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Analysis Of Ridge-Forming Implements And Technical Equipment For Row-Planted Crops In Vegetable Production

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ABSTRACT

This scientific study analyzes the technology of row planting of vegetable crops and examines the types, structures, operating principles, and efficiency of implements and technical equipment used for ridge formation. Ridge formation is considered a key agronomic factor in meeting agrotechnical requirements, improving crop growth, and increasing yield. The research provides a comparative assessment of existing technical means, including ridge formers, combined aggregates, and mechanized equipment, highlighting their advantages and disadvantages. In addition, technological solutions adapted to local soil and climatic conditions are proposed.

Keywords: Soil, ridge, food, root, absorption, nutrients, mechanical, neutral, seed, planting.

INTRODUCTION

Vegetable crops are cultivated under all agricultural climatic conditions worldwide. In Uzbekistan, the main directions of scientific research aimed at the development of vegetable production include the following [1]:

1. Development of early-maturing, high-yielding, high-quality vegetable varieties and hybrids resistant to unfavorable natural and climatic conditions.

2. Expansion of the range of vegetable crops and improvement of their quality.

3. Investigation of methods and tools for improving product quality and development of technologies for producing environmentally friendly agricultural products.

4. Conducting comprehensive research on the cultivation of vegetable crops in greenhouses and protected areas during winter and spring to ensure year-round supply.

5. Reduction of production costs through the development and widespread implementation of high-performance, energy- and resource-efficient technologies and technical means for soil preparation prior to planting.

The classification of vegetable crops into annual, biennial, and perennial groups is considered somewhat conventional. Crops such as tomato, eggplant, sweet pepper, and pepper are typically cultivated as annual plants under local conditions, although they are perennial in their native habitats. Annual vegetable crops complete their life cycle within one growing season, flowering and producing fruit and seeds once, whereas perennial vegetable

crops are polycarpic and flower and bear fruit annually.

Vegetable crops are more demanding in terms of soil fertility compared to many other agricultural crops. This is due to the fact that most currently cultivated vegetable varieties have been developed by humans and have historically been grown on fertile, nutrient-rich soils over many centuries. As a result, the root systems of most vegetable crops are relatively weak, shallow-rooted, and adapted to absorbing nutrients primarily from the upper soil layers.

When preparing soil for vegetable cultivation, the following agrotechnical requirements must be met. In autumn, the field is plowed to a depth of 28–30 cm using plows such as PN-4-35, PYa-3-35, and PD-4-35. In spring, soil tillage is performed to a depth of 10–12 cm using a ChKU-4-1 chisel cultivator. Surface tillage to a depth of 5–6 cm is carried out using toothed harrows BETS-0.1. Land leveling is performed using a KZU-0.3 machine, after which furrows are prepared for transplanting vegetable seedlings.

Most vegetable crops are cultivated using the row planting method. In this method, crops are planted in rows at uniform longitudinal spacing. Tomatoes, eggplants, sweet peppers, and similar crops are commonly grown using row planting technology. Therefore, soil tillage and ridge formation play a crucial role in vegetable crop production.

Currently, significant attention is being paid in European countries and the Russian Federation to improving ridge-based vegetable cultivation technologies and the technical means used to implement them.

In row planting systems, soil tillage and ridge formation methods are determined based on regional soil and climatic conditions as well as soil type. Priority is given to energy-efficient, resource-saving, and environmentally safe soil tillage and ridge formation methods that preserve soil moisture and fertility [3].

Accordingly, soil preparation and ridge formation methods for vegetable cultivation can be classified into six groups based on:

– the technological processes performed,

– the number of passes of aggregates across the field,

– combined technological operations,

– the interaction of working bodies with the soil,

– the shape of the formed ridge,

– and the timing of technological operations.

Russian scientists N.F. Ermakov and A.K. Poperekina developed a ridge formation method and a corresponding device for its implementation (Figure 1) [2].

Figure 1. Cross-sectional view of the ridge formed simultaneously with soil tillage

In this process, furrows are opened using furrow openers, and the cut soil layer is lifted, inverted, and placed at the ridge formation zone. Subsequently, the ridge soil is loosened by rotary blades to the seed placement depth, after which the ridge surface is leveled and smoothed. As a result, ridges with a height not exceeding 15 cm and a top surface width of 15–20 cm are formed.

According to Russian Patent RU No. 2284093 [2], a ridge-forming device was proposed by V.A. Smelik et al. (Figure 2). The device consists of a frame (1), furrow opener (2), rotor (3), ridge-forming barrier (4), roller (5), hitch (6), and rod (7).

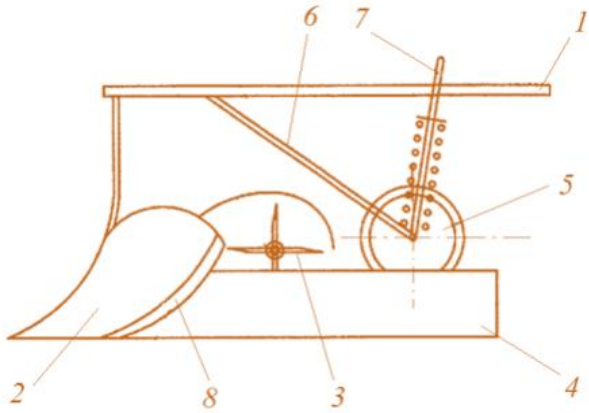

Figure 2. Ridge-forming device according to Patent RU No. 2284093

Ridge formation is carried out by means of the side panels of the forming barrier. The ridge is compacted by a roller mounted on the frame via a rod pressed by a compression spring positioned between the side panels. Cutting plates are installed on the side wings of the furrow openers and are hingedly connected to the field cutter. In addition, the slope and width of the ridge sides are interrelated, and their adjustment is performed using a screw-type mechanism.

E.I. Ponomarev substantiated the parameters of the GX-4 ridge former (Figure 3), designed for forming ridges with row spacings of 60 or 90 cm, as well as wide-row ridges with inter-row spacings of 120–180 cm on previously plowed and leveled fields during spring, summer, or autumn seasons [1].

The GX-4 ridge former consists of a frame, support wheels, hydraulically controlled markers, working bodies, and support columns, and is aggregated with a tractor using an SA-2 automatic hitch. Markers are mounted on the front

beams of the ridge former by means of brackets and are controlled by hydraulic cylinders.

Ridge formation is performed by the side panels of the forming barrier, while ridge compaction is achieved by a roller mounted on the frame through a rod loaded by a compression spring located between the side panels. Cutting plates are installed on the side wings of the furrow openers and are hingedly connected to the field cutter. The slope and width of the ridge sides are interdependent and are adjusted by a screw mechanism.

Figure 3. GX-4 ridge former

In the machine, the working bodies are arranged in the following sequence depending on the technological operation: formation of four ridges with a row spacing of 90 cm; formation of eight ridges with a row spacing of 60 cm; opening of two furrows to form ridges with a spacing of 180 cm; and opening of four furrows to form ridges with a row spacing of 120 cm. The main drawback of this ridge former is that it performs only a single furrow-opening operation. As a result, in fields with large soil clods, coarse aggregates are buried inside the ridge, which negatively affects plant growth and development.

Unlike the GX-4, two types of rotary furrow openers have been developed at JSC “BMKB-Agromash” [7]. These include the GF-2 rotary tiller (Figure 4) and the GF-4 rotary tillers, which ensure the formation of finely crumbled ridges with a small soil fraction.

The GF-2 rotary ridge former was developed on the basis of a soil rotary tiller and is designed to form two ridges with a row spacing of 70 cm after potato planting. In addition, it can be used as a soil rotary tiller. Furthermore, the ridge-forming hood, together with its rod, can be detached from the frame, and a compacting roller equipped with a cleaner and an adjustable sliding gate can be installed on the rear part of the frame.

Figure 4. GF-2 rotary tillage machine

The GF-4 rotary ridge former was developed on the basis of the GF-2 rotary ridge formers and is intended for continuous rotary tillage of soil over a working width of 2.8 m. After re-equipping, it can also be used to form four ridges with a row spacing of 70 cm in fields previously planted with potatoes.

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