

### A Plow with Inclined Disc Knives

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#### Article Information

**Received:** Oct 29, 2023

**Accepted:** Nov 28, 2023

**Published:** Dec 30, 2023

**Keywords:** *plow, soil, sub-arable layer, decompression, soil dredger.*

#### ABSTRACT

*The existing plows used in agriculture have large dimensions and weight, and also have low longitudinal stability of the unit. At the same time, they do not copy the terrain of the field well. A plow with inclined disc knives is proposed. The device, the principle of operation and the results of its experimental studies are presented. It has been found that the use of inclined disc knives improves the depth of the plow, the turnover of the formation, the sealing of plant residues, the stability of the stroke and reduces the traction resistance of the plow, as well as reduce the longitudinal distance between the housings to 510 mm. The optimal values of the angles of inclination are established: in the transverse-vertical plane 200°, in the longitudinal-vertical plane 15°.*

**Introduction.** In agriculture of our country, three, four, five and eight-hulled general-purpose plows are widely used. Well-known general-purpose plows contain housings, pre-lugs in front of each housing, and a disc knife in front of the last housing.

In the designs of existing general-purpose trailed and mounted plows, the distance between the housings in the longitudinal direction is 750-800 mm. This placement of the buildings is caused by the need to ensure the free passage of soil layers when installing planks and field boards of the same length on each building. It causes the large dimensions and weight of plows (especially multi-body ones), poor copying of the field relief by them, a decrease in the quality of tillage, and a violation of the longitudinal stability of the unit [1-3].

**Results.** The author developed a short-sized plow with inclined disc knives (Fig.1) based on the plow PLN-4-35. The minimum distance between the bodies of the short-sized plow was 510mm (Fig.2). This significantly reduced the specific metal consumption of the plow [4-7]. Disc knives with a diameter of 500 mm were installed at an angle  $\alpha$  in the longitudinal and at an angle  $\gamma$  in the transverse planes. At the same time, the lower cutting edge of the knife blade was above the toe of the housing ploughshare. The effect of the soil on the inclined disk, as well as on the body of the plow, can lead to a longitudinal one  $R_x^{\circ}$  (Fig.3)  $R_y^{\circ}$  transverse and vertical - components of the soil reaction. These forces depend on the properties of the soil, the speed of movement, and the angles  $\alpha$  and  $\gamma$ .

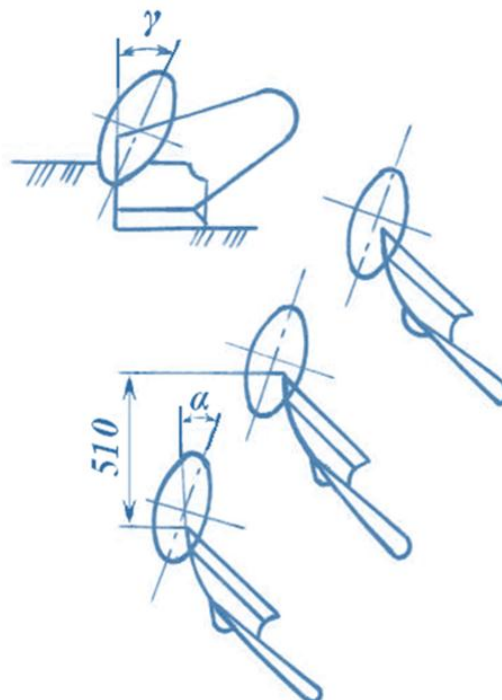
During operation, the resultant horizontal forces of the soil reaction  $R_{xy}^{\circ}$  creates a moment

$M=R_{xy}l$  (Fig.2) relative to the point of the trailer of the plow, which unloads the field boards. Thus, there is no need to install field boards and their harmful resistance is replaced by the useful work of disc knives, as a result, of which the traction resistance of the plow decreases [8].

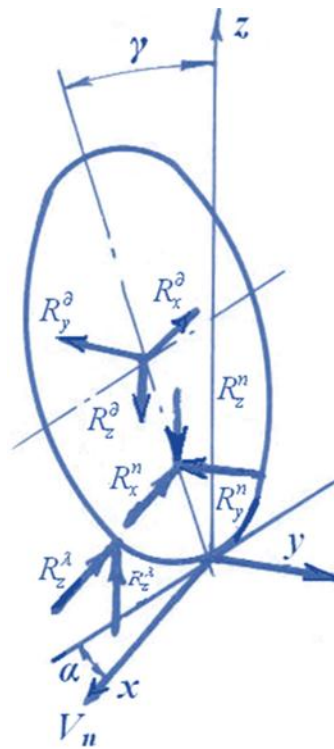
The magnitude and direction of the vertical component of the soil  $R_z^\delta$  resistance to the disk depends on the pressure of the soil  $R_z^\Delta$  on its surface and on the strength of the soil resistance applied to the blade and chamfers, i.e  $R_z^\delta = R_z^\Delta + R_z^P$ .



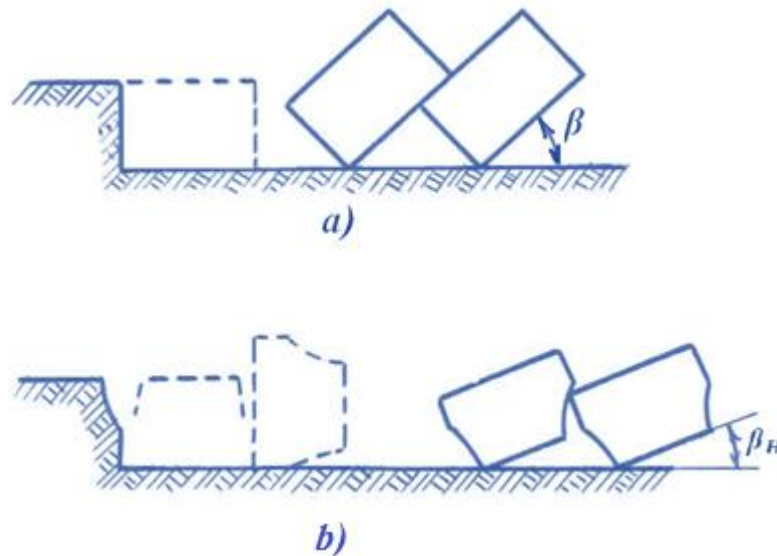
**Fig. 1.** A short-sized plow with inclined disc knives [9, 10]



**Fig.2.** Diagram of a short-dimensional plow with inclined disc knives



**Fig.3.** Forces acting on an inclined disk



**Fig.4.** Formation turnover during plowing: a) with a serial plow; b) with a plow with inclined discs

The downward force contributes to the deepening of the plow and improves its stability  $R_z^{\text{II}}$  [11-15].

As a result of the inclination of the disks and the planes of movement and transversely vertical, a polygonal formation is obtained (Fig.4). At the same time, the laying of the formation into the furrow, its turnover, sealing of crop and plant residues improves, energy costs for the turnover of the formation decrease [16-20].

The test results show that the installation of inclined disc knives on a short-sized plow contributes, in comparison with a standard plow, to a decrease in its resistivity to 22.6% [119], coefficients of variation of the width of the grip and depth of plowing by 22.5 and 12%, and an

improvement in the turnover of the formation by 7.8%.

**Table 1. The results of comparative tests of the short-dimensional and serial plow PLN-4-35**

Indicators	Serial	Short overall
The speed of the unit, km/h	6,35	6,38
Stroke depth, cm	24,3	25,1
Coefficient of variation of stroke depth, %	6,59	4,91
The width of the grip, cm	111,2	107,3
Coefficient of variation of the width of the grip, %	6,94	6,1
Sealing of plant residues, %	91,8	89,7
Resistivity, kPa	64,2	51,07

**Conclusions.** The use of inclined disc knives in transverse and longitudinally vertical planes improves the depth of the plow, the turnover of the formation, the sealing of plant residues, the stability of the stroke and reduces the traction resistance of the plow, as well as reduce the longitudinal distance between the housings to 510 mm.

The optimal values of the angles of inclination are established: in the transversely vertical plane 200, in the longitudinally vertical plane 150.

### References

1. Mamatov F., Kodirov U. Energy-resource saving machine for preparing soil for planting root crops on ridges // European Science Review, 125-1262016.
2. Mamatov F, Mirzaev B, Toshtemirov S, Hamroyev O, Razzaqov T. Study on the development of a machine to prepare the soil for cotton sowing on ridges// IOP Conference Series: Earth and Environmental Science 939 (1), 0120642021
3. Маматов Ф, Файзуллаев Х, Эргашев И, Мирзаев Б. Определение тягового сопротивления почвоуглубителя с наклонной стойкой// Международная агроинженерия 42, 2012.
4. Lobachevskij J, Mamatov F, Jergashev I. Frontal'nyj plug dlja hlopkovodstva// Хлопок 6, 35-37. 1991.
5. Fayzullaev K, Mamatov F, Mirzaev B, Irgashev D, Mustapakulov S. Study on mechanisms of tillage for melon cultivation under the film// E3S Web of Conferences 304, 030122021.
6. Mamatov F, Mirzaev B, Berdimuratov P, Aytmuratov M, Shaymardanov B. Traction resistances of the cotton seeder moulder// IOP Conference Series: Earth and Environmental Science 868 (1), 012052 2021.
7. Mirzaev B, Mamatov F, Tulaganov B, Sadirov A, Khudayqulov R. Suggestions on increasing the germination seeds of pasture fodder plants// E3S Web of Conferences 264, 040332021
8. Mamatov F, Mirzaev B, Avazov I. Agrotehnicheskie osnovy sozdaniya protivojerozionnyh vlagosbergajushhih tehnikeskih sredstv obrabotki pochvy v uslovijah Uzbekistana// Prirodoobustrojstvo, 2014.
9. Toshtemirov S, Mamatov F, Batirov Z. Energy-resource-saving technologies and machine for preparing soil for sowing// European science review, 284-286. 2018
10. Лобачевский Я, Маматов Ф, Эргашев И. Фронтальный плуг для хлопководства// Хлопок, 35-37. 1991

11. Маматов Ф, Мирзаев Б, Авазов И. Агротехнические основы создания противоэрозионных влагосберегающих технических средств обработки почвы в условиях Узбекистана// Природообустройство, 86-88. 2014
12. Mamatov F, Karimov R, Gapparov S, Karshiev F, Choriyev R. Determination of the parameters of the canonical working body of the straw chopper// IOP Conference Series: Earth and Environmental Science 1076 (1), 012025. 2022
13. Маматов Ф, Эргашев И, Мирзаев Б, Мирзаходжаев Ш. Комбинированный фронтальный плуг// Сельский механизатор, 10-11. 2011
14. Mirzaev B, Mamatov F, Kodirov U, Shirinboyev X. Study on working bodies of the soil preparation machine for sowing potatoes// IOP Conference Series: Earth and Environmental Science 939 (1), 012068. 2021
15. Mamatov F, Karimov R, Gapparov S, Musurmonov I. Study of the parameters of the field of the cone-shaped working body straw chopper// IOP Conference Series: Earth and Environmental Science 1076 (1), 0120262022.
16. Маматов Ф, Батиров З, Мирзаев Б, Халилов М. Тяговое сопротивление глубокорыхлителя с тукопроводом-распределителем для трехслойного внесения удобрений// Молодой ученый, 252-255. 2013
17. Mamatov F, Mirzaev B. The new antierosion and water saving technologies and tools for soil cultivation under the conditions of Uzbekistan// *Ekologiya i stroitelstvo*, 2017.
18. Mamatov F, Temirov I, Berdimuratov P, Mambetsheripova A, Ochilov S. Study on plowing of cotton soil using two- tier plow// IOP Conference Series: Earth and Environmental Science 939 (1), 012066. 2021
19. Tulaganov B, Mirzaev B, Mamatov F, Yuldashev S, Rajabov N. Machines for strengthening the fodder of arid livestock// IOP Conference Series: Earth and Environmental Science 868 (1), 012062, 2021
20. Mamatov F., Batirov Z., Halilov M. Chisel-cultivator-fertilizer for forming ridges and applying fertilizers// *European science review*, 267-269. 2018