



RESEARCH ARTICLE

BIOTECHNOLOGY

COMPARATIVE X-RAY CRYSTALLOGRAPHIC STUDIES OF TWO SYSTEMIC FUNGICIDES TRICYCLAZOLE AND TRIADIMEFON**DR JYOTSNA CHAUHAN**

Lecturer in Physics Department Rajeev Gandhi Technical University Bhopal

ABSTRACT

The activity of fungicides is intimately related to its chemical structure. Knowledge about the chemical structure of a chemical is useful for the synthesis of new compounds with more specific actions and fewer adverse reactions, to increase/decrease the duration of action of the original drug or to get a more potent compound, to restrict the action to a specific system of the body and to reduce the adverse reactions, toxicity and other disadvantages associated. We can understand the basic chemical groups responsible for drug action¹.

Recently it has been observed that some of the fungicides are losing their effects. If their structures are known, so analogous compounds can be designed as substitute. A rational approach to test these fungicides is to know the three-dimensional structure of these compounds and macromolecular receptor sites as well as their molecular complex. The structures of these compounds can be obtained by X-ray diffraction method in crystalline form and they will invariably be similar to their structure in solutions. The composition of crystal **Tricyclazole** is confirmed by comparing the infra-red spectra of two components. The unit cell parameters are $a=14.896(5)$ Å, $b=7.410(5)$ Å, $c=7.556(5)$ Å, $\alpha=90(5)^\circ$, $\beta=90.000(5)^\circ$, $\gamma=90.000(5)^\circ$. The crystal system is Orthorhombic and space group is Pca21. The unit cell parameter of **Triadimefon** are $a=8.16(10)$ Å, $b=16.81(3)$ Å, $c=22.05(2)$ Å, $\alpha=90^\circ$, $\beta=92.37(1)^\circ$, $\gamma=90^\circ$ and $Z=8$ and space group is determined $P2_1/n$. The measured density is $1.291\mu\text{g}/\text{cm}^3$ and calculated density is $1.295\mu\text{g}/\text{cm}^3$. Thus we determine the three-dimensional structure, molecular dimensions, molecular geometry, electronic structure and the conformation of fungicides and analyze their crystal structures also. Then correlate the chemical activity by substituting the chemically active groups at the crucial sites of the model fungicide to enhance chemical affinity and introduce conformational changes in the fungicides to make them more effective, active and to some extent cheaper.



KEYWORDS

X-ray crystallography, Systemic fungicides, Triazole structure X-Ray diffraction

INTRODUCTION

A systemic fungicide is defined as systemic fungi toxic compound that controls a fungus pathogen remote from the point of application and that can be detected or identified². These compounds are absorbed by the plant and get trans located within it, thus providing protection as well as eradicating already established infection.

EXPERIMENTAL

First grow the crystals of existing fungicides available and synthesize their derivatives in lab. The determination of structural perturbation in fungicide derivatives and comparison of the result of their molecular association with other receptor sites by X-Ray crystallography techniques will be done. In parallel with these structural studies, spectroscopic studies carried out on them. The goal is then to tie together the structural and spectroscopic studies to have more comprehensive account of the precise shape of these molecules, the non-covalent interaction which are likely to be involved in and the changes introduced in molecular geometry and electronic structure of these compounds as a result of their molecular association with other compounds. Thus we study the structure of variety of such compounds and correlate their structure with biological activity, so that more safer and effective fungicides at reasonable price can be developed. The density of crystal is measured by floatation method the mixture of benzene and Bromoform. The unit cell parameters are determined by directly on CAD-4 Enraf Nonious 4-circle automatic Diffractometer

Data collection and Structure Solution: The intensity data are collected on a computerized automatic CAD-4 Enraf Nonious 4-circled Diffractometer. The data collection is done on ω - 2θ scan mode. Each intensity measurement involved in a scan over the reflection peak, a back ground measurement at each end of the scan range and measurement of the peak height. The structure determination is carried out on VAX machine using SHELXS-97³. All the non-hydrogen atoms are located in the beginning itself.

REFINEMENT: The positional co-ordinates, which were obtained from SHELXS 97 and isotropic temperature factors, were subjected to refinement by SHELXL⁴ refinement program. After so many cycles of refinement the R factors dropped to 0.0533. Further refinement of the structure was carried out with individuals an isotropic temperature factor of the exponential form.

$-2P_1^2[h^2a^2U_{11} + \dots + 2hKa^*bxU_{12}]$
Reduced R factor to 0.0511. The hydrogen atoms were fixed at this stage by geometrical considerations and were not refined. Refinement of the structure was terminated after two more cycles when all the deviations in parameters became much smaller than the corresponding estimated standard derivations

RESULTS AND DISCUSSION

The ORTEP Diagram of TRIADIMEFON is shown in figure 1

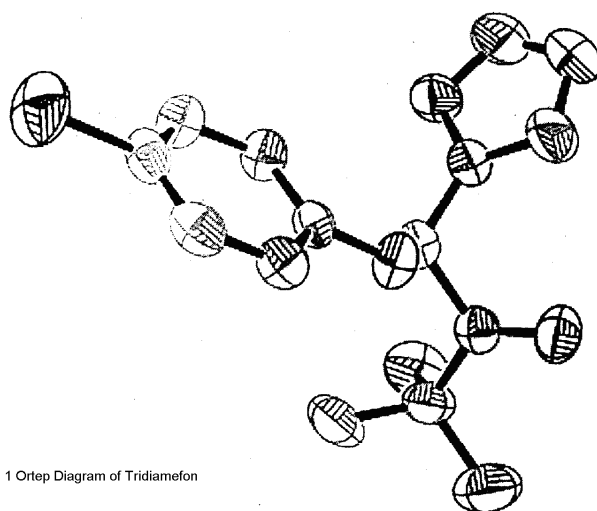
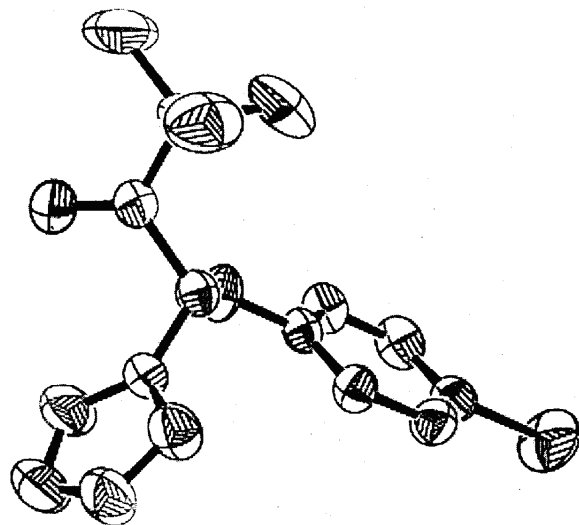


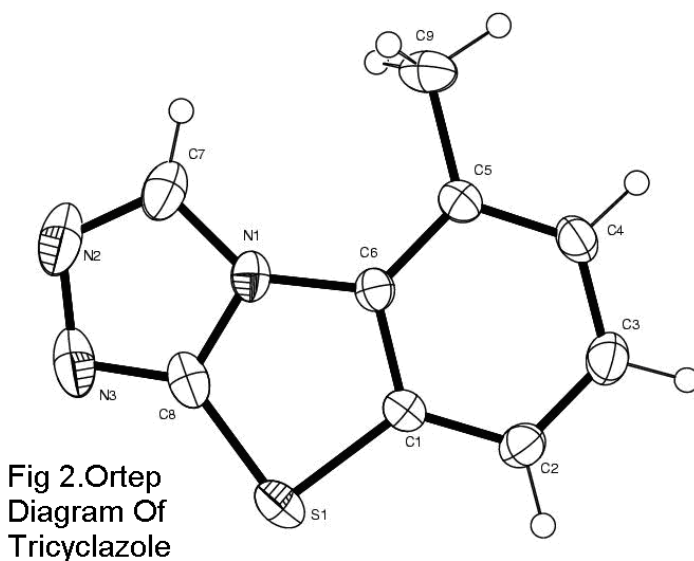
fig 1 Ortep Diagram of Triadimefon

The ORTEP⁵ diagram of *TRICYCLAZOLE* is shown in fig.2. The packing Diagram of *TRICYCLAZOLE* is shown in figure 3. In *TRIADIMEFON* the average bond distance of C-H is 0.95Å. The bond lengths and angles in the

benzene rings show regular features in both the molecules. The Cl (1A)-C (4A) and Cl (1 B)-C (4B) distances are 1.733Å and 1.738Å in *TRIADIMEFON*. The bond distances around C(7A) and C(7B) are usual shorter than single

bond values in **TRIADIMEFON**. They may also appear to bear a partial double bond character. In **TRICYCLAZOLE** the average bond distances of C-H is 0.96(2) Å. The bond distances of C(7)-N(1) is 1.368 Å, C(8)-N(1) is 1.360 Å. The bond distances of N(2)-N(3) is 1.396 Å, C(8)-S(1) is 1.7316 Å. The Triazole ring is distorted in shape⁶. The average bond distances for C-N and N-N bonds are 1.354 Å and 1.396 Å. The bond lengths and angles in the benzene ring show regular features in the molecules⁷. C-C distances are short and shortening may be due to delocalization of electrons from the benzene rings⁸. The whole molecules appeared to be twisted and folded and reason may be due to stacking constraints⁹. The bond distance around C(7) is as usual shorter than single bond value. This may also appears to bear a partial double bond character. The bond distances in the five member ring are comparable to corresponding

distances in heterocyclic ring 1.339(Å)¹⁰ the average value of bond lengths and angles in the rings derived from most reliable set of data by Spencer¹¹ are 1.377 Å and 119°, respectively. The dimensions of the methyl groups are normal and comparable with those in 0-methyl obtusaquinone and moscaline hydrobromide. The average bond angle around C(9) is 109.5°. The molecule is found to adopt a conformation such that the Triazole ring is inclined angle of 72.9(9)° to the aromatic ring¹². The resulting arrangement lead approach of the ortho-H, H(2A) to the Triazole, atoms N(1) and N(2) such that both N-H distances lie within the Sum of the Vander Walls radii of N and H¹³. The equations of the Least squares planes, calculated using Blow method¹⁴ and the displacements of the relevant atoms from the mean planes for different planer groups together with the respective.



The triazol ring is planer with C(7) lying only 0.063(7) Å from the mean plane. All four C-N distances are shorter than a normal single bond (1.47 Å). The N(1)-N(2) bond is also shorter than a normal single bond (1.45 Å). The

three atoms bonded to N(1) are almost co planer with it. Taken together these data indicate extensive delocalization within the heterocyclic ring. The most note worthy feature of the heterocyclic ring. is the asymmetry of the

exocyclic angles at N(1A) [$130.80^\circ 1$. We have observed a similar pattern in related Triazole systems and it appear to be a function of a triazolyl ring itself rather than the influence of any inter or intramolecular interactions.. The torsion angles of C(6)-C(1)-C(2)-C(3) is $-0.9(3)^\circ$. The torsion angles of S(1)-C(1)-C(2)-C(3) is $179.43(15)^\circ$ and C(3)-C(4)-C(5)-C(9) is $179.49(19)$ show that this ring is almost symmetric.

The packing diagram is shown in Fig3. The crystal structure consists of parallel sheets stacked along *a*-axis. The molecules overlap while running along the *a*-axis. It is interesting to note that when there are minor differences in the

cell parameters and growth conditions in the two independent studies, the molecular geometry, overall dimensions, crystal packing are almost same under the error limits whatever small differences are there, they are not really significant, which suggest that the molecular parameters remain unchanged even there is a change in growth condition the crystal forces, therefore, they don't alter the molecular geometry

Thus we study the structure of variety of such compounds and correlate their structure with biological activity, so that more safer and effective fungicides at reasonable price can be developed.

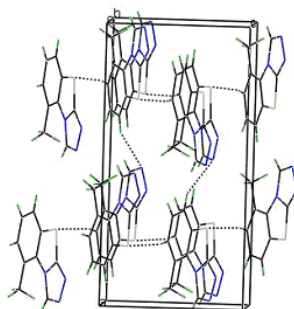


fig 3 Packing Diagram Tricyclazole

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REFERENCES

1. Wang, Yu. & Liao, J.H. Acta Cryst. B45, 65-69. (1989)
2. Clark. T., D.R. Clifford, A.H Deas, P. Gendle and D.A.M. Watkins (1978), Pestic.Sci.9, 497-506.
3. Sheldrich, G.M. (1997), SHELXS-97, Program for the solution of crystal structure.
4. Sheldrich, G.M. (1997), SHELXL-97, Program for crystal structure determination.
5. Jolmson, C.K. (1965), ORTEP, Report ORNL-3794. Oak Ridge National laboratory, Tennessee, U.S.A.
6. Wilson, N.K. J. Phys. Chem. 75, 1067-1072.(1971)



7. Bucheauer, H. (1976). Z. Pflanzeschut. B3, 368-367.
8. Martin, T.J. & Morris, D.B. (1979) Pflanzenschutz Nachr. Am. Ed. 32, 3 1-79
9. Senger, Jyotsna, Ph.D. Thesis, Jiwaji University, Gwalior India (2002).
10. Haridus, M., Kulkarni, N.R., Tiwari; R.K. and Singh T.P. (1982), Curr. Sci. (India) 51(23), 1111.
11. Spencer, M. (1959), Acta Cryst. 12, 50.
12. Palmer. K.J., Wang, R.Y. and Jurd, L. (1973), Acta Cryst. B29, 1509.
13. Ernst, S.R. and Cogle Jr. F.W. (1973), Acta Cryst. B29, 1543.
14. Blow, O.M. (1960), Acta Cryst. 13, 168.