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A novel spot test for detection of Paraquat and Monocrotophos

World's first example of detection of a pesticide using another pesticide as a reagent

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Abstract : A novel spot test is reported for detection of highly poisonous herbicide paraquat and organophosphorus insecticide Monocrotophos.

***IndexTerms* – spot test, paraquat, diquat, monocrotophos, viologens, organophosphorus insecticide, forensic**

I INTRODUCTION

Paraquat and diquat are one of the most commonly used herbicides worldwide for protection of various crops. These are mostly used as a contact herbicide to control weed, desiccants and as plant growth- regulator and are highly toxic to humans and animals alike (1). easy availability of these compounds leads to many suicidal and homicidal poisoning cases. Hence the detection of such compounds in medico-legal cases is very obligatory. earlier reported reagents for detection of paraquat include sodium dithionite (2), sodium borohydride(3), ascorbic acid(4), glucose(5), sodium tetraphenylborate(6), alkaline phenylhydrazine (7) and alkaline stannous chloride (8) were used for the detection of such herbicides using spot test, spectrophotometric and thin layer chromatography method for biological samples of forensic interest.

Organophosphorus insecticide monocrotophos is one of the most used and easily available insecticide in agriculture to control insects. Many accidental and suicidal poisoning cases reported involve fatal poising due to monocrotophos i,ndicating necessity to identify such compound at trace level. Several chromogenic reagents like diazotized sulphanilamide or sulphanilic acid (9), vanillin (10), Methanolic Ferric chloride(11) and Sodium Nitroprusside(12) have been reported for detection of monocrotophos.

This work shows the first example in the world in which organophosphorus insecticide Monocrotophos is used for the detection of paraquat. Oppositely monocrotophos can be detected by using paraquat and Diquat . Such use of one poison to detect another poison has never been reported to the best of our knowledge.

II. NEED OF THE STUDY.

The detection of poisons is of utmost importance especially in cases of Forensic interest. In a country like India, where Agriculture is still a main source of income of crores of population the use of pesticide is inevitable for crop protection The ever growing population of the country demands high production of agri foods and hence the crop protection using just organic pesticides is impossible. The man-made chemical pesticides are a need of time.

There is very little awareness among farmers about the poisonous nature of the pesticides they are using in farms. This leads to accidental deaths by consumption of these poisons. However the major chunk of the Forensic cases that are dues to pesticide poisoning is due to suicidal consumption of these substances. No matter what is the history of poisoning, the duty of Forensic expert is to find the poison involved in suicidal death of the victim. After autopsy, when the visceral material is sent to the Forensic department the expert needs to find the poison involved in the death. To do so, he must have reagents which can detect the presence of poison from visceral material. Viscera being a complex matrix, the detection of any poison from viscera is critical as compared to its detection in pure form. More the specificity of the reagent, more it can point out towards the exact poison involved. More the sensitivity, the more it can detect the minute quantities of the poison. The need for specific and sensitive reagents for detection of poisons is thus very clear in the field of Forensic.

III RESEARCH METHODOLOGY

3.1 Detection of paraquat by using alkaline Monocrotophos

A drop of dilute commercial formulation of Paraquat Dichloride was taken into spot dish depression labeled as 'A', 'B' and 'C'. Few drops of 2N sodium hydroxide were added to 'A'. Few drops of dilute commercial formulation of monocrotophos were added to 'B' and few drops of 2N sodium Hydroxide and diluted solution of monocrotophos were added into 'C' . Intense purple color was developed in depression 'C' which represents the presence of paraquat. Depression 'A' shows there is no change in color by addition of 2N Sodium Hydroxide. Similarly depression 'B' represents this reaction is not possible without alkaline condition.

3.2 Detection Monocrotophos by using Paraquat

Few drops of diluted solution of Monocrotophos in depression 'D', 'E' and 'F' was taken for a spot test. Then a few drops of 2N sodium hydroxide into 'D', paraquat into 'E' and in 'F'. Then a few drops of sodium hydroxide followed by a diluted solution of Paraquat were added. intense purple color is observed in only depression 'F'. there is no reaction in depression 'D' and 'E' shows that there is no color change between Monocrotophos - Sodium hydroxide and monocrotophos paraquat

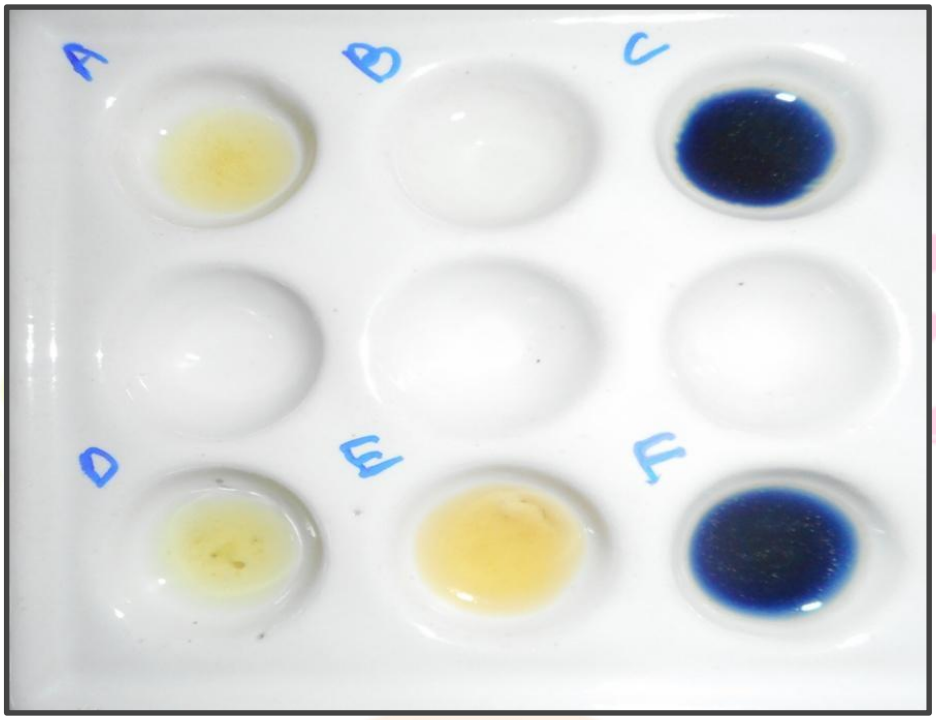

Fig 1. Spot dish showing reaction of Paraquat dichloride Sodium Hydroxide and Monocrotophos with each other . A) First paraquat dichloride and then Sodium Hydroxide.B) First paraquat dichloride then Monocrotophos C) First paraquat dichloride then Sodium Hydroxide and then Monocrotophos , D) First Monocrotophos and then paraquat dichloride. E) First Monocrotophos then Sodium Hydroxide F) First Monocrotophos then Sodium Hydroxide and then paraquat dichloride.

IV Result and discussion

After addition of all reagents intense purple color is developed for reaction between paraquat, monocrotophos and sodium hydroxide. Paraquat has redox properties, paraquat on reduction forms intense purple colored radical cation fig 2. Reducing reagents like phenylhydrazine (7) Stannous chloride (8) are reported for reduction reaction of paraquat into intense purple colored radical cation. Interestingly intense purple color observed in reaction between paraquat dichloride , sodium hydroxide and Monocrotophos Fig.1 depression 'C' and 'F' but there no reaction between paraquat and monocrotophos without Sodium Hydroxide Fig.1 (A,B,D and E). Organophosphorus insecticide Monocrotophos (Nuvacron) produces beta keto amide Fig 2. On hydrolysis with sodium hydroxide this formation of beta keto amide is well known (12). This beta keto amide is very reactive because of its active methylene group. This active methylene participates in redox reaction via radical reaction to form radical cation in intense purple in color.

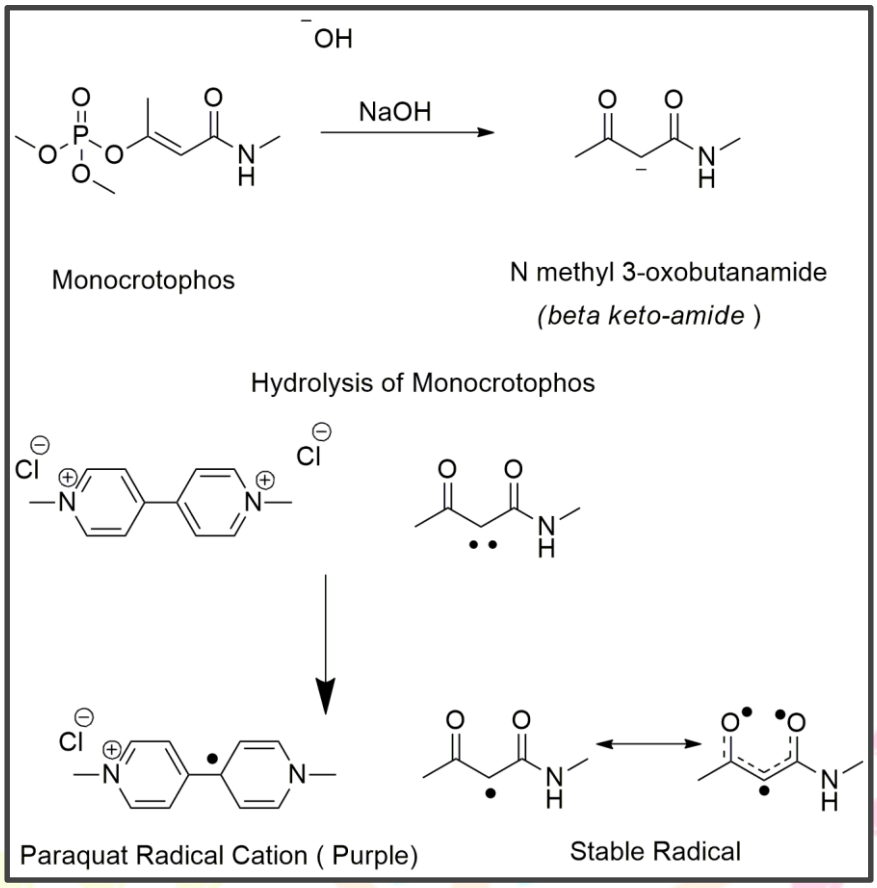

Fig 2 . Probable mechanism of reaction between Paraquat dichloride , Sodium Hydroxide and Monocrotophos.

V Significance of the work

There are many examples where some type of known chemical reagent is used to detect various pesticides. However this is probably the world's first example where one pesticide sample is used as a reagent for detection of another pesticide.

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