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Optımızıng The Constructıve Parameters Of The Combıned Plough That Increases Productıvıty In Graın Farmıng

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Abstract

Currently, one of the leading areas of food security in the world is grain growing.Our goal is to develop grain growing on slopes.For the first time, the technological process of applying fertilizer in equal amounts to the soil on slopes and the constructive design of the working bodies, improved in the direction of obtaining quality grain in the cultivation of grain crops and increasing productivity, ensures the equal and quantity of sowing on sloping places by placing a "equal fertilizer spreader" working body at the outlet of the fertilizer pipe.The mineral fertilizer spreader is technologically and constructively new.The invention was patented by the Intellectual Property Agency of the Republic of Azerbaijan under document number F20240021.The efficient and optimal technological constructive parameters of the mineral fertilizer spreader have been substantiated.The optimal values were selected by building mathematical tables based on the parameters of the main parts of the newly created "equal fertilizer spreader".In a field test of the "equal fertilizer spreader" designed based on optimal values, the even distribution of urea fertilizer under the plow was 92%, double superphosphate was 94%, and potassium chloride was 93%.

Key words: equal fertilizer spreader,combined pluogh,constructive parametrs,mineral ferilizer,even distribution

Introductıon

Since the vast majority of Azerbaijani soils are carbonate, when phosphorus fertilizers are applied to such soils, phosphorus compounds combine with iron, aluminum, etc. in the soil, becoming insoluble compounds and poorly absorbed. In order to increase the efficiency of phosphorus fertilizers in these soils, it is of great importance to apply them under deep plowing as the main fertilizer. When the annual norm of phosphorus is high, it is advisable to apply part of it under plowing as the main fertilizer, and the rest together with sowing and as a feeding during the vegetation period, and to deeply bury it. It is useful to apply half of the annual norm of potassium fertilizer under plowing as the main fertilizer, and the rest as a feeding during the vegetation period. When calculating the usefulness of fertilizers, it is necessary to take into account not only their direct effect on the soil in the year of application, but also their effect in subsequent years, improvement of product quality, and increase in soil fertility (Abbasov İ.D.2011.,Alakbarov F.2016.).

Currently, various methods are used to apply fertilizers under plowing. At the same time, in our republic, mineral fertilizers are spread on the surface of the soil after harvesting with “Amazone ZA M” brand centrifugal disc fertilizer spreaders. Immediately after sowing, plowing is carried out with a plow so that the spread fertilizers fall under the soil. The operation is carried out in such a technological form.

The working width of the spreader always exceeds the design dimensions of machines with centrifugal working bodies, which is one of their main advantages. In this case, the uniformity of the spreader usually works with a previously unknown overlap of adjacent passages. The impossibility of strictly fixing the optimal working width is one of the main disadvantages of centrifugal working bodies of fertilizer spreaders. With changing operating conditions, the optimal working width determined experimentally for a particular type of fertilizer is limited to this. In addition, the actual working width of the machine does not always correspond to the optimal sowing, which leads to changes in speed and uneven application. It follows from this that the agro technical indicators of the centrifugal working bodies of the machines are interdependent and do not remain constant during operation due to the influence of many factors (Alakbarov J, al.et.2001)

In order to obtain high-quality grain and increase productivity in grain farming, the technology of applying equal amount of fertilizer to the soil and the justification of the design and technological parameters of the combined tillage were carried out, and laboratory and farm tests were carried out on a newly created experimental facility.

As you can see from the, two ATP-2 fertilizer spreaders are installed on the plough.The movement of the spreaders apparatus is provided by the support wheel of the plough.Fertilizer spreading rate is adjusted by changing wheels (Qurbanov H.N., 2023).

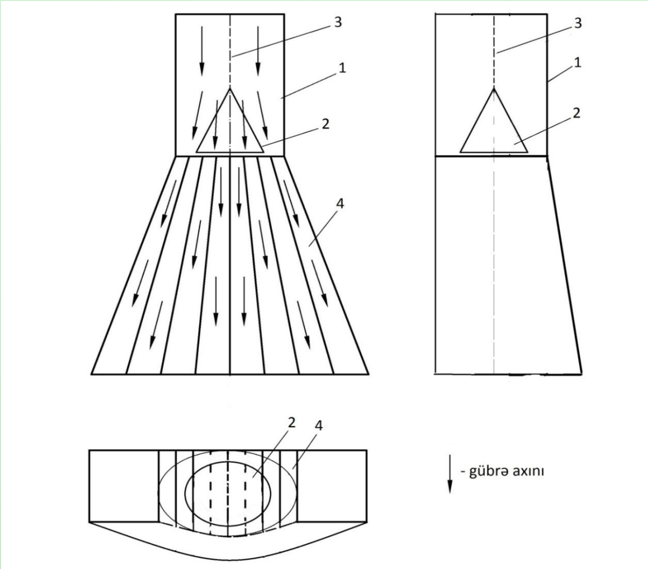

Fig.1 Equal spreader
1 - main cover, 2 - pendulum cone, 3 - chain, 4 - fertilizer channels

The field test of the combined plough is shown in figure 3.The combined plough consists of two ATP-2 fertilizer spreaders mounted on a SP-12 4-body plough manufactured in Turkey.Fertilizer devices get the movement from the support wheel of the plough through chain transmissions.Fertilizer spreaders, driven by the support wheel, deliver the fertilizer under the plow through four fertilizer tubes fig.2.

Figure 2 Laboratory test

A equal spreader is attached to the outlet of the pipes to ensure equal spreading of fertilizers.The use of the combined plough completely reduces the operation of spreading fertilizer with fertilizer spreaders before the plowing operation, the costs and labor spent on it, at the same time, high efficiency of the use of fertilizers is ensured, equal distribution the fertilizer under the soil prevents its loss, ensures its equal spreading, etc figure 1.In addition, time is significantly saved and operations can be performed in a short time (Qurbanov H.N., 2022).

Fig. 3 Field test

Material And Methods

The dimension parameters of the pendulum cone, which is the working body of the equal scatterer, are taken as the basis of the cone (tg γ) angle, cone height (h), cone diameter (d), distance between the cone and the wall (Z), and the charge distance from the cone to the partitions (h1) (OST. 70.71 – 2000);(Melnikov S.V. al.et.,1980).The main parameters of the subject on spreading width (D) were calculated and are given in Table-1. Based on mathematical calculations, the parameters of the working subject were selected spreading width (D). According to the conditions of the one-factor experiment, the distance between the cone and the wall (Z) and the charge distance from the cone to the partitions (h1) were taken with fixed numerical values by obtaining mathematical dependencies.

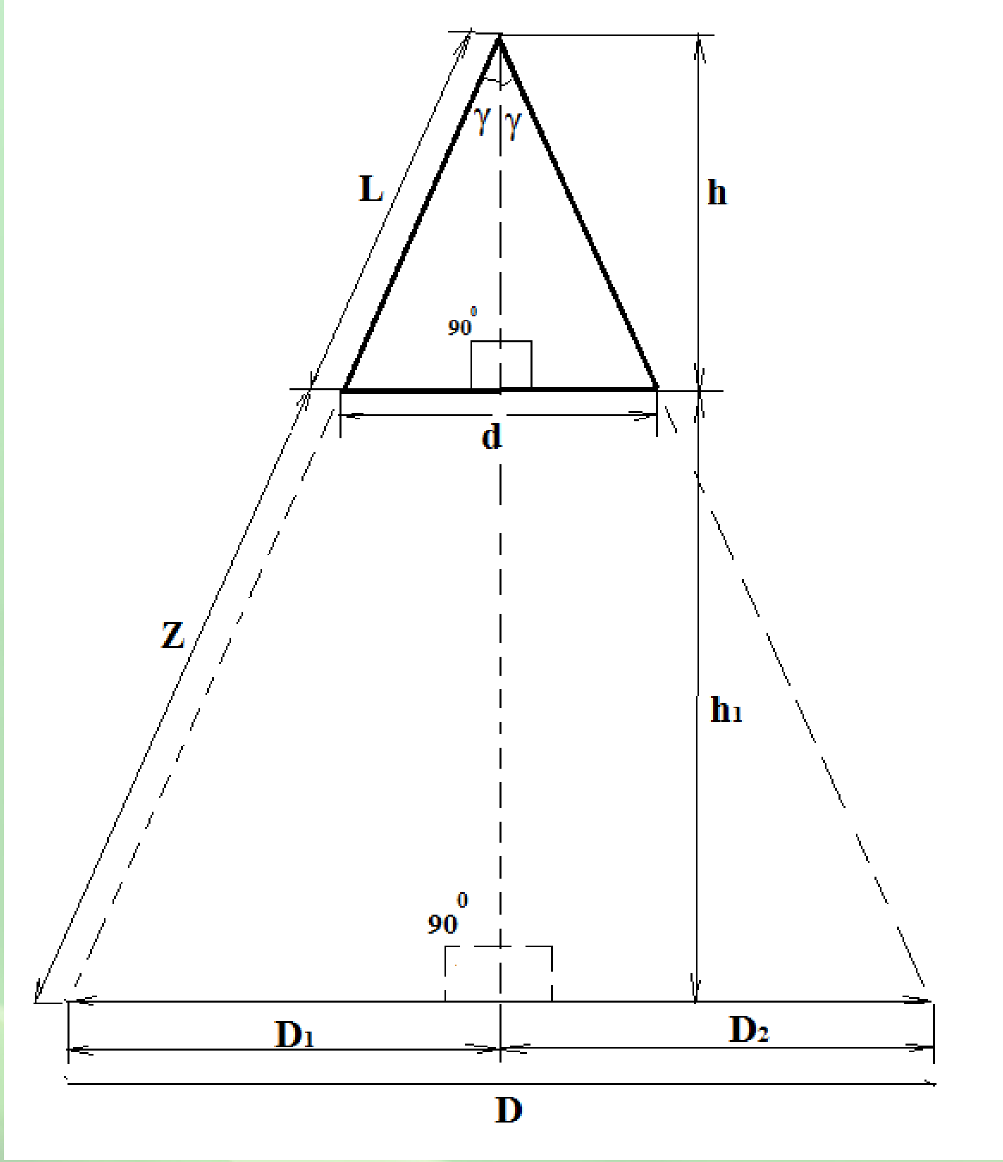

Figure 4 Dimensions and scattering parameters of the cone

Figure 4 is based on mathematical geometric calculation, based on the Pythagorean theorem of a right triangle, we can write the following formulas,

$L^2 = h^2 + (d/2)^2$; .... (1)

$(L+Z)^2 = (h+h_1)^2 + D_1^2$; ....(2)

$D_1^2 = (L+Z)^2 - (h+h_1)^2$; ....(3)

$D_1 = \sqrt{(L+Z)^2 - (h+h_1)^2}$; .... (4)

$D_2 = \sqrt{(L+Z)^2 - (h+h_1)^2}$; .... (5)

$D = D_1 + D_2$; .... (6)

$d = \sqrt{L^2 - h^2}$; .... (7)

Tabel 1.Optimizing cone size parameters

№	distribution angle, tg γ	h, height , sm	d, diameter, sm	cone-to-wall clearance distance (Z), sm	h_1, distribution distance from the cone to the partitions, sm	D, spread width, sm
1.	20	3	2.18	1	25	20.38
2.	21	3	2.30	1	25	21.49
3.	22	3.5	2.83	1	25	23.03
4.	23	3.5	2.97	1	25	24.19
5.	24	4	3.56	1	25	25.82
6.	25	4	3.73	1	25	26.87
7.	26	4.5	4.39	1	25	28.77
8.	27	4.5	4.59	1	25	30.06
9.	28	5	5.32	1	25	31.90
10.	29	5	5.54	1	25	33.26
11.	**30**	**5.5**	**6.35**	**1**	**25**	**35.20**
12.	31	5.5	6.61	1	25	36.65
13.	32	6	7.49	1	25	38.74
14.	33	6	7.79	1	25	40.26
15.	34	6.5	8.77	1	25	42.49
16.	35	6.5	9.10	1	25	44.11
17.	36	7	10.17	1	25	46.50
18.	37	7	10.55	1	25	48.23
19.	38	7.5	11.72	1	25	50.78
20.	39	7.5	12.15	1	25	52.64
21.	40	8	13.44	1	25	55.38

Fertilizer application rate (G), slope inclination (α°) were taken as the main factors influencing the uniform distribution of fertilizer to the combined plough.The sequence of experiments in the experiment planning matrix was determined using a table of random numbers.

In order to determine the rate of fertilizer spreading, the data of the Ministry of Agriculture for the Goy-gol region and the rate of spreading of laboratory research were selected: the upper limit for changing the movement speed of the aggregate was taken as 1.66 m/s.The researches were carried out in October, when the main rate was applied during the preparation of the soil for the planting of autumn cereals in 2020-2021.

In the flow pipe of the fertilizer spreader, a conical pendulum is placed in front of the flow to spread the inclined flow evenly.A section consisting of a partition divided into eight equal parts is prepared.Fertilizer is applied to the rear part of the 35 cm wide ladder by dividing the particles scattered from the conical pendulum into eight equal parts.

Results And Discussion

Mathematical models were constructed on the obtained parameters, calculating the percentage of equal dispersion in the direction of different angles in the laboratory conditions of a smooth disperser.

Reliability of distribution according to the technological scheme can be achieved under the condition that the selection of structural dimensions of the smooth spreading part allows optimal fertilizer distribution (Pyataev M.V.,2010).

Due to the fact that the working width of the cranberry in the plough trunk is 35 cm, the required spreading width D=35.2 cm, the angle of the cone tg γ =30 degrees, cone height h = 5.5 cm, and cone diameter d = 6.35 cm are taken from Table 1.The clearance distance between the cone and the wall Z =1 cm and the charge distance from the cone h_1 = 25 cm are taken as fixed values.

In order to verify the reliability of the control studies, to improve the proposed design of the machine and to justify its operating modes, field studies are determined, which ensures the spreading of fertilizers in the field.

Phosphorous and potassium fertilizers are not soluble in water, so the penetration area in the soil is small.However, since nitrogen-containing fertilizers are water-soluble, the penetration area in the soil is large.The spread of mineral fertilizers in the soil, the penetration of phosphorus substance from the place where it falls is 5.6 cm, and potassium substance is 6 cm (Klyatis L.M.,et.al., 1979);(Bagirov B. et.al.,2018).If we accept the penetration area of granular

particle as circular, then we can calculate the penetration area of phosphorus and potassium particle by mathematical method.
Penetration area of the phosphorus particle
$S_p = \pi r^2 = 3.14*2.8^2 = 24.62$ sm²
Penetration area of potassium particle
$S_k = \pi r^2 = 3.14*3^2 = 28.26$ sm²
Since the width of the plough cranberry is 35 cm, let's select the number of partitions that divide the distribution area in the size of the width of the cranberry.

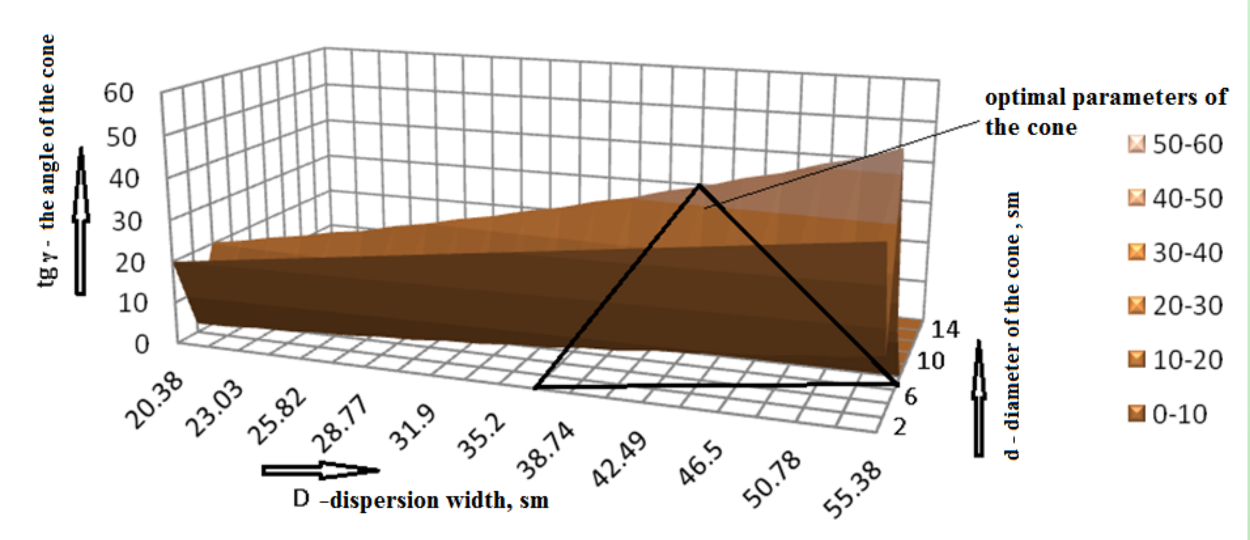

Fig. 5 Optimization graph of cone parameters

Table 2 Selection of the optimal value of the numerical content of partitions according to the penetration area of fertilizer particles

№	Partitions number, ps	number of channels, ps	The distance between partitions, sm	Channel width,sm	Area of a canal, sm²	Penetration area of potassium particle, sm²	Penetration area of the phosphorus particle, sm²
1	4	5	8.75	5.5	48.13	28.26	24.62
2	5	6	7.0	5.5	38.5	28.26	24.62
3	6	7	5.83	5.5	32.1	28.26	24.62
4	**7**	**8**	**5.0**	**5.5**	**27.5**	**28.26**	**24.62**
5	8	9	4.38	5.5	24.09	28.26	24.62
6	9	10	3.89	5.5	21.4	28.26	24.62
7	10	11	3.50	5.5	19.25	28.26	24.62
8	11	12	3.18	5.5	17.5	28.26	24.62

Partitions, which are one of the structural main parts of the smooth spreader, create channels, and the optimal value of the number content of the penetration areas of fertilizer particles is selected from table 2.The number of partitions is 7, the number of channels is 8, the area of one channel is 27.5 cm².
In mountain agriculture, one of the main issues is to apply mineral fertilizers in equal amount to the soil before sowing the grain seeds. Mineral fertilizers containing phosphorus and potassium, distributed evenly under the soil, are easier to be absorbed by plants. From our research, it is clear that if the soil is cultivated at a depth of 18 cm, there is better distribution.
The nutritional area of each grain seed buried in the soil is provided with 90-97% nutrients. Even distribution significantly affects the development of the plant stem, its height, and the quality of the grain.
Analyzes showed that the fertilizer spreaders for the application of mineral fertilizers do not meet the agro technical requirements by unevenly distributing the fertilizers in the cultivated area, which leads to uneven development of plants and yield loss. Increasing the efficiency of the use of mineral fertilizers can be achieved by using technical means developed on the basis of scientifically based technological and technical solutions that ensure adaptation of the processes to the requirements of cultivated plants in terms of norms and types of mineral nutrition. The use of a combined plough completely reduces the operation of spreading fertilizer with fertilizer spreaders before the

plowing operation, the costs and labor spent on it, saving time and ensuring that the operations are performed in a short time. Distribute equally fertilizer under the soil is environmentally friendly and prevents fertilizer loss. Compared to centrifugal disc type machines, the most promising machines for application of solid mineral fertilizers are made with a combined plough, which ensures smooth spreading by reducing the unevenness of the horizontal, longitudinal and, accordingly, total spreading by 15-20%.The design of the combined plough has been developed, including: frame, bunker, sowing apparatus, equal spreader, motion transmissions, and plough.
We consider the combined plough to be a convenient technical tool for farmers.

Conclusions

1. The optimal size parameters and location of the pendulum cone, which is the working body of the equal fertilizer spreader, have been determined. The angle of the cone was tg γ=30°, the height was h=5.5 cm, the diameter was d=6.35 cm, the gap between the cone and the wall was Z=1, the distribution area from the cone to the partitions was h_1=25 cm, and the scattering width of the particles from the cone was D=35.2 cm.
2. The optimal number of partitioned fertilizer channels with an equal amount of fertilizer spreader and a working body has been determined. The number of partitions was 7, the number of fertilizer channels was 8, the distance between the partitions was 5 cm, the width of the channels was 5.5 cm, and the area of one channel was 27.5 cm^2.
3. As a result of selecting the optimal parameters, the "equal fertilizer spreader" evenly distributed granular fertilizers under the soil, and the urea fertilizer was 92.0%, double superphosphate - 94.0%, and potassium chloride - 93.0%.

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