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Technological basis for sowing winter wheat in the rows of growing cotton

A Igamberdiyev[1], S Alikulov[1], U Berdimurodov[1], O Usarov[1] and N Razikov[1]

[1]Tashkent institute of irrigation and agricultural mechanization engineers, Uzbekistan

asqar1959@mail.ru

Abstract. A scheme of the technological process of work and the design of the opener of the sowing machine for sowing winter wheat in the rows of cotton are proposed. Increases the efficiency of cultivation technology compared to the traditional maximum use of the furrow profile. Comparative analyzes of the methods of cultivating winter grain cultivations are made. Narrow-row sowing of winter wheat in the rows between growing cotton with a sowing rate of 180-200 kg/ha is recommended.

1. Introduction

The analysis of a present condition of seeding machines shows that there are different varies- ties of seeders, divided into groups according to their purpose. The biggest group of seeders is universal seeders. Also, there are special seeders for sowing one of the limited number of crops. These seeders are specified, first of all, by the physical and technological properties of cultivated crops and their seeds (the method and sowing depth, rate of seeding, the size of seeds, etc) [1, 2, 3, 4, 5, 6, 7, 8]. However, nowadays, the intensification of agriculture is raising new requirements for crop production. According to these requirements, improvement of the crop seeding ways should develop highly productive, energy – and resource-saving, the soil-protective, and ecologically sound technologies reducing the number of tractors passing across the field for 3-4 times and raising productivity to 15-20 % (table 1).

Table 1. Development layout of seeding technology

Seeding technology	
High productive	Seed quality
	Seed germination factors
	Uniformity of seed placement
	Optimal density
	Vegetation period
	Optimal seeding time
	Uniformity of feeding area
	Maximum use of cotton inter-row furrow profile
Moisture conservation	Direct seeding
	Seeding on mulch (straw)
	Combination of operations
	Seeding under film layer

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	Direct seeding into the standing cotton rows
Soil protective	Seeding with minimal tillage
	Combination of operations
	Broadcast seeding with wide-cover spreaders
	Reduction of soil compaction by wheels
	Seeding into the cotton rows
	Seeding minimal tillage
	Broadcast seeding
	Combination of operations
	Precise seeding
	Seeding into the cotton rows
Ecologically safe	Seeding with local entering of the basic rate of
	Seeding under film layer
	Seedling seeding

The yield of cultivated crops significantly depends on the quality of the seeding technology and its performance [7]. The questions related to the definition of the dependence of the quality of seeding grain crops into the cotton rows and substantiation of seeder openers from a surface profile for row-spaces 60 … 90 cm in conditions of Uzbekistan are researched insufficiently. At winter wheat seeding into the cotton rows, the most important agrotechnical requirements are the maximum furrow profile use, uniform distribution of seeds on the sowed area, maintenance of the best conditions for germination, and obtaining optimum density. There is no exact scientifically proved row width for sowing the grain seeds into the cotton rows so far. In connection with this, basic agrotechnical requirements for the technological process of the grain seeding into the cotton rows remain as follows:

- placement of the fixed number of seeds on the given area;
- their uniform distribution across the sowed area;
- uniform placement in the fixed depth.

For seeding the winter wheat into the cotton rows spreaders and machines with distributors of the various types and designs are commonly used. Among these machines, there are passive type reflectors in which a blow-reflection or sliding principles are used to seed crops. Spreaders with different adaptations are used as a seeder for sowing cotton cultivators. Mainly the sowing will be done by broadcasting and then placing the seeds with the cultivator elements.

The basic drawbacks of existing seeding ways of seeding grain crops into the cotton rows remain:

- The impracticality of the seeders intended for seeding in open furrows;
- Shortage of seeders for the sowing of grain crops into the cotton rows;
- The excessively high rate of grain seeds for broadcasting into the cotton rows;
- Repeated (3-4 times) passing of the different machines for broadcasting and placing the seeds into the cotton rows;
- Non-uniform distribution of the fixed quantity of seeds in the given area.

2. Materials and methods

It is known, that crop yield depends not only on the feeding area of plants but also on its configuration. The typical shape of the feeding area for row crops is a rectangle with a considerable difference in the ratio of the sides. It is impossible to elaborate on the uniform distribution of the seeds across the field during broadcasting. The elaboration method with the meter framework divided into squares of the fixed size (5x5 cm), does not support criticism as only at an equal number of squares and plants per unit of the estimated area, such method can be considered correct. Elaboration

on uniform distribution of the seeds by broadcasting cannot be justified in a cross-section direction, i.e. uniformity as a whole, especially in the cotton rows (fig. 1).

Figure 1. Placement of winter wheat shoots in broadcasting into the cotton rows

The most perspective way of seeding crops into the cotton rows is the narrow-spaced subsoil method, which allows to equally distributing seeds across the feeding area (fig. 2).

Quality of seeding significantly depends on the sowing, seed selection, fixed-rate, and distribution devices. In many countries sowing machines are often used with the bobbin sowing device.

Figure 2. The placement of winter wheat shoots at narrow-spaced, sub soiled way of seeding into the cotton rows

These days the park of the seeders is more and more sated with seeders that possess precise sowing devices of mechanical, pneumatic, and pneumo-mechanical types. Seeders with pneumatic and pneumo-mechanical devices are mainly intended to seed large seeds with high germination [8, 9, 10, 11, 12, 13, 14].

Precise sowing devices are unsuitable for the small size seeds, are complicated in exploitation, are unreliable in functioning; require expensive materials, automatic tools to control the seed rate and distributive systems. Also, there are requirements to change the openers and use the optimum parameters and operating modes for the seeding of various seeds with high accuracy in

manufacturing and application. Their usage proposes the section design of seeders that increases metal consumption, expenses, time for the qualified service at seed rate change, the crops scheme, etc.

In connection with the conditions listed above creation of the universal seeders with a simple and reliable design, with small metal consumption, a universal change of openers, not requiring expensive materials is more preferable, to seed into the cotton rows.

The actual problem is the development of openers that seed in a given way, because nowadays due to the lack of such openers, spreaders and machines with the distributors of various types and designs are used.

Figure 3. Seeder for cotton rows and special coulters

The work of the seeder consists of the following steps: openers 6 are mounted on beams 3 along the width of the row on certain distances as assembly moves. In a cross-section direction it can be fixed on distance 5.7 cm from cotton stalks, further on 7…. 10 cm from each other along the whole width and along the whole height of a furrow, are adjusted independently on depth 5… 7 cm by adjusting mechanisms 7. Openers 6 on beams 3 are located in a way that each opener can seed irrespectively of a shape and configuration of a furrow, into the rows on fixed depth.

The seeder prototype has been tested with sharp angle openers i.e. during the experiments the key soil physical-mechanical properties of the experimental site have been defined. The field experiments were conducted on the fields of a research farm of the Tashkent institute of irrigation and melioration (TIIAME). The key soil physical-mechanical properties of the experimental field are illustrated in Table 2.

Table 2. The key physical-mechanical properties of the experimental field

Soil layers, *cm*	0...5	5...10	10...15
Moisture, *%*	11.09...11.44	12.96...16.12	15.58...17.32
Hardness, *MPa*	2.56...3.42	2.50...3.23	1.52...1.62
Density, g/cm^3	1.36...1.56	1.29...1.40	1.19...1.41

During the experiments, the accumulation of weeds and cotton leaves on the openers was observed while the seeder was moving, consequently seeding quality decreased. The conducted experiments proved the expediency of application of the openers with an obtuse angle when seeding the winter wheat into the cotton rows.

Experiments' results formed the basis for the development of a new universal seeder with an opener of a support runner type. In connection with these new designs of the openers and technological processes have been developed [15, 16, 17, 18, 19, 20, 21].

The analyses of the experiments, dedicated to the development of the openers and seeders, have outlined the necessity for a preliminary study of a surface profile while seeding into the rows of 60-90 cm. It would particularly allow answering the questions regarding the forms and parameters of the openers and seeders.

Surface profiles of the row-spaces were studied on the fields of the Andizhan and Tashkent regions, and also on the fields of TIIAME research farm. 100 profiles have been taken from each experimental field. Profiles were measured after each 5 cm along the width of row-spaces with the accuracy of 0.5 cm by a special device, suggested by *G*. Koshevnikov. Field measurements intended to define the profile ordinates in system *X(b), Y(h)* (fig. 4).

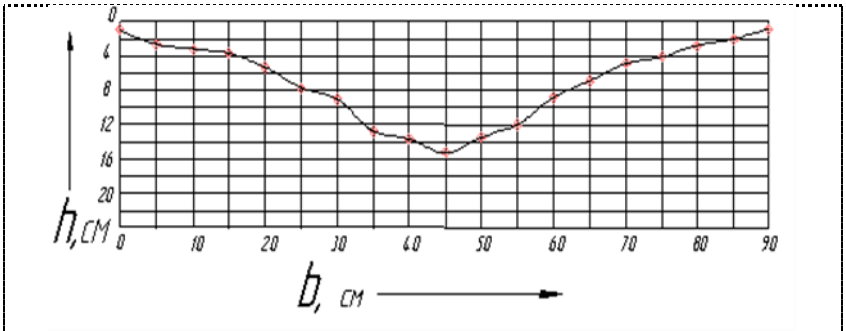

Figure 4. Measurement and surface profile results

Preliminary analyses of the made measurements have shown, that the depth of the furrows in row-spaces fluctuated from 12.5 to 17.0 cm. The methods of processing the profile measurements and the study of a surface profile (fig. 5) have allowed selecting the opener's form and parameters. On the basis of the obtained results, the seeder with runner type of the opener (fig. 5) was developed.

The seeder and coverer (fig. 5 and fig. 6) consist of the opener runner 1 for formation, copying and pressing of a furrow shape; of the wedge-shaped opener, that is located perpendicularly to the bottom side on an inclined surface of the opener and of the adjustment mechanism of an inclination angle.

Figure 5. General view of the seeder

The form of the runner opener (Fig. 8) in cross-section copies the form of a furrow shape. The coverer falls with the help of the hinged device and leans on a furrow bottom, then slides on a row-space surface, copying roughness of a furrow's bottom.

Figure 6. General view of the coverer

Wedge-shaped openers (figure 7) cut the soil apart and move to different sides under some angle, form small furrows in the soil where the seeds, delivered by the sowing device, are placed.

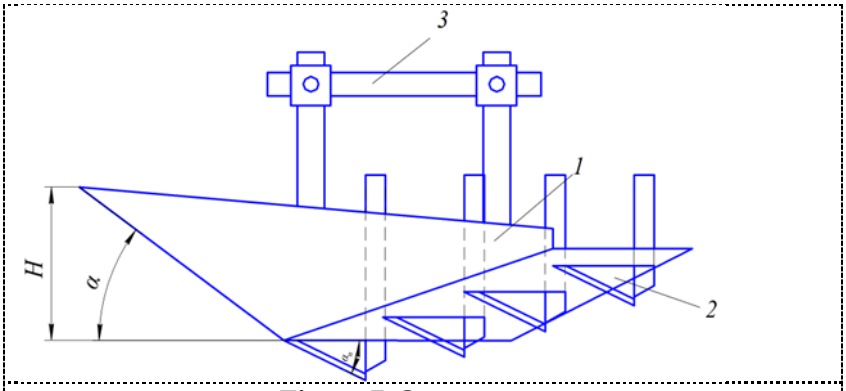

Figure 7. Opener runner

Wedge-shaped openers (figure 8), are mounted in an oblique angle from the bottom side of the runner and designed in a way that assures easy access to clods and weeds. Formation and soil compaction on the furrow perimeter happens simultaneously with the seeding. Moreover, there will be an opportunity for moisture to run under the seeds of underlying layers. The runner limits the deepening of the wedge-shaped openers, guaranteeing the uniform distribution of the seeds on the surface of the cotton row-spaces.

Such a scheme of seed placement allows maximizing the usage of a furrow's surface throughout the whole profile, seeding directly in a protective zone of the cotton.

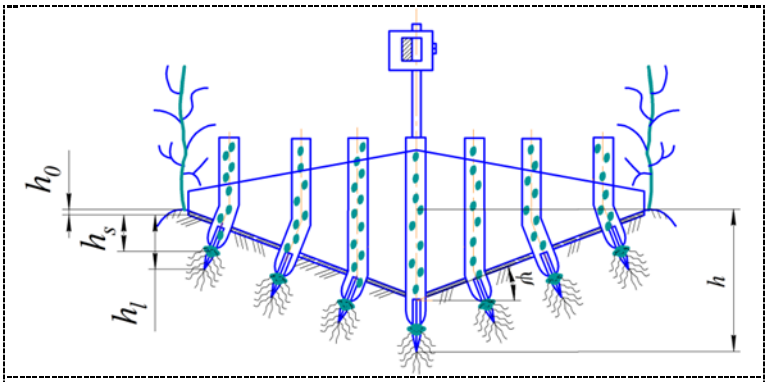

Figure 8. Wedge-shaped opener

Newly offered technology provides regular narrow -interval spaced seeding of the grains into the cotton row-spaces from 8 to 12 rows. Due to the keeping the furrow forms of row-spaces the effective area for seeding increases to 9…22% in comparison to the usual flat way of seeding.

The maximum usage of the useful area of a cross-section profile provides optimum placing of the fixed quantity of seeds, their uniform distribution throughout the whole depth, the best condition for germination, and obtaining optimum density with the high yield. To implement this particular method of seeding and these seeder design priorities of the patent department of the Republic of Uzbekistan are received. For comparison purposes, existing and the prototype of the proposed seeder were juxtaposed in the field studies in 2008-2009 on experimental fields of research farm of TIIM, on maximum use of a useful area of a cross-section profile, maintenance of optimum seed placement of the fixed quantity, their uniform distribution throughout the depth, the best condition for germination and obtaining optimum density with high yield.

The soil of the experimental field was loamy because of the old irrigation with a deep underground water level (10-12 m). Soil moisture and hardness before carrying out the experiments per layer of 0-5; 5-10 cm accordingly, constituted 11.5; 14.3 % and 2.23; 1.90 MPa.

Comparative studies were conducted with the use of the sowing units consisting of the tractor-cultivator MTC-80C, seeder prototype GS-3.6 TIIM coverer type of opener runner, a spreader of mineral fertilizers MSF-0.5 and also ripper (cultivator) CCU -3.6 for spreading and a seed cover.

3. Results and Discussion

Experiments were conducted in three passes - in a direct and return direction. On these passes, 1 m for the whole width of the capture of the seeder was measured on the three record plots, where the seed placement depth was defined.

"Kroshka" was taken as winter wheat specie with a germination coefficient of 95 %. The results are given in Table 2.

Table 2. Comparative assessment of seeder on sowing ways of winter wheat at rate of 220 *kg/ha*

Seedertype (seeding way)	Seed placement depth	Average number of spikes, Num/m^2	Thousand kernel weight		Average kernel number in spikes		Yield, ton/ha
			g	%	number	%	
Prototype (narrow spaced)	3-4	471	37.5	103.3	30.9	136.1	5.46
CCU-4 (spreading)	0...15	397	37.7	103.8	26.1	114.9	3.91
ControlMSF-0.5 (spreader)	0-12	456	36.3	100	22.7	100	3.76

Joint researches dedicated to the influence of the seeding rate on winter wheat yield of a "Kroshka" specie were carried out. On experimental plots seeds of winter wheat at the seeding rate of 150, 180, 200, 220 and 250 kg/ha have been sowed; and obtained 530.9; 594.7; 635.6; 546.7 and 533.3 gr of grains from each m2 accordingly. It can be seen from the obtained results (fig.9), that seeding rates from 170 to 200 kg/hectares appeared to have the most positive effect on the yield and the number of productive stems among the all compared seeding ways.

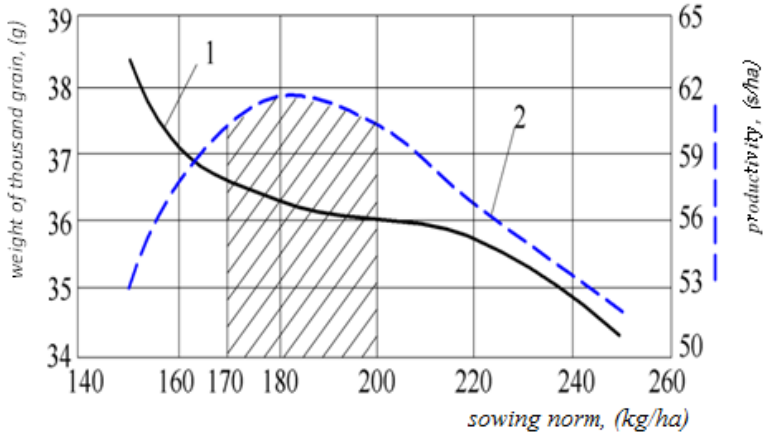

Figure 9. Changes of thousand kernel weight and yield from the seed rate of winter wheat

As follows from the above analysis, it is necessary to have fixed seeding rates, as grain yield depends not only on the feeding area but also on its configuration.

References

[1] Baojie ChiaYanjun Zhanga Dongmei ZhangaXiaojie Zhanga Jianlong Daia Hez hong Dongab 2019 *Wide-strip intercropping of cotton and peanut combined with strip rotation increases crop productivity and economic returns Field Crops Research* **243(1)** 107617

[2] Frédéric B, Alain N, Innocent H, João Vasco 2019 How to increase the productivity and profitability of smallholder rainfed wheat in the Eastern African highlands? Northern Rwanda as a case study *Field Crops Research* **236** pp 121-131

[3] Zheng Liu, Jia Gao, Fei Gao, Peng Liu, Bin Zhao, Jiwang Zhang, Late harvest improves yield and nitrogen utilization efficiency of summer maize *Field Crops Research* **232** pp 88-94 https://doi.org/10.1016/j.fcr.2018.12.014

[4] lSukanta K, Sudhanshu S, Virender K, Ashish K, Parbodh C and David E 2019 Tillage and crop establishment options for enhancing the productivity, profitability, and resource use efficiency of rice-rabi systems of the salt-affected coastal lowlands of eastern India *Field Crops Research* 107494.https://doi.org/10.1016/j.fcr.2019.03.016.

[5] Meimei L and Qiping H 2019 Exploring the relationship between agricultural intensification and changes in cropland areas in the *US Agriculture Ecosystems and Environment* **274** pp 33-40 https://doi.org/10.1016/j.agee.2018.12.019

[6] Fischer R, Moreno R, Ortiz M and Sayre K 2019 Yield response to plant density, row spacing and raised beds in low latitude spring wheat with ample soil resources: An update *Field Crops Research* **232** pp 95-105 https://doi.org/10.1016/j.fcr.2018.12.011

[7] Gicheru P T 1994 Effects of residue mulch and tillage on soil moisture conservation. Soil Technology **7** Issue 3 pp 209-220 https://doi.org/10.1016/0933-3630(94)90022-1

[8] Patil L and Sheelavantar M 2004 Effect of cultural practices on soil properties and grain yield of winter sorghum *Agricultural Water Management* **64** Issue 1 pp 49-67 https://doi.org/10.1016/S0378-3774(03)00178-1

[9] Pradeep KSharma and C LAcharya 2000 Carry-over of residual soil moisture with mulching and conservation tillage practices for sowing of rainfed wheat (*Triticumaestivum* L.) in north-west India *Soil and Tillage Research* **57**, Issues 1–2 pp 43-52 https://doi.org/10.1016/S0167-1987(00)00141-0

[10] Shaychov M K, Pisarev O C and Artomonov V A 2005 Motivation parameter distributorforstripof the sowingofthecorncultures *Technical inagricultures* No 5 pp 3-5 Moscow

[11] Veretennicov N D, Borovikov Y A, Vasileva O P Distributing device seed seeders-cultivation S K Mechanization and electrification in agriculture 2009 №6 pp 3-5

[12] Achalaya B X 2002 About increasing quality seeding seed Technical inagricultures 5 pp14-16 Moscow

[13] Grabinski J, Wyzinska, M 2019 Productivity and technological value of spring wheat in conditions of autumn sowing date *th International Scientific Conference Engineering for Rural Development* **18** pp 583-59318 Jelgava Latvia

[14] Sun H, Liu X, Zhang X Regulations of salt and water of saline-alkali soil *A review Chinese Journal of Eco-Agriculture* **26**, Issue 10(1) pp 1528-1536

[15] Zhai C, Long J, Taylor, R, Weckler P, Wang N 2020 «Field scale row unit vibration affecting planting quality» *Precision Agriculture* Vol **21** Issue 3 pp 589-602

[16] Zong R, Wang Z, Wu Q, Guo L and Lin H 2020 Characteristics of carbon emissions in cotton fields under mulched drip irrigation *Agricultural Water Management* **231** 105992

[17] Darawsheh M K, Kakabouki I, Roussis I and Bilalis D J 2019 Cotton response to planting patterns under effect of typical and limited irrigation regime *Notulae Botanicae Horti Agrobotanici Cluj-Napoca* **47** Issue 4 pp 1206-1214
[18] Uddin J, Smith R, Gillies M H, Moller P and Robson D Smart automated furrow irrigation of cotton» *Journal of Irrigation and Drainage Engineering* **144** Issue 5 04018005
[19] Kornecki T S Effect of different rolling crimping directions and row cleaners for cereal rye cover crop on cotton growth in a conservation system **61** Issue 6 pp 1845-185
[20] Tahir S, Ahmad A, Khaliq T and Cheema M 2019 Evaluating the impact of seed rate and sowing dates on wheat productivity in semi-arid environment *International Journal of Agriculture and Biology* Vol 22, Issue 1 pp 57-64
[21] Macholdt J and Honermeier B 2017 Yield stability in winter wheat production A survey on German farmers' and advisors' views *Agronomy* Vol **7** Issue 3 p 26