THE RESULTS OF EXPLORATORY RESEARCHES OF PLOUGHSHARES FOR DIRECT SOWING OF GRAIN CROPS

Aduov Mubarak Aduovich, Kapov Sultan Nanuovich , Nukusheva Saule Abaidildinovna,
S. Seifullin Kazakh Agro Technical University,
Stavropol State Agrarian University

At present the agricultural sector of the Republic of Kazakhstan in the cultivation of crops applying No-till techniques and direct seeding drills of various abroad firms "Amazone», «John Deere», «Gherardi», «MASCHIO-GASPARDO», «Kuhn», «Köckerling», «Horsch» and others are widely used. Drills are equipped with disk, chisel and tine coulter and neighboring countries seeders mainly are equipped with disc openers. Chisel and tine chisel coulters are reliable and easy to set planting depth, well-maintained and deepened at constant planting depth either [1]. But, they badly cut the plant remains, leading to clogging of interploughshare space.

Practice shows that the single-disc coulters do not always cut crop residues and not completely hide the furrow, and in the wet and heavy soils a packed furrow is formed. Double disc coulters although don't have the above drawbacks, but in drought periods have uneven progress of the working parts and deepening the working part to the desired depth of seeding the soil requires effort up to 200 kg. This in its turn requires the installation of the individual cylinder for each coulter, which leads to an increase in mass of the drill and to its expensiveness.

Based on a search of experimental and theoretical assumptions we offer direct sowing with the following configuration options for openers:

- *Option 1* installation disk and chisel openers in two rows: one of them is chisel, and in another - disc, ensuring high throughput and low tractive resistance at work after cereal raw backgrounds;
- *Option 2* - installation disc and tines with distribution of seeds for sowing a wide belt (belt drill seeding), providing high throughput, low driving resistance and high yields.

According to the programming and methodology of research in view of the proposed options experimental samples disk and chisel coulters with suspension mechanisms were made, Figures 1 and 2.

The guide is connected to the link and a safety mechanism that allows you to copy the surface of the field openers. Compression spring of the safety mechanism is designed to force 250 kg. Search experiments set the sizes of suspension mechanism of links openers: *lAC = 130 mm, lCD = 300 mm and LCF = 300mm.*

Figure 1 *– Experimental disc coulter with suspension mechanism*

Figure 2 *- Experimental chisel opener with the suspension mechanism*

For the energy assessment of working parts the theoretical research was done and the traction resistance of the structural and technological parameters of chisel and disc coulter dependences are set. Thus, the traction resistance of chisel coulter is defined as [2, 3]:

$$R_{XЧ} = (B_{\partial} \cdot h + h_{кр}{}^2 tg\psi_{ck})(K_{ЧT} + K_{ЧP} + K_{ЧK}) \quad (1)$$

Where $K_{ЧT} = 0{,}5 \cdot m_v . A_{\alpha_o} \cdot A_1 \cdot \gamma \cdot h \cdot g$ - factors that take into account the cost of energy to overcome the pressure of the soil layer at the bit opener;

$K_{ЧP} = m_v \cdot A_\alpha \cdot A_1 \cdot C \cdot cos(\varphi)$ - coefficient taking into account the energy costs of the destruction of the soil layer at the bit opener ($A_\alpha = A_{\alpha_0}$);

$K_{ЧK} = A_\psi \cdot \gamma_p \cdot v^2$ - coefficient taking into account the energy cost of the informing and change of the movement speed direction along the chisel opener ($A_\psi = A_{\psi_0}$).

Components of disc coulter resistance are determined by taking into account the soil cutting resistance forces by the blade of a flat disk F_p, the horizontal components of the soil deformation resistance force is defined by the disk tip $F_{\partial x}$, force of dynamic resistance of soil formation F_κ, soil friction forces F_m and effort on the ground crumpling F_c.

As a result, the traction resistance of disc coulter is defined as [4]:

$$F_{T\,X} = F_{Xm} + F_{Xp} + F_{Xk} \quad (2)$$

Where $F_{Xm} = K \cdot h \cdot b(\cos\beta + \cos\gamma + tg\varphi \cdot \cos\beta)$, $F_{Xp} = K_C \cdot h \cdot b \cdot \rho \cdot V^2$, $F_{Xk} = 0.5 \cdot g \cdot h^2 \cdot b$ - resistance, respectively, to overcome friction and soil formation pressure on the opener, the destruction of the reservoir and to the informing and change the speed of the formation direction of movement along the wedge.

Analysis of the obtained formula (1) and (2) shows that the tractive resistance of the coulter depending on the depth and processing speed varies depending on the parabolic dependence.

For research with experimental openers laboratory apparatus was made and highly technical measuring instruments and equipment were used.

To verify the theoretical calculations to determine the traction resistance of chisel opener in accordance with the established methodology, laboratory experiments in the soil at a depth of sealing channe from 4 to 7 cm. and with moving at a speed of 0.87 to 3.1 m/s were conducted.

The results of theoretical and experimental research in the form of dependency change of the traction resistance of the chisel opener speed at a depth h = 4cm treatment are presented in Figure 3.

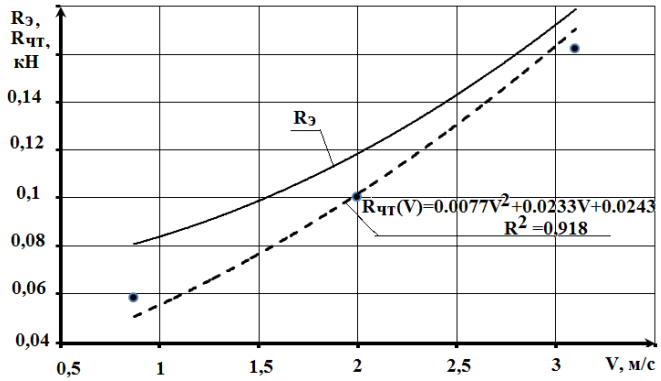

Figure 3 *- The theoretical $R_{чТ}$ and experimental $F_э$ dependences of the resistance of the traction of the chisel opener speed V when working at depth h = 4 cm.*

Similarly laboratory experiments in soil channel for disc coulters were conducted. Tests at different depths seed and fertilizer from 4 to 10 cm were carried out with a change in movement speed from 0.87 to 3.1 m / s. The results of theoretical and experimental research in the form of dependency change of the traction resistance of the speed of the disc coulters are shown in Figure 4.

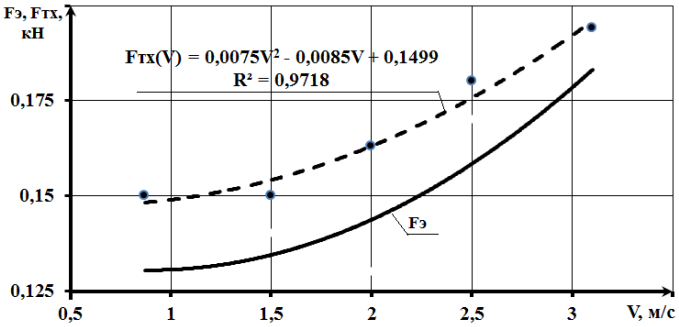

Figure 4 *- Theoretical and experimental F x Fe depending on the traction resistance of the disc coulter speed V when working at depth h = 7 cm.*

According to the schedule 4 we have that an increase in speed from *0.87 to 3.1m / s* theoretical $F_{тх}$ and experimental Fe dependences increase depending on a parabolic pattern. In addition, the disc coulter parameters are justified which are: disc diameter of *375 mm*, the angle between the discs *α = 100*, the position of the vanishing point drives *β = 400* and the distance between axes of *115mm* discs. For chisel opener with the mechanism of suspension the following parameters are justified: length of leashes l_{CD} = *300mm* and l_{CF} = *300mm*, width *20mm* chisel. Although experimental values exceed the theoretical but in general, they are supported by common methodological research position. In order to obtain reliable results and findings on the justification of parameters of working bodies are planned for further laboratory and field studies using experimental working bodies and drills with combined openers.

References

1. Akshalov K., Mainel T., Klyshbekov T., Bayakhmetov D., Tayshuher J., J. Nelis, Les C. Seeders for direct sowing «Citan Z» and «Condor 12001". The experience of testing and use at the farm level in the Northern Kazakhstan. Shortandy. – SPCCF after A.I. Barayev. - 2011. - 32 p.
2. Matyushkov M.I. 1-2008 departmental protocol on the test of direct seeding drills for minimum and direct seeding from 10.02.01.14. Shortandy. - "KazAgroInnovation". - 2008.
3. Aduov M.A. Scientific and technological bases of instruments of seed crops seeds and mineral fertilizers (on the sample of the northern area of Kazakhstan): dis ... doc.tech.sci. -Almaty. - 2008. – 224p.
4. Kapov S.N. Mechanical and technological basis for the development of energy-efficient tillers. Diss ... Doctor. techn. sciences. Chelyabinsk, 1999. - 355p.