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Indicators of quality of functioning of the MTA row, interrow processing of soybean crops

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Abstract. The effectiveness of weed control in soybean crops depends largely on the quality of inter-row processing. The main indicators of the inter-row processing quality of soybean crops as well as the criteria affecting the choice of tillage unit and the possible limit of increasing the speed of its movement are: damage to soybean plants during cultivation, the weeds destruction degree and the stability of the working bodies' depth. The article presents the results of comparative experimental studies to determine the quality of the wide-coverage unit as a part of the tractor T-150, mid-lift coupling with a layered arrangement of machines, three cultivators KRN-5,6 and conventional single-machine unit as a part of the universal tillage tractor MTZ-80 and cultivator KRN-5,6 on inter-row processing of band-row-free soybean crops.

1. Introduction

At present, soybean drill seeding with a row spacing of 0.15 m (continuous) is widespread in the farms of the Russian Far East. This method of seeding excludes mechanical treatment of soybean row spacing during the growing season. The main technological condition for weed control here is the introduction of significant doses of herbicides. The use of only chemical means of weed control results in deterioration of the soil structure, insufficient supply of soybean plants with oxygen and nutrients, reduced fertility, in addition, has a negative impact on people and nature.

At the same time, there is the experience in the use of band-row and band-row-free (strip) soybean crops in the region. Our research and production soybean crops in a number of farms show that band sowing is more effective than sowing in drills. The increase in soybean yield with band sowing methods is due to the efficient use of plant nutrition area, soil moisture, lighting. Moreover, traditional mechanical methods of weed control are more effective in band-row-free sowing than in sowing in drills. The effectiveness of weed control in soybean crops largely depends on the quality of the inter-row processing.

2. The problem of processing soybean crops

The most important indicator of the inter-row processing quality as well as the criterion that determines the choice of tillage unit and the possible limit of its movement speed increasing, is the damage to soybean plants (D) during cultivation. The main causes of damage to plants include: pruning, extirpation and covering with soil. The number of damaged plants depends on both technological and operational factors. The main ones are the technological features of soybean sowing,



the size of the protective zones, the speed of movement and the kinematic characteristics of the tillage unit.

3. Research methods

When processing sowing in drills, it is recommended to set the size of the protective zone of 0.12 m, i.e. when the row spacing is 0.45 m, only 47% of the area is processed. When reducing the size of the protective zones, it is possible to cut out a large number of plants due to their deviation from the middle line of the row. Due to the peculiarities of the technological scheme of band-row-free sowing, the losses of cultivated plants during its processing are 2-3 times less than when processing row spacing of sowing in drills. Comparing the data characterizing the degree of damage to soybean plants during the processing of band-row-free crops with a wide-coverage unit as a part of a T-150 tractor, a mid-lift coupling with a layered arrangement of machines, three cultivators KRN-5,6 (option 1) and a conventional unit as a part of a universal tillage tractor MTZ-80 + KRN-5,6 (option 2), we make sure that there are no large differences in the quality of processing between them (Fig.1). This is due to the kinematic and dynamic characteristics of mid-lift coupling and convenient location of cultivators, which allows the tractor operator to observe the working bodies during the unit operation.

Tillage units for the first inter-row processing of band-row-free soybean crops were equipped with one-sided flat-cutting razors, installed two in each row, heels to the tape and blades. In the second and third cultivations, the razors unfolded with blades toward the tape. In order to less damage the root system of soybeans, the ends of the blades were bent upwards.

The results of comparative tests of tillage units are shown in figure 1. As it can be seen from the graphs, in the processing of row spacing, increasing the movement speed of the studied units and reducing the size of the protective zone leads to an increase in the number of damaged soybean plants. The nature of the considered dependence is the same for both wide-and single-machine units. The number of damaged soybean plants in the speed range from 1.52 to 2.25 m/s varies slightly. Further increase in the movement speed of units causes a sharp increase (2-3 times) losses of cultivated plants. This is due to the fact that the number of plants that are covered with soil significantly increases. To avoid plants covering when processing crops at high speeds, it is necessary to use protective devices (discs, shields). The agrotechnical limit of the speed increase of the tillage units movement at a protective zone of 0,04 m should not exceed 2,4 m/s. When processing crops with a protective zone equal to 0.08 m, the movement speed of tillage units can be increased to 2.8 m / s.

4. Received results

When assessing the quality of band-row-free soybean crops processing and the technological efficiency of the units used, an important indicator is the degree of weeds destruction (WD). The research results show that with the increase in the cultivation speed the degree of weed destruction at all sizes of protective zones increases (Fig.1). On average, the number of weeds destroyed increases by 5-6% per each unit of increase in the cultivation speed. This is due to the more intense impact of the working bodies on weeds. The size of the protective zone has significant impact on the degree of weeds destruction. Its reducing contributes to more complete weeds destruction.

With the increase in the movement speed, the amplitude of the lateral fluctuations of the cultivator working bodies increases and, accordingly, the number of weed plants in the protective zones decreases. In addition, with the increase in the speed of cultivation, the influence time of the cultivators working bodies on weeds decreases and the cutting speed increases. All this improves pruning of weeds.

When band-row-free soybean crops are processed with reduced to 0.04 m protective zones, the number of destroyed weeds is per 27-30% more than in the processing of band-row crops. There is no significant difference in the degree of weed destruction depending on the coverage of the studied units.

The quality of cultivation is influenced by the depth stability of the working bodies. At the first cultivation, the installation of the working bodies was carried to a depth of 0.1 m. At each subsequent

processing the depth decreased by 0.01m. With an increase in the speed of the tillage unit by 0.5 m/s, the stroke depth of the working bodies decreases on average by 0.004 m.

The analysis of the rows processing depth within the standard deviation of the cultivator blades stroke from 0.016 to 0.018 m shows that the degree of its unevenness, characterized by the coefficient of variation, increases with the speed from 9.8 to 17.5%.

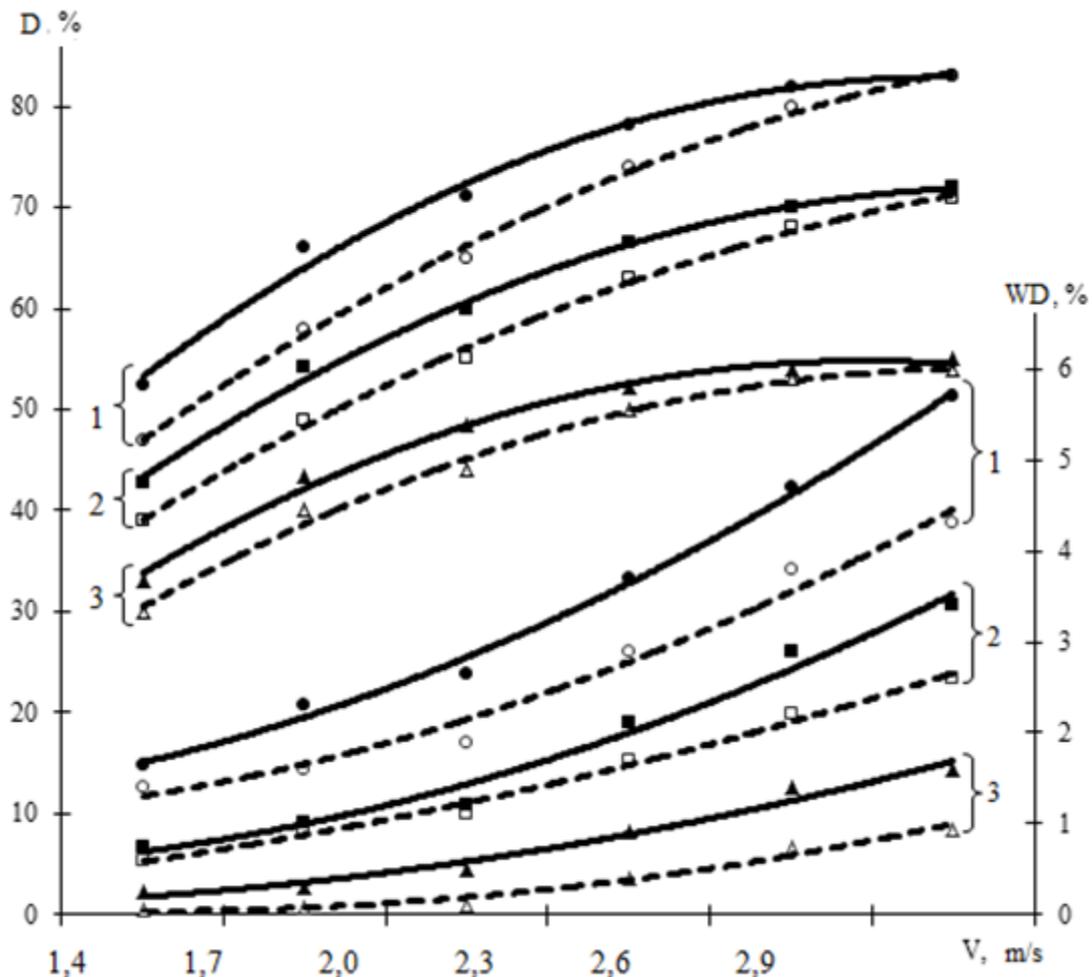


Figure.1 Influence of the movement speed of the units and the width of the protective zone on the weed destruction degree (WD) and damage to soybean plants (D) during inter-row processing of belt-free crops.

Width of protection zone: 1 - 0,04 m; 2 – 0,08 m; 3 - 0.12 m.
 unit with tractor T-150 + mid-lift coupling + 3 KRN-5,6 (option 1);
 unit with MTZ-80 + KRN-5,6 tractor (option 2)

5. Conclusion

1. The use of wide-coverage unit with mid-lift coupling with layered arrangement of the machine allows qualitatively within agroallowance performing of soybeans inter-row cultivation.

2. The protective zones reduction in the processing of band- row-free sowing to 0.04-0.05 m allows reducing the contamination of crops by 30-40% without the use of high doses of herbicides which provides an increase in soybean yield and its ecological purity.

3. The movement speed of tillage units during inter-row processing of band-row-free soybean crops with a protective zone of 0.04 m should not exceed 2.4 m/s. When processing crops with a protective zone equal to 0.08 m, the movement speed of tillage units can be increased to 2.8 m/s.

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