SELECTION OF THE LEVELER TYPE AND JUSTIFICATION OF ITS MAIN DIMENSIONS WHEN WORKING ON SMALL CONTURAL AREAS

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Annotation: In the article, due to the low efficiency of existing land leveling machines in small-contour cultivated areas (up to 3 hectares), the results of choosing an effective leveling machine(П-2,8А, П-4, ПА-3 and ППА -3,1 and others) and justifying its main dimensions are presented. The advantages and disadvantages of the selected PU-14 ground leveler are identified. As a result of the research, a ground leveler with an improved surface, which differs from the existing leveler in terms of leveling technology (smoothing at the same time as cutting the soil layer by layer), quality of work and less effort, was created. It is based on the optimal dimensions of the ground leveler with improved roof. Using the improved leveler in small areas increases productivity by 1.6 times compared to the existing leveler, reduces power consumption by 1...7%

Key words: Small contour, base levelers, leveling level, unevenness, maneuverability, long base leveler, irrigated soil softener.

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Introduction

Land leveling is an integral process both in reclamation construction and agricultural production. It is one of the most effective agrotechnical measures that ensures increased crop yields, reduced irrigation water consumption, and improved operating conditions for agricultural machinery at subsequent stages [1].

As is well known, irrigated agriculture is mainly based on surface (flood) irrigation methods, which require careful land surface planning. During operation, various factors affect the land surface, leading to its deformation. This necessitates special measures known as operational leveling to eliminate these deformations.

Various types and modifications of long-base leveling machines are widely used for such operations. According to data from the literature [2,3], routine and operational leveling must be carried out annually within short agrotechnical periods. Currently, in each farm, operational leveling is performed in autumn or spring before sowing on 25–35% of the total cultivated area using long-base levelers such as P-2.8A, P-4A, PA-3, PPA-3.1, and others designed for agricultural purposes. The weight of these levelers is at least 2.5 tons; they have low maneuverability and high energy consumption. When leveling small-contour fields using these aggregates, corner areas often remain un-leveled due to their turning radius being no less than 15–20 meters. As a result, despite their long base, their maneuverability is insufficient, which reduces productivity.

For leveling small-contour fields, grader-levelers of the GN-2.8A and GN-4 types are used. These are mounted implements designed for tractors of traction classes 0.9–1.4 and class 4. However, due to their relatively short base, these levelers cannot ensure the required leveling quality.

Studies conducted by several researchers [4–9] indicate that effective use of long-base levelers requires field areas of at least 6 hectares. Exploratory research and analysis of irrigated lands in certain farms of the Republic of Uzbekistan showed that approximately 30% of the total cultivated area consists of small-contour fields of up to

3 hectares [10]. Therefore, irrigated fields smaller than 3 hectares were classified as small-contour fields.

A review of the literature [11–15] shows that the selection of appropriate leveling equipment, rationalization of operating technology, and determination of certain design parameters for leveling small-contour fields have not been sufficiently studied. At present, some land operations in small irrigated fields are still performed manually because the use of existing machine-tractor aggregates in such fields is inefficient due to low maneuverability and high energy consumption. Given the increase in tenant farmers, small farms, and private enterprises that use small land plots, the issue of revising the applicability of existing leveling machines for small-contour irrigated lands has become increasingly important.

Based on the above, the following working hypothesis was proposed: for leveling small-contour fields, an appropriately selected type of leveler combined with an improved operating technology-specifically, a working tool capable of layer-by-layer soil cutting with simultaneous loosening-can improve leveling quality and reduce energy consumption to a certain extent.

Methods

Standard research methodologies were used during the study, with additional refinements introduced where necessary. Special laboratory–field installations, including devices equipped with tensometric sensors, were developed. Laboratory experiments were conducted in a soil channel, while field experiments were carried out on the experimental fields of the institute in accordance with OST 70.12.1.74 “Reclamation, drainage and irrigation machines. Programs and test methods”.

Experimental results were processed using methods of mathematical statistics. The parameters of the proposed leveling bucket were optimized based on experimental leveling methods. According to source [13], uniform soil moisture distribution on leveled fields is ensured, and irrigation water consumption is significantly reduced. In the United States, great importance is attached to land leveling of irrigated areas; more than half of irrigated lands are leveled annually [14]. Investments in land leveling are considered justified, as they increase crop yields and reduce production costs.

Results and Discussion

Studies by M.A. Ahmedjanov [3] showed that irrigation on leveled land requires only 70–80 liters of water for furrows 300–350 meters long, compared to about 200 liters on non-leveled land. This increases labor productivity of irrigators by 3.5–4 times and significantly improves irrigation quality. These results are confirmed by other researchers. Proper land leveling enables mechanization and automation of irrigation processes.

Land leveling is particularly important in saline soils, where it increases the efficiency of leaching irrigation. Due to uniform surface conditions, leaching water is evenly distributed, ensuring uniform salt removal across the field. At the same time, water consumption for leaching is reduced by half, and labor costs for ridge formation and leveling are also reduced by half. This is achieved by increasing check size and reducing ridge height.

In leveled fields, the cost of constructing temporary irrigation networks is reduced by 1.9 times, usable land area increases by up to 4.6%, and the productivity of tractor aggregates improves.

Thus, proper land leveling plays a crucial role in efficient use of irrigated lands, saving irrigation water, and improving the efficiency of machine-tractor aggregates (MTA). Current trends in leveler development focus on reducing metal consumption, increasing maneuverability, and improving work quality and productivity. Accordingly, various levelers adapted to different soil and climatic conditions are produced in foreign countries.

Our studies [16] and those of other researchers [8,12,17,18] indicate that short-base levelers with automatic control are the most effective. Ahmedjanov's research [2,3] studied the operating technology of long-base levelers for irrigated lands. The best results in production and operational leveling are obtained in the first two passes:

the first in a diagonal-cross direction, and the second along the irrigation direction; subsequent passes are ineffective.

Based on theoretical and experimental research, N.N. Kim [6] concluded that:

The effectiveness of the ripper mounted on the leveler depends on the length of surface irregularities and its position relative to the bucket; closer placement improves soil loosening, especially for small irregularities.

A two-row staggered ripper with 45 mm width, 400 mm row spacing, and total row spacing of 140 mm is recommended.

One pass with a ripper-equipped leveler is equivalent to three passes without a ripper.

The draft resistance of a ripper-equipped leveler is 7% lower than that of a conventional leveler.

Long-base levelers with rippers are most effective for leveling irregularities up to 20 m long and 10–20 cm high.

Experimental results showed that the highest leveling quality was achieved with the PPA-3.1 leveler (24.5–28.2%), followed by P-2.8A (20.4–22.3%) and PU-14 (18.4–20.2%). The lowest performance was observed with the GN-4 grader (15.4–17.5%).

Productivity analysis indicated that the highest efficiency per unit working width was achieved by the PU-14 leveler arperated with an MTZ-80 tractor, mainly due to its high maneuverability and effective use of working time. Economic evaluation also confirmed that this combination provides the greatest cost-effectiveness, especially as plot size increases from 1 to 3 hectares.

Comparative tests of P-2.8A, PPA-3.1, GN-4, and the experimental PU-14 leveler showed that the universal PU-14 leveler is the most effective tool for small-contour fields. Tests demonstrated reduced draft resistance (by 4–7%) due to the use of a front blade and ripper, improved leveling quality, increased productivity by 1.6 times, and reduced labor costs by 35%.

Table 2.

Results of the operational and technical evaluation of the PU-14 leveler

Indicator name	Values
Technological process reliability coefficient	0,96/0,97
Operational reliability coefficient	0,92/0,95
Metal consumption per hectare, kg·h/ha	1000/926
Hourly productivity, ha/h - based on effective (main) working time - based on shift time - based on operational time	 1,35/0,84 0,95/0,63 0,98/0,66
Minimum fuel consumption per hectare during main working time, kg/ha	3,8/6,65
Increase rate of metal consumption, %	7,4
Operational time utilization coefficient	0,73/0,78
Shift time utilization coefficient	0,70/0,75

Note: *the numerator represents the values obtained when operating with a bucket equipped with an additional blade and ripper, while the denominator represents the values obtained when operating with a conventional bucket.*

Conclusion:

The use of existing long-base levelers on small-contour fields is inefficient, as leveling quality decreases, large turning areas remain untreated, and both work productivity and the coefficient of leveling completeness are reduced.

In small-contour fields, the height and length of surface irregularities are slightly smaller than those in conventional fields. The height of irregularities is 3–6 cm lower, and their length is 3–5 m shorter. This has a positive effect on the operating quality of short-base PU-14 type levelers aggregated with an MTZ-80 tractor.

On non-loosened soil, a single pass of the recommended leveler provides work quality equivalent to two passes of a conventional leveler.

Experimental results show that the draft resistance of the proposed leveler is 4–7% lower than that of a conventional leveler. The combined resistance of the front blade and rippers accounts for approximately 40% of the total draft resistance of the proposed leveler.

The leveling technology based on layer-by-layer cutting with simultaneous loosening improves the leveling capability of the агрегате and reduces the need to perform soil pre-loosening as a separate operation.

REFERENCES

1. Khasanov, I., Kuchkarov, J., Nuriddinov, H. ***Efficiency of irrigated land meliorativity through the usage of fixing softening disk device to base leveler***. IOP Conference Series: Materials Science and Engineering, 2020, 883(1), 012174.

2. Akhmedzhanov, M.A. ***Operational planning of irrigated lands in arid zones***. Moscow: “Kolos”, 1982. – p.148

3. Akhmedzhanov, M.A. ***Comprehensive research and development of technology and tools for operational planning of irrigated lands***. Tashkent: Fan Publishing, 1984. – p.143

4. Samsonova, N.P. ***Planning of irrigated areas***. Selkhozgiz, Moscow: 1952. – p. 23

5. Batrakov, Yu.G., et al. ***Planning of irrigated lands***.M: Kolos Publishing, 1964. – p.199

6. Kim, G.N. ***Research and justification of main parameters of a long-base leveler with a ripper***. PhD dissertation in technical sciences, Yangiyul, 1972. – p.170

7. Khikmatov, P.G. ***Research on quality and technological indicators of a long-base leveler to justify optimal working width and movement speed***. PhD dissertation in technical sciences, Yangiyul, 1978. – p.147

8. Babadzhanov, I.A. ***Justification of type and parameters of a leveler with a hydromechanical control system for the working body***. PhD dissertation in technical sciences, Yangiyul, 1985. – p.162

ISSN 2181-

9. Akhmedzhanov, M.A., Khikmatov, P.G., Khasanov, I.S. ***Influence of run length and average area of irrigated plots on the efficiency of leveling machines***. Journal "Mechanization of Cotton Production", No. 12, 1990. – pp. 3–4

10. Khasanov, I.S. ***Operation of leveling machines on small-contour plots***. In: Mechanization of Labor-Intensive Production Processes in Cotton-Growing Zones. Scientific-Practical Conference Abstracts, Tashkent: 1992. – p.19

11. Kuzin, E.I., Dubinskaya, V.I. ***Ways to improve the leveling ability of field levelers***. Journal "Construction and Road Machines", No. 10, 1975. – pp. 13–15

12. Kuzin, E.I., et al. ***Leveling ability of short-base levelers***. Proceedings of Universities: Construction and Architecture, No. 11, 1977. – pp. 169–173.

13. Akhmedzhanov, M.A. ***National economic importance of land leveling in crop cultivation***. Journal "Mechanization of Cotton Production", 1992, No. 5. – pp. 10–11.

14. Budarin, I.I. ***Irrigation furrow and planned arrangement of plots***. Journal "Hydrotechnics and Melioration", 1959, No. 7. – pp. 10–16

15. Brusentsev, V.F. ***Leveling transplant soils in the Hungry Steppe***. Journal "Cotton Growing", 1962, No. 4. – pp. 15–17.

16. ***Scientific and technical report of the Laboratory of Mechanization of Land Planning Works for 1992***, Yangiyul, 1993. – pp. 191–204.

17. Nemirovsky, E.E. ***Automation of leveling machines***. Moscow: Higher School, 1965. – p.39

18. Shalagin, Yu.M. ***Study of some methods for controlling the working body of a leveling machine***. PhD dissertation in technical sciences, Tashkent: 1971. – p.126

19. Bratyshev, I.P., Tomin, E. ***Leveler with an automatic control system***. Technology in Agriculture. 1971, No. 4. – p. 49

20. Tverdokhleb, V.A. ***Operation of machine-tractor units on small-contour fields***. Journal. Mechanization and Electrification of Agriculture. 1969, No. 12. – pp. 12–13.

21. Akhmedzhanov, M.A. ***Study of the semi-mounted short-base leveler P-2.8A***. Journal Mechanization of Cotton Production. 1983, No. 1. – pp. 7–9.

22. Akhmedzhanov, M.A., Khikmatov, P.G., Khasanov, I.S. ***Increasing productivity of long-base levelers on small-contour plots***. Journal Mechanization of Cotton Production. 1992, No. 1. – pp. 3–4.

23. Kim, G.N. ***Methodology for assessing the quality of leveling machine work***. Journal Mechanization of Cotton Production. 1969, No. 10. – pp. 3–6.