УДК 631.95

4.3.1. Технологии, машины и оборудование для агропромышленного комплекса (технические науки, сельскохозяйственные науки)

**ИССЛЕДОВАНИЕ ВОДЯНОЙ СТРУИ В ПРОЦЕССЕ ОТМЫВА ЗАГРЯЗНЕНИЙ ОТ КОРНЕКЛУБНЕПЛОДОВ**

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В работе предлагается актуальное решение повышения качества очистки корнеклубнеплодов и показывает целесообразность разработки конструкции корнеклубнемойки по средствам динамической` водяной струи

Ключевые слова: КОРНЕКЛУБНЕПЛОДЫ, ПОЧВА, ВОДА, СТРУЯ, ДАВЛЕНИЕ

http://dx.doi.org/10.21515/1990-4665-213-004

UDC 631.95

4.3.1. Technologies, machinery and equipment for the agro-industrial complex (technical and agricultural sciences)

**INVESTIGATION OF A WATER JET IN THE PROCESS OF WASHING IMPURITIES FROM ROOT CROPS**

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The article proposes an urgent solution to improve the quality of root crop cleaning and shows the feasibility of developing a root cleaning design using dynamic water jet technology

Keywords: ROOT CROPS, SOIL, WATER, JET, PRESSURE

**Statement of the problem.** If you consider the wide variety of root crop washers, it's easy to see that the role of water in these machines is limited to soaking and rinsing the product being washed. The soaking process is time-consuming, and naturally, machines based on this cleaning principle are inefficient and bulky.

This principle does not correspond to the level of modern technology and the whole world is searching for new principles of separating contaminants from the surface of the washed product.

Indeed, the action of water cannot be reduced to just soaking dirt and rinsing the product; the jet of washing liquid should be the main factor in the washing machine.

**Solution methods.** It's crucial to properly select the design elements of the jet's primary working element, namely the nozzle diameter and the discharge pressure. It should be noted that the interaction between the cleaning fluid and the contaminants is highly complex, and analyzing it primarily requires studying the physical and mechanical properties of the contaminants being cleaned.

The main soil property that has the most significant impact on the leaching process is its root connectivity. Such data have not been reported in the literature to date.

To study soil-root connectivity, we constructed a special device (Figure 1). It consists of a platform 1, a fixed block 2, and a rod 3 located between ball bearings 4. A rod 5 with a pointed end is secured to the rod. Root holders 6 are mounted on the frame.

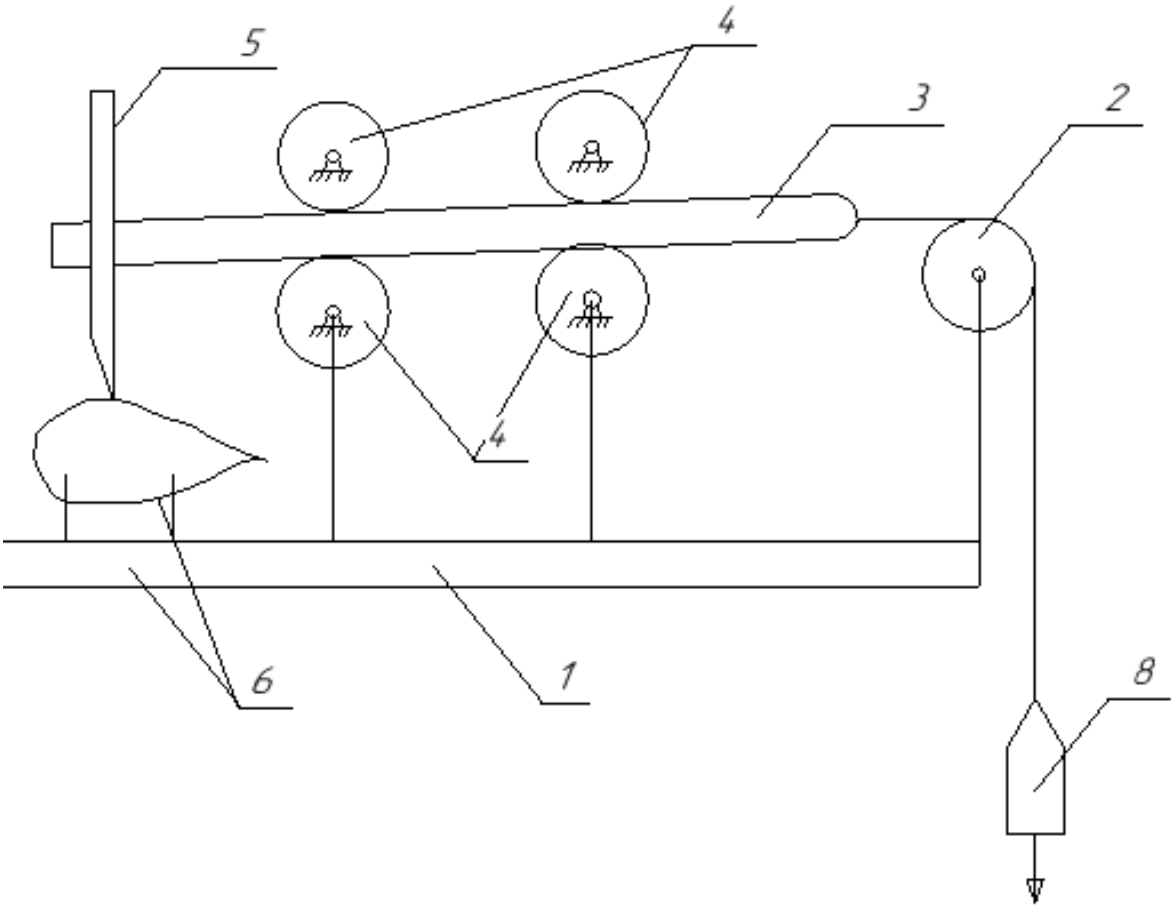

Figure 1. Diagram of a device for determining the force required to separate soil from root crops.

Operating the device. The selected area of contamination on the root is cut into a rectangle. Root 7 is secured in holders 6 so that the gap between the prepared area of contamination and the pointed end of rod 5 is 10-15 mm. By moving rod 3 with the rod, the horizontal position of the surface of the examined area of contamination is checked and, if necessary, the root is leveled. The rod is then positioned so that the gap between the root surface and its pointed end is 0.5-1.0 mm. The platform is loaded with sand until the pointed end of the rod chips off the selected area of contamination.

Soil tear-off forces were measured at sugar beet roots after ten days of storage. The sugar beets were grown on moderately leached chernozem; the average soil moisture at the time of the experiments was 15.2%. The experimental results are presented in Table 1.

The average value of the specific tear force was Pd = 1.26 kg/cm² and the standard deviation was σ = 0.271 kg/cm².

Thus, removing 1 cm² of soil from the surface of a sugar beet root requires a force of 1.26 kg. So how should you select a nozzle that delivers sufficient active pressure from the open jet to remove contaminants from the root surface?

Let us denote the area of the hole by μ, and since Co =√2gH and Q = μC0", then formula (1) will take the form:

$$x = 2y\omega H \quad (1)$$

where H is the fluid pressure.

If, when exposed to a jet of water, the contaminants were separated into pieces with an area of 1 cm², then it could be considered:

$$P_{уд} = 2y\omega H \quad (2)$$

In reality, since the soil contains microcracks and, when exposed to a strong jet, it disintegrates into a series of elements with an area of less than 1 cm². To obtain equality (3), it was reasonable to introduce a correction factor, after which formula (3) can be rewritten as follows:$P_{уд} \neq 2y\omega H$

$$P_{уд} = \eta 2y\omega H \quad (3)$$

where η is the correction factor.

Let's determine the hole diameter that, under a given pressure, will ensure soil separation from the root surface. Expressing the hole area through its diameter, using formula (2), we obtain:

$$d = \sqrt{\frac{2P_{уд}}{\pi\eta yH}} \quad (4)$$

For the practical use of formula (4), it is necessary to determine the value of the coefficient 1. For this purpose, experiments were conducted in which the hole diameter and pressure were varied.

From hydraulics, the formula for the active pressure of a jet on an obstacle is known:

$$x = \frac{y}{g} Q C_0 \quad (5)$$

where x is the active pressure of the jet

y is the volumetric weight of the liquid;

g — acceleration due to gravity;

Q — liquid flow rate;

Co is the velocity of liquid exiting the hole.

**Research results.** Experiments have shown that a water jet exiting a 1 and 2 mm diameter hole at a pressure of up to 5 kg/cm² gradually erodes the soil. A jet exiting a 3.4 and 5 mm diameter hole ensures soil separation from the roots. The fluid pressure should be between 2 and 2.5 kg/cm².

Comparison of experimental results with theoretical ones gives a value of the coefficient η equal to 2.15.

**Conclusion**. Observations of the effect of a water jet on contaminants made it possible to establish that the separation of pieces of soil occurs in a very short period of time, within 0.01–0.03 seconds.

The experiments conducted demonstrated the feasibility of developing a design for a root and tuber washer in which the separation of contaminants would be carried out through the dynamic action of a water jet.

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