4. After 16 50 6.5 73 +170 2 0.2 0.04 0.03 0.04 22 days' Treatment 5. After 24 50 6.5 73 +178 2 0.2 0.04 0.03 0.05 22 days' Treatment

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**Table 5b:** Comparison of various parameters of Ni-dithiocarbamates in soil at different concentration & time interval at 100ppm.

S.No.	Test	Conc. (ppm)	Hq	Moisture (%)	ORP (mV)	Conductivity	тос. (%)	z	٩	Potash	F.C.
1.	Before Treatment	0	6.5	62	+150	2	0.2	0.04	0.03	0.04	24
2.	After Treatment (0 days)	100	6.5	73	+175	2	0.2	0.04	0.03	0.04	23
3.	After 8 days' Treatment	100	6.5	73	+178	2	0.2	0.04	0.03	0.04	23
4.	After 16 days' Treatment	100	6.5	78	+185	2	0.2	0.04	0.03	0.04	22
5.	After 24 days' Treatment	100	6.5	78	+190	2	0.2	0.04	0.03	0.05	22

**Table 5c:** Comparison of various parameters of Ni-dithiocarbamates in soil at different concentration & time interval at 500ppm.

S.No.	Test	Conc. (ppm)	Hd	Moisture (%)	ORP (mV)	Conductivity	тос. (%)	z	٩	Potash	F.C.
1.	Before Treatment	0	6.5	62	+150	2	0.2	0.04	0.03	0.04	24

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2.	After Treatment (0 days)	500	8	75	+180	2	0.2	0.04	0.03	0.04	22
3.	After 8 days' Treatment	500	8	78	+185	2	0.2	0.04	0.03	0.04	21
4.	After 16 days' Treatment	500	8	81	+190	2	0.2	0.04	0.03	0.04	20
5.	After 24 days' Treatment	500	8	88	+198	2	0.2	0.04	0.03	0.05	20

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**Table 5d:** Comparison of various parameters of Ni-dithiocarbamates in soil at different concentration & time interval at 1000ppm.

S.No.	Test	Conc. (ppm)	Hq	Moisture (%)	ORP (mV)	Conductivity	тос. (%)	z	٩	Potash	F.C.
1.	Before Treatment	0	6.5	62	+150	2	0.2	0.04	0.03	0.04	24
2.	After Treatment (0 days)	1000	8	80	+180	3	0.2	0.05	0.03	0.05	22
3.	After 8 days' Treatment	1000	8	81	+185	3	0.2	0.05	0.03	0.05	20
4.	After 16 days' Treatment	1000	8	88	+190	3	0.2	0.05	0.03	0.05	19
5.	After 24 days' Treatment	1000	8	85	+198	3	0.2	0.05	0.03	0.05	19

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