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SYNERGY BETWEEN AN ALIPHATIC ALDEHYDE AND AN AROMATIC ALDEHYDE IN CONTROLLING FUNGAL INFECTION IN GRAINS

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Aliphatic aldehydes (citronellal and cinnamaldehyde) and aromatic aldehydes (furfural and cuminaldehyde) were applied separately and in binary mixtures to the grains of pearl-millet. The mixtures of two types of aldehydes, one aliphatic and the other aromatic, exhibited a strong synergism in controlling fungal growth in grains. The synergy factors were 5.9 , 5.48, 4.77 and 4.61 for the combinations, citronellal + furfural, cinnamaldehyde + furfural, citronellal + cuminaldehyde and cinnamaldehyde + cuminaldehyde respectively.

INTRODUCTION

The antifungal compounds in binary mixtures often exibit synergism in controlling fungal growth in grains. Such synergistic actions not only accelerate the death of seed-borne fungi but also do so at a much lower dose (Hearting and Drury, 1974). Thus the application of a fungicide mixture is practically useful and quite promising in view of its low EFL (effective fungicidal level). In recent past, therefore, some experiments have been carried out to evaluate the synergistic action of some anti-fungal fatty acids, aldehydes, ketones and esters in mixtures (Nandi and Fries, 1976; Nandi, 1977 ; Nandi, 1978). Nevertheless, our knowledge in this direction is still very meagre.

In the present investigation, the synergy between an aliphatic and an aromatic aldehydes in controlling fungal infection in grains has been studied.

MATERIALS AND METHODS

Treatment with aldehydes

Grains (with 25% fungal infection) of pearl-millet (*Pennisitum typhoideum*) were collected after harvest and kept in closed polythene bags. These were treated with citronellal, cinnamaldehyde, (aliphatic aldehydes), furfural and cuminaldehyde (aromatic aldehydes) individually and in binary combinations (aliphatic aldehyde +aromatic aldehyde) at measured volume of 5μl/g of grains. Replicate sets, together with control (untreated) were kept for 3 days with periodic shaking after

which the polythene bags were made perforated for a easy escape of the excess volatile compounds. Grains were then stored at room temperature under natural conditions for 30 days.

Estimation of synergistic action

Synergistic action of binary mixtures of an aliphatic and an aromatic aldehydes was determined by estimating percentage control of infection in grains (both untreated, and treated with individual aldehydes and their mixtures) after 30 days of storage. Grains (surface sterilized with 2% sodium hypochlorite) were placed both on malt agar and on salt malt agar (10% NaCl in 2% malt agar) in petriplates and incubated at 30°± 1°C for 10 days. Fungi that grew out of the grains were isolated and identified.

Synergy factor determination

Synergy factor was calculated by the formula of Samoucha and Cohen (1984) :

$$\text{Synergy factor(Sf)} = \frac{C_M}{(C_a + C_b) - 0.01\, C_a C_b.}$$

where C_a and C_b are the percentages of 'infection control' by the compounds a and b respectively, and C_M represents percentage of 'infection control' by their mixtures. An Sf value greater than 1 indicates synergistic action, while the Sf value of 1 indicates additive action.

RESULTS

The untreated control grains showed a 100% fungal infection after 30 days of storage. *Aspergillus flavus*, *A. glaucus* and *A. Sydowi* were the predominant fnngi. Grain infection was controlled by 10%, 12% 5% and 11% when treated with citronellal, cinnamaldehyde, furfural and cuminaldehyde respectively at 5μl/g of grains (Table 1). Binary mixtures (5 + 5μl/g) of citronellal + furfural, cinnamaldehyde + furfural. citronellal + cuminaldehyde and cinnamaldehyde + cuminaldehyde controlled fungal infection 86%, 90%, 95% and 100% of grains respectively through their synergistic action showing synergy factors of 5.93 to 4 61. It was interesting to note that the mixture of cinnamaldehyde and cuminaldehyde, though controlled the grain infection by 100%, exhibited less synergism (Sf =4.61) than that of the other combinations. Similarly, the combination citronellal + furfural though provided a 86% control, showed the highest synergism (Sf= 5.93).

DISCUSSION

It is clearly evident from the results depicted in Table 1 that there exists a strong

Table 1. *Synergistic action of aldehydes in binary mixtures in controlling fungal growth for 30 days of storage*

Compounds and treatment level (μl/g)				Infection* Control(%)	Synergy factor
Aliphatic Aldehydes		*Aromatic aldehydes*			
Citronellal	Cinnamaldehyde	Furfural	Cuminaldehyde		
5	0	0	0	10	—
0	5	0	0	12	—
0	0	5	0	5	—
0	0	0	5	11	—
5	0	5	0	86	5.93
0	5	5	0	90	5.48
0	5	0	5	100	4.61
5	0	0	5	95	4.77

* Mean of three replicates

synergism between an aliphatic aldehyde and an aromatic aldehyde i.e , the fungicidal efficacy of a mixture of two types of aldehydes, one aliphatic and the other aromatic, is much greater than the arithmatic sum of the efficacies of the individual compounds. Amongst the four sets of combinations studied, citronellal + furfural exbits the highest synergism with a synergy factor of 5.93. The synergism between cinnamaldehyde and furfural is also quite high (Sf=5.48). The combinations, citronellal + cuminaldehyde and cinnamaldehyde + cuminaldehyde show almost the same degree of synergism possessing the synergy factor of 4.77 and 4.61 respectively,

The mechanism by which such synergism occurs, remains to be seen. However, it is apparent that the sub-lethal dose of one type of aldehyde affects the fungal cell to such an extent that a sub-lethal dose of another aldehyde becomes fatal. It would therefore, be reasonable to speculate that the two types of aldehydes have different modes of action and they affect important metabolic reactions simultaneously.

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