

Positioning of Measurement Points when Measuring the Noise Impact of Tractors on Agricultural Workers

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ABSTRACT:The article examines the study of existing schemes for measuring points in determining the level of noise produced by tractors. The positioning of the seats, and hence the auxiliary agricultural workers, in the horizontal and vertical directions of the seedling planting machines. It was established that the seats are not located along an arc of a circle, but in a line or checkerboard in a rectangular area horizontally, vertically the points must be at two levels - 1.1 m and 1.7 m. The results will serve in subsequent measurements to more accurately determine the noise level at a specific workplace (seat of the machine), from which it follows that more adequate measures will be taken to protect the worker's health.

KEYWORDS: Noise, measuring points, scheme, agricultural workers, tractor

I. INTRODUCTION

In the past, traction power came from animal traction - horses, mules and donkeys, oxen and cows, camels and others. Nowadays, animal traction is used only on the smallest farms, while the rest use a tractor with an internal combustion diesel engine.

According to Kolev [1], now the main energy source in agriculture is the tractor equipped with an internal combustion engine.

The authors Dimitrov and Velev [2] have established that in agriculture the tractor is the main energy machine in carrying out almost the entire cycle of growing, harvesting and transporting agricultural produce.

Other authors have concluded that the agricultural tractor led to the development of the agricultural industry, but, like other new

technologies, it created noise pollution in the fields and created some problems for drivers and farmers [3].

The author Mihailov [4] specified the unit that creates noise pollution, namely: one of the main sources of noise in vehicles equipped with a diesel engine is the engine itself [5].

Noise pollution of the environment is also caused by the various systems and additional equipment of the tractor during the execution of a certain technological process.

In order to be able to establish the level of noise produced by the tractor and to analyze its impact on auxiliary agricultural workers, a scheme of the location of the measurement points is needed.

One such scheme was published by Kekhayov and Trifonov [6] in the article: "Noise effect of tractor stayer 942 upon the subsidiary agricultural workers" and then used by other authors (Fig. 1).

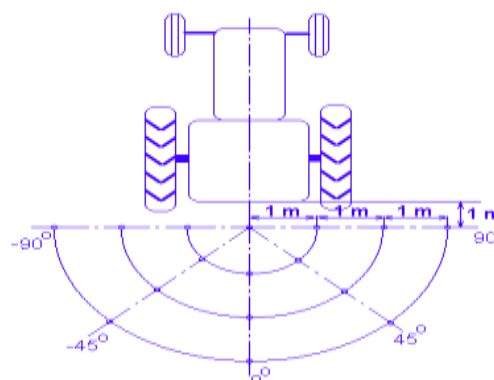


Figure 1. A scheme for positioning of measure points [5, 6, 7]

In the article: "Acoustic comparative analysis for tractors", the authors Sfiru et al [8] published another scheme (Fig. 2):

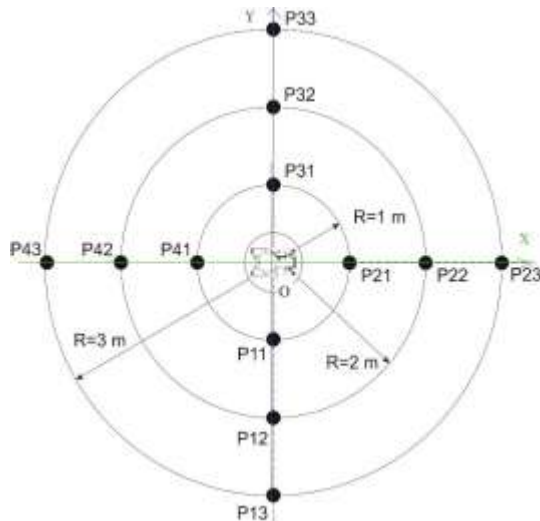


Figure 2. The scheme of the acoustic field measurement system generated by the operation of the tractor engine [8]

In the two schemes presented (Fig. 1 and Fig. 2), the measuring points behind the tractor are located on arcs of circles.

Ghotbi et al [3] and Monazzam [9] in their articles use a completely different scheme from the first two (Fig. 3):

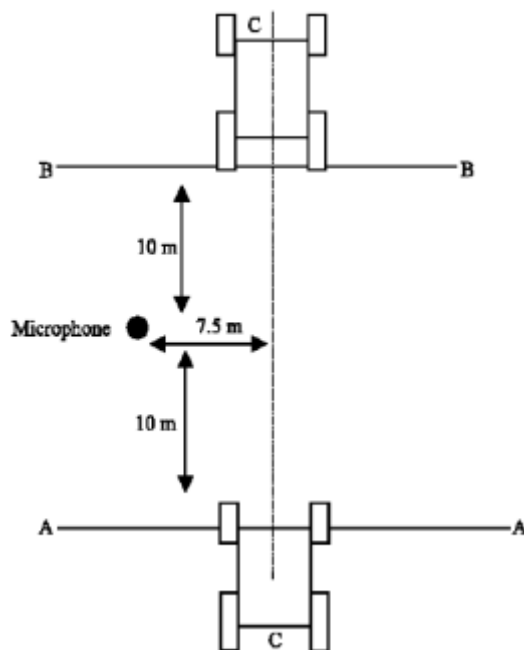


Figure 3. Scheme of Ghotbiet al [3] и Monazzam[9]

In this scheme, the microphone is placed on the sides motionless, and the tractor moves past it.

According to the "Approved methodology for determining the total sound power emitted into the environment by an industrial enterprise and determining the noise level at the point of impact" of the Ministry of Environment and Water of the Republic of Bulgaria [10] the measurement of the equivalent noise level L_{eq} , dB (A) is performed at measurement points located on a measurement loop (Fig. 4).

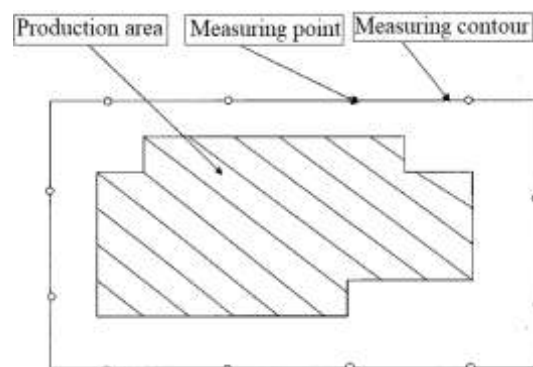


Figure 4. Measuring loop and measuring points [10]

According to Zahariev and Atanasov, the height of the location of the microphone above the earth's surface should be 1.1 m [7].

According to data of the international network of scientists in the field of health care NCD-RisC [11], the height of Bulgarian men is 174.2 cm, and of Bulgarian women 164.6 cm [12]. In the presence of different schemes for measuring the noise level, it is not yet fully understood which one is preferable.

II. MATERIALS AND METHODS

To determine the location of noise measurement points and its impact on auxiliary agricultural workers, the agricultural machine is analyzed. The places where it is possible to have sitting or standing workers are determined. The level of availability of their hearing organs - the ears. The way of positioning in relation to the source of noise - facing, with the back or on the sides. The device of the agricultural machine is taken into account, and more specifically, the presence of noise-insulating partitions or cabins. The presence of additional equipment mounted on the tractor, which in working conditions would represent a barrier to reduce the level of noise impact, is taken into account.

It is taken into account whether the technological process requires a tractor working on the spot or the

tractor is in motion together with the agricultural machine (in case of non-standard operations). The terrain on which the agricultural machine will work and its characteristics in terms of noise are determined.

III. RESULTS AND ANALYSIS

Different schemes of measuring point arrangement published by different authors were considered (Fig. 1 to Fig. 4).

The types of technological operations in which there is a presence of auxiliary agricultural workers (except for the tractor driver) are planting, sowing and others, which require slow movement of the machine on the field. The location of the agricultural machine is behind the tractor. Therefore, the location of the measuring points must be for the tractor.

This conclusion was also reached by the authors Zahariev & Atanasov [7] in the article "Noise effect of tractors purchased "second hand" upon the agricultural workers".

The constructions of various brands and models of agricultural machinery, in which there is a presence of auxiliary agricultural workers, were analyzed and the following was established:

With grain drills, the workers are standing and watching the process;

With the seedling machines, the workers are seated, which can be done in three variants:

- Facing the tractor;
- With your back to the tractor;
- Chess (Fig. 5).

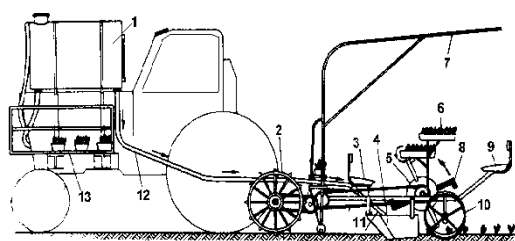


Figure 5. Schematic diagram of a seedling machine [13]

1 - water tank; 2 - wheel; 3 - first row of seats; 4 - boot; 5 - drive; 6 - seedling; 7 - canopy; 8 - planting device; 9 - second row of seats; 10 - wheels; 11 - tip; 12 - pipeline; 13 - rack

From the way the seats are arranged, the workers are arranged in a line or on a certain area with a rectangular shape.

In some machine designs, the seedling stands serve as a sound-insulating partition.

In the presence of additional equipment mounted on the tractor such as: seedling trays, water tanks also reduce noise.

When a canopy is installed to protect workers from the sun, we will have an increase in noise due to the fact that it acts resonantly.

Based on the analysis made so far for the placement of the microphone, the following can be summarized:

1. There are two positioning points in height above the earth's surface:

- at 1.1 m - from the study by Zahariev and Atanasov [7];

- at 1.7 m - average height of men and women in the Republic of Bulgaria:

$$(1.742 + 1.646) / 2 = 1.694 \approx 1.7 \text{ m}$$

The second height point of 1.7 m is introduced due to two facts:

- The possibility of having people walking behind the machine or standing on a step to the frame of the machine;

- from figure 5 it is clear that some machines have two rows of seats located at different levels.

2. The measurement points in the horizontal direction must not be located in an arc of a circle, but in straight lines perpendicular to the axis of the tractor and standing parallel to each other at a distance of 1 m, as visualized in figure 6.

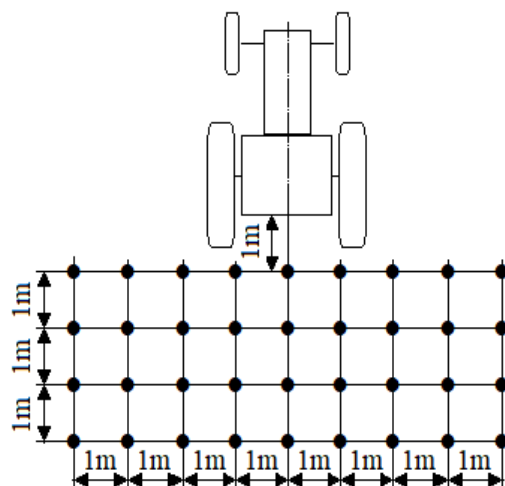


Figure 6. Scheme of the location of the measuring points

This layout of the measurement points (Fig. 6) makes it possible to accurately determine the noise level of each seat and to take individual adequate measures to protect the health of each worker.

IV. CONCLUSIONS

Based on the above, the following conclusions can be formulated:

1. The layout schemes of the measurement points used by different authors were examined.
2. After the analysis of existing constructions of agricultural machines, it was found that the arrangement of the seats of the workers are arranged in a line or on a certain area with a rectangular shape;
3. In terms of height, the measuring points are at two levels – 1.1 and 1.7 m above the ground.

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