X-Ray Crystallographic analysis of Fungicide monceren N-((4-chlorophenyl)methyl)-N-cyclopentyl-N'-phenylurea

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Abstract : Monceren N-((4-chlorophenyl)methyl)-N-cyclopentyl-N'-phenylurea, a local Non systemic fungicide with good protectant 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 fungicide action.Recently it has been observed that some of the fungicides are loosing their effects. If their structures are known. , analogous compounds can be designed as a 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 **Monceren N-((4-chlorophenyl)methyl)-N-cyclopentyl-N'-phenylurea** molecular structures obtain by the X- Ray Diffraction method in crystalline form. Crystal size of monceren is nearly 0.46 x 0.120 x 0.060 mm. We determine the three- dimensional structure, molecular dimensional, molecular geometry, electronic structure and the conformation of fungicides and analyze their crystal structures also. The composition of crystal **Monceren N-((4-chlorophenyl)methyl)-N-cyclopentyl-N'-phenylurea** is confirmed by comparing the infra-red spectra The unit cell parameters are a = **12.1887(12)**) Å b = **8.7677(8)** Å ,c = **33.063**Å, $\alpha = 90^{o}$, $\beta =$ **90.00** ^{0}, $\gamma = 90^{o}$ **The Crystal system is Orthorhombic.**

Keywords: X-ray crystallography, fungicides, Triazole structure

Introduction: Pencycuron (C19H21ClN2O) is a Synthetic Substance of Phenylurea group. it comes under the Product Category of Foliar Fungicide Its IUPAC name is 1-(4-chlorobenzyl)-1-cyclopentyl-3-phenylurea. and CAS Number is [66063-05-6] (2). It exists in the form of Colorless, odorless crystals. In India it was registered in 2006 and is available as Monceren® 125 DS Fungicide. Pencycuron is a slightly toxic compound.
Pencycuron exerts its effects by Contact Action. It Inhibits mitosis and cell division(4). It is recommended for different agricultural uses like seed treatment for potatoes [3] and protection of sugar beet, vegetables, Paddy Crops, ornamentals etc. It is also recommended as a preventive application for Sheath Blight control -mostly targeting first round of application. Pencycuron is IPM friendly, reliable and give excellent Results (2). Pencycuron presents a low hazard to birds, earthworms, bees and mammals. It is toxic to algae and Daphnia (2). But the formulated product is much less toxic to Daphnia. Acute and subchronic toxicities of different agricultural chemicals of common uses have been investigated on Daphnia magna, a useful aquatic organism for testing ecological toxicities. In this study, pencycuron was suggested to have slow-acting toxicity

.**Different compounds, developed to protect crops are now themselves causing significant health hazards. Acute agrochemical poisoning is a global public health problem and a leading cause of mortality and morbidity in the developing countries of Asia - Pacific region including India. This is mostly due to exposure to organophosphates (most common in India), organochlorines, and aluminium phosphide compounds which are an integral part of agriculture within this region and are readily available at very cheap rate. Due to their intrinsic toxicity, new chemicals of high potency and low toxicity continue to be developed e.g.Imidacloprid, Pendimethalin, and Pencycuron etc, but they are released to the market without appropriate data on direct human toxicity. Instead, human toxicity is often extrapolated from toxicological studies in animals, the relevance of which is poorly defined. They are classified as a "moderate toxic", and generally demonstrate low human lethality but at times they may be hazardous.**

Experimental: - 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. 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.. Firstly grow the crystal by evaporation method fungicides are available .we synthesizes their derivatives in lab.. In that particular fungicide yellow well formed crystals of size 0.46 x 0.120 x 0.060 mm are obtain by slow evaporation from a solution **293(**^{o} K

temperature.. These crystals have been grown within few days. The crystals obtained are rectangular in shape. The density of crystal **1.238** Mg/m^3 is measured by floatation method with the mixture of benzene and Bromoform .The unit cell parameters were determined by automatic computerized 4-circled Enraf-Nonius CAD-4 Diffractometer. The preliminary information about crystal is given in Table.2.

Data collection and Structure Solution:

X-ray crystallographic data were collected at 297^o K with **Cu** $_{K\alpha}$ radiation (λ = **1.54184** Å) using a Bruker Nonius SMART CCD diffractometer equipped with graphite monochromator. The SMART software was used for data collection and also for indexing the reflections and determining the unit cell parameters; the collected data were integrated using SAINT software. The structures were solved by direct methods and refined by full-matrix least-squares calculations using SHELXTL software. All the non-H atoms were refined in the anisotropic approximation against F^2 of all reflections. The H-atoms, placed at their calculated positions and refined in the isotropic approximation; those attached to heteroatom (N and O) were located in the difference Fourier maps, and refined with isotropic displacement coefficients.

The three dimensional intensity data were collected on a computerized automatic 4-circle CAD-4 Enraf-Nonius diffractometer using graphite filtered **Cu** $_{K\alpha}$ radiation (λ = **1.54184** Å)at SAIF Madras.. Temperature of crystal during data collection was **293**°K. All the data were corrected for Lorentz and Polarization effect. Three standard reflection were measured where hkl indices varies from -14<=h<=7, -10<=k<=5, -33<=l<=40. The total number of reflections were 7501 out of which unique reflection were **3391 .** 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 was solved using [5]SHELXS- program for crystal structure solution.

REFINEMENT: The positional co-ordinates, which were obtained from SHELXS 97 and isotropic temperature factors, were subjected to refinement by [6]SHELXL refinement program. After so many cycles of refinement the R factors dropped to **0.0225** Further refinement of the structure was carried out with individuals an isotropic temperature factors of the exponential form.**-2P$_1$^ 2[h^2a*^2U$_{11}$+----------+2hKa*bxU$_{12}$** reduced R factor to **0.0225**. 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.

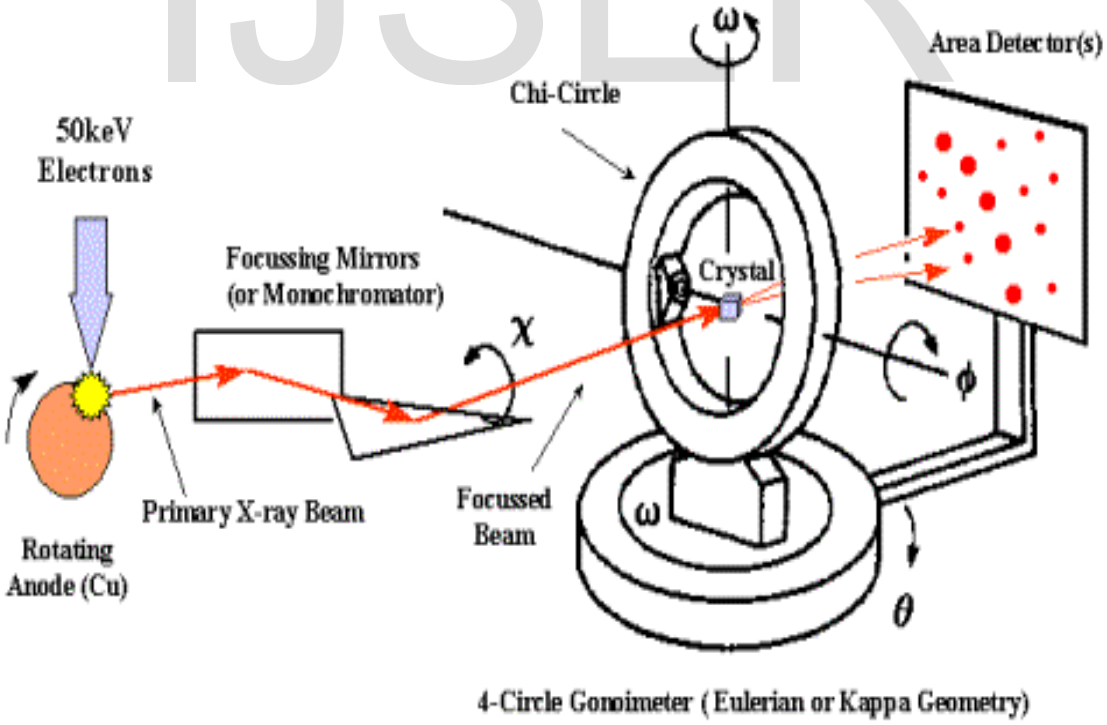

Figure 1. The experimental setup of 4- circle Gonioimeter (Eulerian or Kappa Geometry)

Table 1- Preliminary Crystal data of Monceren

Mol. Weight:	328.84
Molecular formula :	C19H21ClN2O
a	**12.1887(12)**
b	**8.7677(8)**
c	**33.063(4)**
angle_alpha	**90** ^{o}
angle_beta	**90** ^{o}
angle_gamma	**90** ^{o}
Crystal Type	**Orthorhombic**
volume	**3533.3(6)** A^3
Z	**8**
temperature	**293(2)** °K
Crystal size_max	**0.46**
Crystal_size_mid	**0.12**
Crystal_size_min	**0.06**
Calculated density	**1.236** Mg/m^3
F(000)	**1392**
Absorption coefficient mu	**1.950**
Absorption correction_T_min	**0.4674**
Absorption correction_T_max	**0.8920**
radiation_wavelength	**1.54184**
radiation_type	**Cu** $K\alpha$
radiation_source	**'fine-focus sealed tube'**
_diffrn_reflns_number	**7501**
_diffrn_reflns_av_R_equivalents	**0.0225**
_diffrn_reflns_av_sigmal/netl	**0.0351**
_diffrn_reflns_limit_h_min	**-14**
_diffrn_reflns_limit_h_max	**7**
_diffrn_reflns_limit_k_min	**-10**
_diffrn_reflns_limit_k_max	**5**
_diffrn_reflns_limit_l_min	**-33**
_diffrn_reflns_limit_l_max	**40**
_diffrn_reflns_theta_min	**4.51**
_diffrn_reflns_theta_max	**71.75**
_reflns_number_total	**3391**
computing_structure_solution	**'SHELXS-97**
_diffrn_measured_fraction_theta_max	**0.979**
diffrn_reflns_theta_full	**25.00**
diffrn_measured_fraction_theta_full	**0.997**
_refine_diff_density_max	**0.158**
_ _refine_diff_density_min	**-0.218**

refine_diff_density_rms	0.035

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Table 2- Fractional coordinates of hydrogen and non-hydrogen atoms and the equivalent isotropic and anisotropic thermal parameter with standard deviations in parenthesis of monceren N-((4-chlorophenyl)methyl)-N-cyclopentyl-N'-phenylurea

atom	x	y	z	U (eq)
H1 H	0.252(2)	0.327(3)	0.6785(8)	0.059(8)
H2 H	0.078(2)	0.348(3)	0.7071(9)	0.074(9)
H3 H	-0.029(3)	0.439(3)	0.7582(9)	0.079(9)
H4 H	0.036(3)	0.617(4)	0.8012(11)	0.106(12)
H5 H	0.222(2)	0.720(3)	0.7882(9)	0.074(9)
H6 H	0.317(2)	0.631(3)	0.7373(8)	0.060(8)
H8 H	0.389(2)	0.216(3)	0.6611(8)	0.063(8)
H9A H	0.351(3)	0.137(4)	0.5964(12)	0.113(13)
H9B H	0.466(3)	0.213(4)	0.5791(11)	0.093(11)
H12A H	0.551(4)	0.213(5)	0.6878(15)	0.142(17)
H12B H	0.598(3)	0.296(4)	0.6493(9)	0.078(10).
H13A H	0.502(2)	0.601(3)	0.6210(9)	0.074(9)
H13B H	0.545(3)	0.439(3)	0.6017(9)	0.082(9)
H15 H	0.535(3)	0.690(3)	0.5511(10)	0.085(10)
H16 H	0.453(3)	0.761(5)	0.4881(13)	0.126(14)
H18 H	0.203(3)	0.488(4)	0.5141(11)	0.095(11)
H19 H	0.283(3)	0.409(4)	0.5720(10)	0.086(10)
C1 C	0.2087(2)	0.4804(3)	0.71608(8)	0.0556(6)
C2 C	0.1040(2)	0.4241(3)	0.72295(10)	0.0645(7)
C3 C	0.0426(3)	0.4760(4)	0.75506(11)	0.0742(8)
C4 C	0.0831(3)	0.5866(4)	0.77989(11)	0.0787(9)
C5 C	0.1863(3)	0.6450(3)	0.77304(10)	0.0744(8)
C6 C	0.2495(2)	0.5906(3)	0.74140(9)	0.0620(7)
C7 C	0.34085(19)	0.4963(3)	0.66016(8)	0.0542(6)
C8 C	0.4376(3)	0.2518(3)	0.64203(10)	0.0726(8)
C9 C	0.4294(4)	0.1577(4)	0.60366(14)	0.0947(11)
C10 C	0.4953(4)	0.0163(4)	0.61387(14)	0.1194(16) Uani
H10A H	0.4499	-0.0577	0.6278	0.143 Uiso
H10B H	0.5240	-0.0303	0.5895	0.143 Uiso
C11 C	0.5868(4)	0.0688(5)	0.64056(16)	0.1188(15)
H11A H	0.6537	0.0809	0.6250	0.143 Uiso
H11B H	0.6002	-0.0052	0.6618	0.143 Uiso
C12 C	0.5528(4)	0.2192(5)	0.65851(15)	0.0938(11) Uani
C13 C	0.4763(2)	0.5021(4)	0.60796(9)	0.0655(7) Uani
C14 C	0.4188(2)	0.5445(3)	0.56883(8)	0.0606(7) Uani
C15 C	0.4689(3)	0.6469(4)	0.54301(10)	0.0712(8) Uani
C16 C	0.4222(3)	0.6857(4)	0.50629(11)	0.0825(9) Uani
C17 C	0.3244(3)	0.6222(4)	0.49557(10)	0.0805(9) Uani
C18 C	0.2719(3)	0.5221(5)	0.52053(12)	0.0861(10) Uani
C19 C	0.3192(3)	0.4834(4)	0.55726(11)	0.0757(8) Uani
N1 N	0.27158(18)	0.4151(2)	0.68468(7)	0.0621(6) Uani
N2 N	0.41112(18)	0.4150(2)	0.63656(7)	0.0626(6) Uani
O1 O	0.34004(14)	0.63661(18)	0.65913(6)	0.0622(5) Uani
Cl1 Cl	0.26582(10)	0.66975(16)	0.44908(3)	0.1236(5) Uani

Table 3 - bond length of **monceren N-((4-chlorophenyl)methyl)-N-cyclopentyl-N'-phenylurea**

Bond	Lenth
C1 - C6	1.372(4)
C1- C2	1.386(4)
C1- N1	1.412(3)
C2 - C3	1.376(4)
C3 - C4	1.363(5)
C4 - C5	1.377(5)
C5- C6	1.383(4)
C7 - O1	1.231(3)
C7- N2	1.360(3)
C7 - N1	1.370(3)
C8 - N2	1.478(4)
C8 - C9	1.516(5)
C8 - C12	1.533(5)
C9 - C10	1.515(6)
C10 - C11	1.495(6)
C11 - C12	1.504(5)
C13 - N2	1.452(3)
C13 - C14	1.518(4)
C14 - C19	1.380(4)
C14 - C15	1.381(4)
C15 - C16	1.383(5)
C16 - C17	1.363(5)
C17 - C18	1.364(5)
C17 - Cl1	1.745(3)
C18 - C19	1.386(5)

Table 4 - **Anisotropic displacement parameters (A^2 x 10^3) for monceren N-((4-chlorophenyl)methyl)-N-cyclopentyl-N'-phenylurea The anisotropic displacement factor exponent takes the form:**

-2 pi^2 [h^2 a*^2 U11 + ... + 2 h k a* b* U12]

Atom	U11	U22	U33	U23	U13	U12
C1	0.0587(14)	0.0428(12)	0.0653(16)	0.0035(11)	0.0076(12)	0.0066(10)
C2	0.0603(15)	0.0527(14)	0.0804(19)	0.0034(14)	0.0089(14)	0.0026(13)
C3	0.0623(16)	0.0694(18)	0.091(2)	0.0125(17)	0.0197(16)	0.0092(15)
C4	0.085(2)	0.0732(19)	0.078(2)	0.0070(17)	0.0242(18)	0.0208(17)
C5	0.091(2)	0.0621(16)	0.0701(19)	-0.0039(15)	0.0067(17)	0.0088(16)
C6	0.0635(15)	0.0499(14)	0.0725(17)	0.0010(12)	0.0106(14)	0.0039(12)
C7	0.0553(13)	0.0473(13)	0.0599(14)	-0.0022(11)	0.0019(11)	0.0001(11)
C8	0.0779(19)	0.0601(16)	0.080(2)	-0.0060(14)	0.0235(17)	0.0048(14)
C9	0.099(3)	0.079(2)	0.106(3)	-0.031(2)	0.011(2)	0.002(2)
C10	0.153(4)	0.075(2)	0.130(4)	-0.031(2)	0.031(3)	0.026(2)
C11	0.124(3)	0.091(3)	0.141(4)	-0.011(3)	0.017(3)	0.040(3)
C12	0.106(3)	0.077(2)	0.098(3)	-0.001(2)	-0.003(2)	0.021(2)
C13	0.0592(15)	0.0702(17)	0.0670(17)	0.0008(14)	0.0123(14)	-0.0067(14)

C14	0.0590(14)	0.0596(15)	0.0633(15)	-0.0094(12)	0.0147(12)	0.0015(12)
C15	0.0677(18)	0.0696(17)	0.0762(19)	-0.0015(15)	0.0101(15)	-0.0032(15)
C16	0.087(2)	0.085(2)	0.075(2)	0.0110(18)	0.0154(18)	0.0076(18)
C17	0.078(2)	0.095(2)	0.0686(19)	-0.0095(17)	0.0053(16)	0.0227(18)
C18	0.066(2)	0.102(3)	0.091(3)	-0.018(2)	-0.0004(18)	0.0040(18)
C19	0.0666(17)	0.080(2)	0.080(2)	0.0008(17)	0.0046(16)	-0.0083(15)
N1	0.0685(13)	0.0417(11)	0.0760(15)	-0.0076(10)	0.0187(12)	-0.0048(10)
N2	0.0662(13)	0.0529(11)	0.0687(13)	-0.0024(10)	0.0162(11)	-0.0006(10)
O1	0.0681(11)	0.0465(9)	0.0718(12)	-0.0010(8)	0.0064(9)	- 0.0023(8)
Cl1	0.1166(8)	0.1766(12)	0.0777(6)	0.0038(6)	-0.0059(5)	0.0452(7)

Table 5

Bond Angles [A] of monceren N-((4-chlorophenyl)methyl)-N-cyclopentyl-N'-phenylurea

C6 C1 C2	119.0(3)	
C6 C1 N1	122.5(2)	
C2 C1 N1	118.4(2)	
C3 C2 C1	120.6(3)	
C4 C3 C2	120.2(3)	
C3 C4 C5	119.7(3)	
C4 C5 C6	120.3(3)	
C1 C6 C5	120.2(3)	
O1 C7 N2	120.9(2)	
O1 C7 N1	122.1(2)	
N2 C7 N1	117.1(2)	
N2 C8 C9	114.2(3)	
N2 C8 C12	115.1(3)	
C9 C8 C12	104.8(3)	
C10 C9 C8	102.9(4)	
C11 C10 C9	106.0(3)	
C10 C11 C12	107.2(3)	
C11 C12 C8	106.0(4)	
N2 C13 C14	115.5(2)	
C19 C14 C15	118.0(3)	
C19 C14 C13	123.2(3)	
C15 C14 C13	118.8(3)	
C14 C15 C16	121.4(3)	
C17 C16 C15	119.2(3)	
C16 C17 C18	121.0(3)	
C16 C17 Cl1	119.3(3)	
C18 C17 Cl1	119.7(3)	
C17 C18 C19	119.5(3)	
C14 C19 C18	120.9(3)	
C7 N1 C1	124.0(2)	
C7 N2 C13	116.3(2)	
C7 N2 C8	125.1(2)	
C13 N2 C8	118.0(2)	

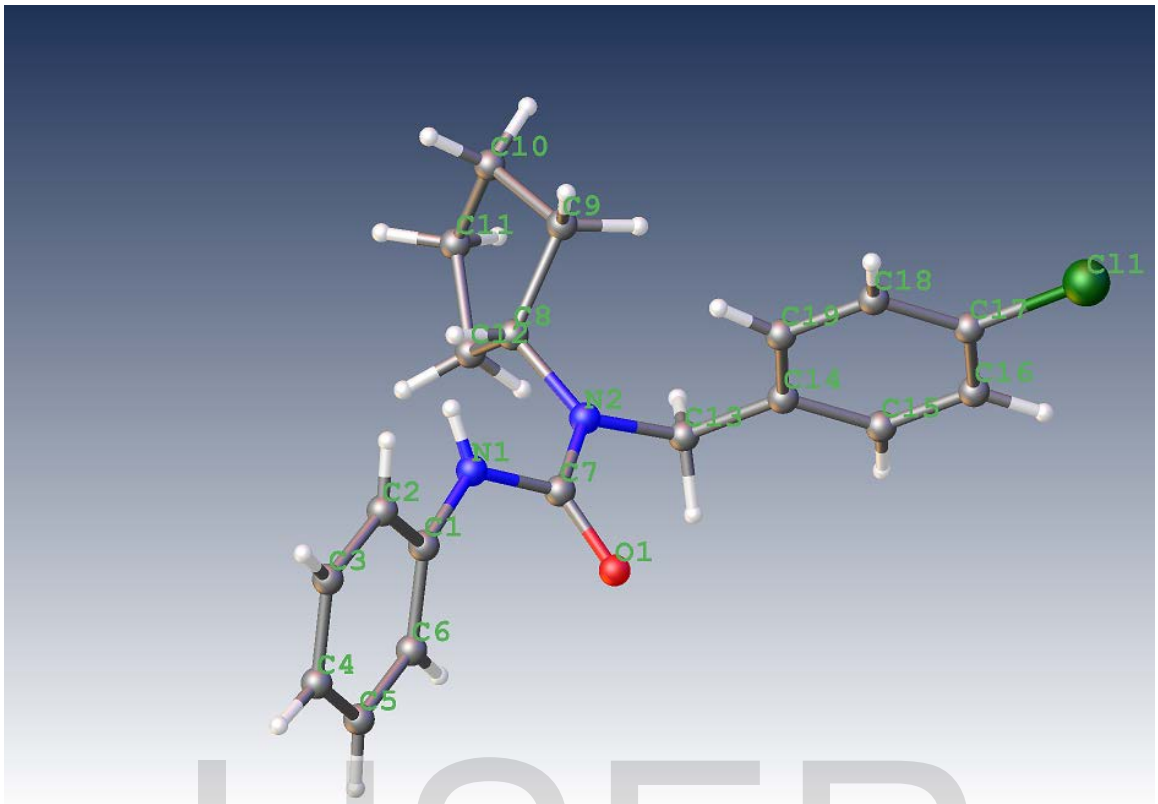

Figure 2 Ortep diagram of Monceren

Discussion: : Atomic coordinates (x 10^4) and equivalent Isotropic displacement parameters (A^2 x 10^3) for Pencycuron is shown in Table 2. Bond lengths [A] Bond angles [deg] for Pencycuron is shown in Table 3.Anisotropic displacement parameters (A^2 x 10^3) for is shown in Table 4. The anisotropic displacement factor exponent takes the form:--2 pi^2 [h^2 a*^2 U11 + ... + 2 h k a* b* U12]. Hydrogen coordinates (x 10^4) and isotropic displacement parameters (A^2 x 10^3) for Pencycuron is shown in Table 5. Torsion angles [deg] is shown in Table 6.The ORTEP[6] diagram is shown in fig.2.. In one Benzene ring distance between C(1)-C(2) is 1.386(4) Å, C(2)-C(3) is 1.376(4) Å C(3)-C(4) is 1.363(3) Å , C(4)-C(5) is 1.377 Å, C(5)-C(6) is 1.383(2 Å) and C(1)-C(6) is 1.372(2) Å.. In another Benzene ring distances between C(14)-C(15) is 1.381(4 Å), C(15)-C(16) is 1.383(4) Å , C(16)-C(17) is 1.363 Å, C(17)-C(18) is 1.364(2) Å and C(18)-C(19) is 1.386(2) Å. The bond lengths and angles in the benzene ring show regular features in the molecule.C-C distances are short and shortening may be due to delocalization of electrons from the benzene rings The average bond distances of C-H is 0. 96(2)Å.The distance **C1- N1 is 1.412(3)** Å **, C7- N2 is 1.360(3)** Å
,C8 - N2 is 1.478(4) Å. The average bond distances of C-N is 1.3205 Å. The whole molecules appeared to be twisted and folded and reason may be due to stacking constraints[8]. 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[9] The bond distances in the five member ring are comparable to corresponding distances in heterocyclic ring 1.

339(Å)[8]. The average value of bond lengths and angles in the rings derived from most reliable set of data by Spencer are 1. 377Å and 119º, respectively.[10]

The equations of the Least squares planes, calculated using [7]Blow method.

Conclusion: Substitution of existing highly toxic agrochemical compounds by the newer less toxic compounds in areas where the incidence of their poisoning is high may help to save a number of precious lives.But such occurrence by these so called nontoxic compounds is a big challenge to community health. Their clinical consequences are not very well described and outcomes rely on early recognition, prompt referral and aggressive treatment in collaboration with different specialties. Therefore such information/case reports may help to improve clinical management and inform pesticide regulators of their relative toxicity. Awareness programs about such new toxicities are also highly valuable.Though the appropriate and timely management has vital role, the importance of preventive measures and public awareness cannot be ignored in saving precious lives and should be implemented at different levels

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

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