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Assessment of particulate matter hazard in wheat thresher operators

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Abstract
The commercial wheat threshers when operated produce a sizeable amount of dust and the farm workers are exposed to it. In the present investigation three commonly used commercial wheat threshers were assessed for their particulate matter emissions. The mean dust concentrations of PM5 and PM10 were measured at the personal breathing zone (collar level) of the workers feeding crop in the feeding chute and collecting threshed grains at the grain outlet of the operating thresher. The research revealed that both the workers were exposed to a high level of dust concentrations exceeding the standard limits of 24 hour mean PM10 standard of 0.10 mg/m^3 recommended by National Ambient Air Quality Standards (NAAQS, 2009) given by Central Pollution Control Board, New Delhi and 0.15 recommended by Environment Protection Agency (EPA, US 2011). The highest mean dust concentration of PM5 and PM10 were observed 1.67 and 3.44 mg/m^3.

Keywords: Mean dust concentration, particulate matter, PM5, PM10, wheat threshing, wheat thresher

1. Introduction
Agricultural activities are often correlated with a work environment having high level of dust, atmospheric temperature, noise, chemical and biological agents and physical drudgery. In 16th century, dust exposure in agriculture was first identified as a cause of respiratory disease and has continued to be a major course of respiratory morbidity among farmers (Schenker 2000) [5]. Dust can result from many farm practices and could be a source of complaint concerning farm activities. Agricultural workers have shown to be exposed to a higher concentration of airborne dusts than non-agricultural workers (Lee *et al.* 2006) [2]. Wheat was amongst one of the first domesticated food crops for mankind. Wheat threshing dust has been identified as the major allergen responsible for mid-April-May nasobronchial allergy seen in north India (Lavasa *et al.* 1996) [1] and may cause asthma or other respiratory health issues over a long exposure in adult population. With India being one of the leading wheat producers of the world, farmers of India are more susceptible to this problem of dust exposure during the process of wheat threshing. The severity of the effects of dust related health hazard in terms of human health depends upon the source of dust particles, particle sizes, dust concentration and exposure time (Whitney 1988) [6]. Hence, the particle size distributions and dust concentrations are critical factors and hence, need to be assessed. The present investigation was conducted in order to assess the concentration of different types of dust fractions that the farm workers operating commercial wheat threshers are exposed to during the process of wheat threshing.

2. Research method
The present study was carried out in farmers field, Udaipur. Three commonly used commercial wheat threshers were selected for the present investigation. The threshers of capacity 600-800 (T1), 800-1200 (T2) and 1200-1500 kg/h (T3), were assessed for their dust emissions. All the three threshers were operated at their recommended PTO speeds. The measurement of mean dust concentration of dust fractions PM5 and PM10 was executed at two locations i.e., personal breathing zone of the worker feeding crop into the feeding chute of the wheat thresher (L1) and worker collecting threshed grains at the grain outlet of the wheat thresher (L2).
The measurements of mean dust concentrations of dust fraction PM10 and PM5 were carried out using Personal dust sampler APM800 and 801, respectively. A total sampling time of 30 minutes was taken for each reading. The sampling heads of the dust samplers were clipped on the collars of the farm workers. The personal respirable dust sampler APM 801 uses a cyclone

system which can be attached to APM 800 making it suitable for monitoring of respirable dust. The cyclone sampler can be clipped in breathing zone. Exploded view of cyclone unit is shown in figure1 and 2. The air leaving cyclone having particles of size 5 microns or less accumulate on glass microfiber filter of 37 mm diameter housed in leak proof Teflon filter holder fitted at the top of cyclone. Accumulated dust on the filter is quantified gravimetrically. For optimum efficiency of the cyclonic system flow rate needs to be maintained between 1.6 to 1.9 l/min.

2.1 Calculation of concentration of dust fractions PM5 and PM10

In the laboratory the filter from the filter cassette was carefully taken off and weighed on a micro balance with least count of 0.001mg.

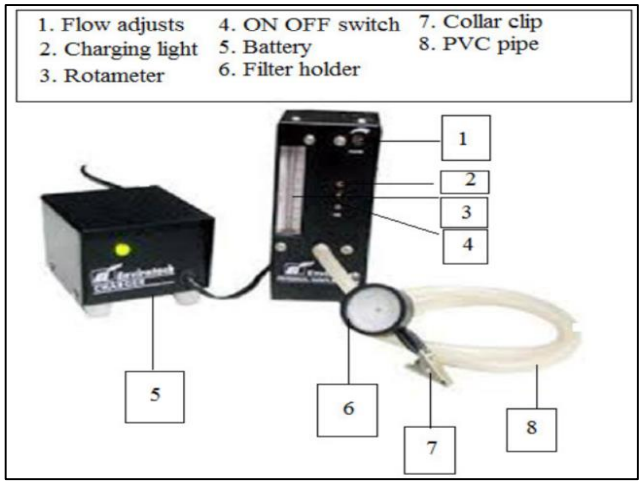

Fig 1: Personal dust sampler APM 800 (for PM10 dust sampling)

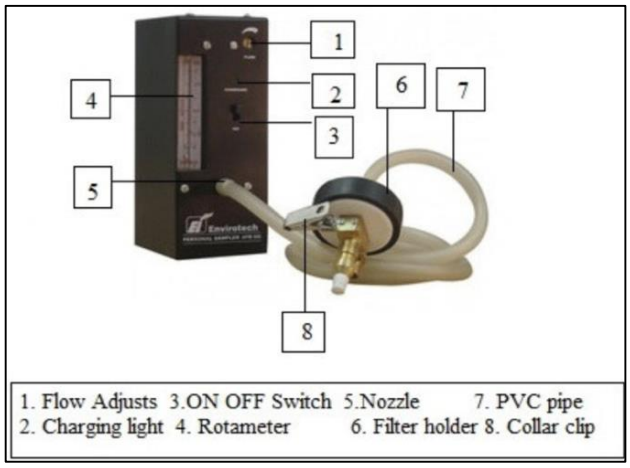

Fig 2: Personal respirable dust sampler APM 801 (for PM5 dust sampling)

The time average concentration of particulate matter in mg/m^3 is calculated by the following formula

$$C = \frac{(W_1 - W_2) \times 1000}{T \times (R_1 + R_2)/2} \quad (1)$$

Where

W_2 = initial filter weight, mg
W_1 = final filter weight, mg
R_1 = flow rate at start of measurement, l/min
R_2 = flow rate just before the end of measurement, l/min
T = sampling time, min

2.2 Statistical Analysis

The data collected in the experiments was analysed statistically in the two factorial CRD model for the significance of difference, if any, among parameters at one per cent and five per cent level of significance. Three replication of each treatment were carried out, where three threshers (T1, T2 and T3) and two location (L1 and L2) at which measurements were executed were the independent parameters. The selected dependent parameters were mean dust concentrations of dust fraction PM5 and PM10.

3. Research findings and Discussions

The mean dust concentrations (mg/m^3) measured at the personal breathing zone of the farm worker feeding crop into the feeding chute for all the three threshers has been presented in table 1. It was observed that thresher T2 exhibited overall highest mean dust concentrations of dust fractions PM5 and PM10 at the personal breathing zone of the workers at feeding chute. The thresher T1 emitted the lowest values of mean dust concentration of dust fractions PM5 and PM10 at the personal breathing zone of the workers at feeding chute. The mean dust concentrations (mg/m^3) measured at the personal breathing zone of the farm worker collecting threshed grains at the grain outlet for all the three threshers has been given in table 2. It was observed that thresher T2 exhibited overall highest mean dust concentration of dust fractions PM5 and PM10 at the personal breathing zone of the workers at grain outlet. The lowest values of mean dust concentration of dust fractions PM5 and PM10 at the personal breathing zone of the workers at grain outlet, were witnessed during the operation of thresher T3

Table 1: Mean concentrations (mg/m^3) of dust fraction PM5 and PM10 at feeding chute of the thresher (L1)

	PM5	**PM10**
T1	1.51	2.74
T2	1.67	3.44
T3	1.61	3.29

Table 2: Mean concentrations (mg/m^3) of dust fraction PM5 and PM10 at grain outlet of the thresher (L2)

	PM5	P10
T1	0.70	1.16
T2	0.78	1.34
T3	0.50	1.04

Table 3: Overall Mean concentrations (mg/m^3) of dust fraction PM5 and PM10 during the operation of thresher T1, T2 and T3

	PM5	**PM10**
T1	1.11	1.95
T2	1.23	2.39
T3	1.05	2.16

The analysis of the variance of the recorded data revealed that a highly significant effect (1 per cent level of significance) on mean dust concentrations of dust fractions PM5 and PM10 was observed at both the locations at which the data were recorded i.e., at the personal breathing zone of the worker feeding crop into the feeding chute and the worker collecting threshed grains from the grain outlet. The higher mean dust concentration of PM5 and PM10 were observed at the personal breathing zone of the worker feeding crop into the

feeding chute and the lower mean dust concentration of PM5 and PM10 were witnessed at the personal breathing zone of the worker gathering threshed grains from the grain outlet. The variation of the threshers also had a highly significant effect (1 per cent level of significance) on the mean dust concentration of PM10 and a significant effect (5 percent level of significance) on PM5. The highest mean dust concentration of both the dust fractions PM5 and PM10 were exhibited during the operation of thresher T2. The lowest mean concentration of PM5 and PM10 was exhibited during the operation of thresher T3 and thresher T1, respectively. The combination of interaction between thresher and the location, had a significant effect (5 per cent level of significance) on the mean dust concentration of PM10 and no effect on the mean dust concentration of PM5. The highest mean dust concentration of PM10 was observed at the treatment combination L1T2. The lowest mean dust concentration of PM10 was observed at the treatment combination L2T3.

The study revealed that overall mean dust concentrations at the breathing zone of farm workers feeding crop into the feeding chute and collecting threshed grains from the grain outlet were significantly high during the operation of Thresher 2 than that of Thresher 1 and Thresher 3. This could be due to the lower crop handling capacity of Thresher 1 and a covered pipe type grain outlet and a bucket type feeding chute of Thresher 3, which was closer to the ground, hence reducing the probability of dust emissions into the breathing zone of the farm workers, whereas, with Thresher 2, the feeding chute was closer to the breathing zone of the workers.

On comparing the recorded values of mean dust concentrations (mg/m^3) of PM10 at the personal breathing zone of the workers feeding crop into the feeding chute and collecting threshed grains from the grain outlet of the thresher with the standard limits of 24 hour mean PM10 standard of 0.15, 0.10 and 0.050 mg/m^3 recommended by Environmental protection agency (EPA US, 2011), National Ambient Air Quality Standards (NAAQS, 2009) given by Central Pollution Control Board, New Delhi and WHO air quality guidelines given in 2018, respectively, it was observed that the mean concentrations of PM10 recorded in the current study exceed the standard limits.

4. Conclusions

It can be concluded that the workers performing wheat threshing operation with commercial wheat threshers are exposed to a potentially higher level of dust concentrations. Since the dust concentrations exceeded all recommenced standard exposure limits, it is imperative to design and develop technologies and policies keeping into consideration the health hazards, wheat thresher operators are exposed to. The results obtained in the study will aid bringing in awareness and knowledge for the same.

5. References

1. Lavasa S, Kumar L, Kaushal SC, Ganguli NK. Wheat threshing dust – A new allergen in April-May nasobronchial allergy. Indian Pediatrics 1996;(33**):**566-570.
2. Lee S, Adhikari A, Grinshpun SA, McKay R, Shukla R, Reponen T. Personal exposure to airborne dust and microorganisms in agricultural environments. Journal Occupational and Environmental Hygiene 2006; 3(3):118-130.
3. National Ambient Air Quality Standards Central Pollution Control Board Notification. New Delhi 2009.
4. Pandirwar A, Kumar A, Singh JK, Mani I, Jha SK, Ramasubramanian V. Agricultural dust protective interventions for farm workers. Indian Journal of Agricultural Sciences 2014;84(1):28-36.
5. Schenker M. Exposures and health effects from inorganic agricultural dusts. Environmental Health Perspectives 2000; 108(4):661-664.
6. Whitney B. Choosing and Using farm Machines. John Wiley and Sons Inc, New York 1988.