SUBSTANTIATION OF THE CONSTRUCTIVE AND TECHNOLOGICAL SCHEME OF THE MACHINE FOR INTRA SOIL DIFFERENTIATED THREE-LAYER INTRODUCTION OF MINERAL FERTILIZERS

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Abstract: *The necessity of accurate placement of the required quantity of nutritious elements concerning root system of plants presupposes intra soil layer-by-layer introduction of the differentiated doses of fertilizers on different depths. Meanwhile, phosphoric fertilizers have to be located in a horizontal tape closer to seeds in the moist layer of the soil, the centers of nitrogen fertilizers should be at different depths that will allow roots of plants to get necessary mineral nutrition during different vegetative periods. For providing adequate nutrition of plants during the whole vegetative period a new technology of the intra soil differentiated three-layer introduction of mineral fertilizers is offered and its constructive and technological scheme is substantiated.*

KEYWORDS: MINERAL FERTILIZERS, DIFFERENTIATED INTRODUCTION, EXACT AGRICULTURE, THE SOWING SYSTEM AND FLAT-CARVING CULTIVATION

It is known that technologies of grain crops cultivation on the soils subject to wind erosion provide several types of processing of the soil without turnover of layer preserving maximum amount of stubble remains on the field surface with minimum dispersion of the processed layer [1]:

- flat-carving cultivation on the depth of 0,08-0,16 m (autumn cultivation, the first and intermediate cultivations of fallow, spring preseeding cultivation, cultivation of the layer of long-term grass);
- flat-carving tillage to the depth of 0,20-0,27 m (autumn cultivation, the first and last cultivations of fallow, cultivation of the layer of long-term grass);
- cultivation of pure fallow to the depth of 0,06-0,08 m;
- surface cultivation of soils to the depth of 0,04-0,06 m (early-spring tillage of the soil, stubble harrowing, care of sowing of long-term grass);
- stubble disking of the soil after harvesting of sunflower or corn for grain;
- paraploughing;
- chisel plowing.

Considering different types of the existing ways of soil cultivation, one of the main requirements which had been put before design of the machine for fertilizer introduction, - to realize three-layer introduction of mineral fertilizers, was its being combined, ability to provide several types of cultivation. For this purpose the installation of 6 rows of operative parts is presented, figure 1:

- 1, 2 rows are arrow-headed harrows with coverage of 0,33 m,
- 3, 4, 5, 6 rows are flat-carving harrows with coverage of 0,50 m.

At the same time arrow-headed operative parts of 1, 2 rows are installed in removable beams, i.e. they can be taken off assembled with a beam. These operative parts have to carry out surface cultivation of soils to the depth of 0,08-0,10 m with simultaneous introduction of mineral fertilizers in a horizontal strip with the width of 0,20-0,30 m.

The following ranks of operative parts are vertical racks with the installed flat-carving harrows with flare angle of 75°. Meanwhile middle ranks (3, 4) have to carry out flat-carving cultivation to the depth of 0,16-0,18 m and to introduce mineral fertilizers to the width of 0,40-0,50 m with the horizontal screen.

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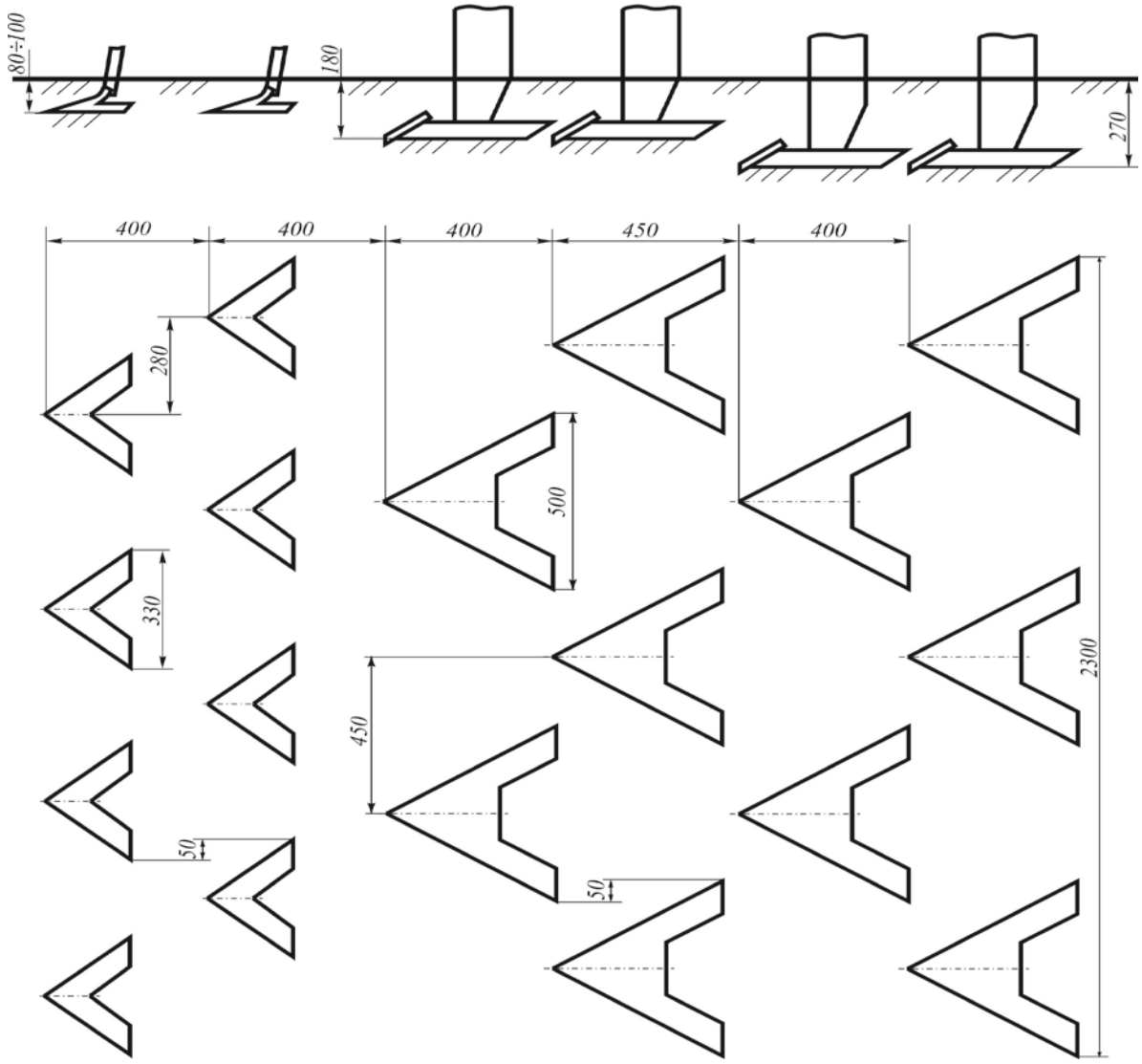

Figure 1 *- Scheme of the arrangement of operative parts*

The last ranks have to carry out flat-carving tillage to the depth of 0,20-0,25 m as well as to introduce fertilizers on width of the cultivated strip, figure 2. Increase in width of a harrow would promote the improvement of quality indicators of their work as at smaller quantity of racks on 1 m of coverage there are more stubble remains on the field surface and less cultivating layer of the soil is pulverized. However when increasing the coverage of a harrow its deepening ability is reduced and it is difficult to provide even distribution of fertilizers granules in underharrow space. Therefore, for ensuring the quality of technological process of distribution of fertilizers in the soil the coverage of a harrow should make 0,5 m.

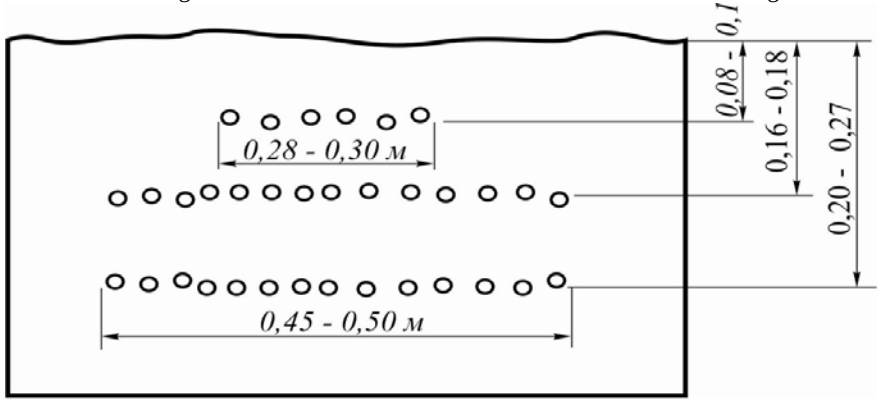

Figure 2 – *The scheme of distribution of fertilizers in the soil*

Not only the shapes of the bottom of furrow and surface of the cultivated field, cutting of weeds and preservation of stubble remains on field surfaces, but also practicability of machine depend on the characteristics installation of operative parts on the engine frame [2, 3, 4]. If the required parameters are not followed, then jamming of the soil between operative parts or emergence of "rake" effect of racks of harrows can happen.

For increasing the distance between harrows in a row and ensuring overlapping between them, their multirow arranging on the engine frame is offered.

Experimental operative parts provide high quality of cultivation, especially condensed and dried up soils. In the process operating parts raise and displace layer, break and crumble the condensed sites of the soil. Designs of operative parts will allow to get minimum backfurrows, and for their smoothing the rollers – supporting and driving machinery are mounted.

A fertilizing machine contains a frame with the multirow operative parts installed on it, supporting rollers and two bunkers, figure 3.

The machine works in the following way. From the bunker mineral fertilizers get to sowing windows and dosed by means of coils, then they get to scatterers of operative parts through fertilizer hose and further are distributed on the coverage of operative parts.

The total coverage makes 2, 3 m. Productivity in an hour of pure working hours is:

$$W_ч=0,1B_p\cdot V_p,$$

where V_p is working speed – 6-8 kph;

B_p is working coverage of the machine - 2,3 m.

$$W_ч=0,1\cdot 2,3\cdot 8=1,84 \text{ hectares per hour}$$

Productivity for an hour of replaceable time is:

$$W=W_ч\cdot K_{up},$$

where K_{up} is coefficient of using working hours, when cultivating fallow

K_{up} =0,8.

$$W=1,84\cdot 0,8=1,47 \text{ hectares per hour}$$

Then the day work of a machine during the single-shift work makes 10-12 hectares. The machine can work both as a fertilizing machine and as equipment for the main cultivating of the soil when taking off a beam with arrow-headed harrows.

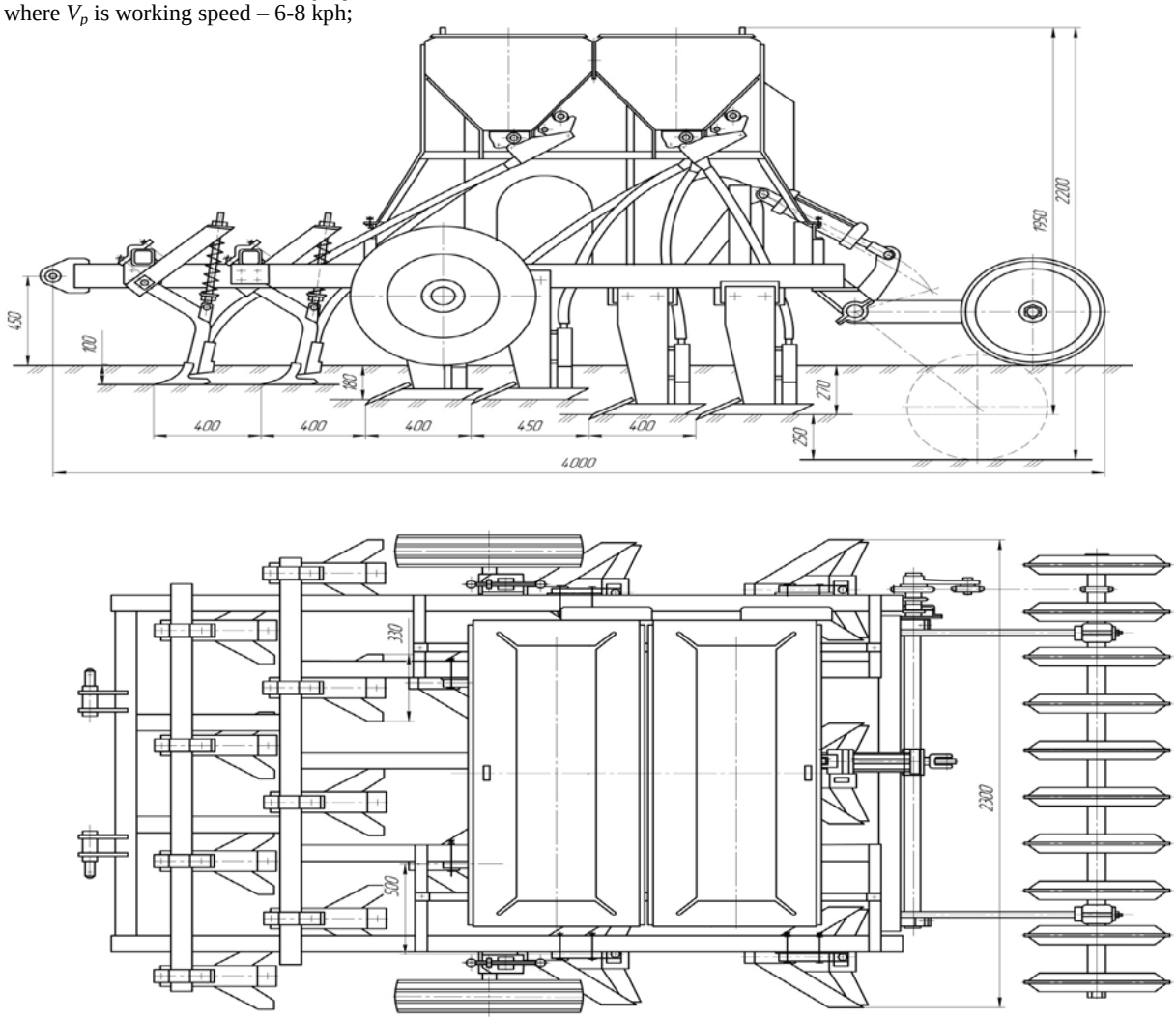

Figure 3 *– A cultivator-fertilizer*

Conclusion. The analysis of various technologies of introduction of mineral fertilizer shows that the need of exact placement of necessary amount of nutritious elements concerning root system of plants assumes intra soil layer-by-layer introduction of the differentiated doses of fertilizers to the depths of 0,08-0,10, 0,16-0,18 and 0,20-0,25 m. And phosphoric fertilizers have to be settled down in a horizontal strip closer to seeds in a humid layer of the soil, the centers of nitrogen fertilizers - at different depths that will allow roots of plants to receive necessary mineral food during the different vegetative periods.

For realizing the technology of three-layer introduction of mineral fertilizers the most effective multirow arranging of operative parts where the first 2 rows provide a surface treatment of soils to the depth of 0,08-0,10 m with simultaneous introduction of mineral fertilizers in a horizontal strip with a width of 0,20-0,30 m, 3, 4 rows provide flat-carving cultivation to the depth of 0,16-0,18 m and introduce mineral fertilizers on width of 0,40-0,50 m by the horizontal screen and 5, 6 rows provide flat-carving tillage to the depth of 0,20-0,25 m as well they introduce fertilizers on the width of the cultivated strip.

Acknowledgements: The authors express their gratitude to the Ministry of Education and Science of the Republic of Kazakhstan for the funding research works on the topic "Development of new technology and equipment for the three-layer subsurface

differentiated application of mineral fertilizers". The current study was carried out within this topic.

References

1 Грибановский А.П., Бидлингмайер А.П. Комплекс противоэрозионных машин (теория, проектирование). – Алматы: Кайнар, 1990. – С.180-183.

2 Seid Hussen, Brzegen Alemub, Fentaye Ahmed. Effect of Planting Depthon Growth Performance of Maize (*Zea-Mays*) at the Experimental Site of Wollo University, Dessie, Ethiopia // International Journal of Sciences: Basic and Applied Research (IJSBAR). 2013, Volume 8, No 1, pp 10-15.

3 Altikat S. Effects of Strip Width and Tractor Forward Speed on Sowing Uniformity of Maize and Sunflower // Bulg. J. Agric. Sci., 2013. 19: 375-382.

4 Rafael Scabello Bertonha1, Carlos Eduardo Angeli Furlani, Vicente Filho Alves Silva, David L. Wright. Tractor performance and corn crop development as a function of furrow opener and working depth in a Red Latosol // Australian Journal of crop Science (AJCS). 2015, 9(9): pp. 812-818.