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Innovative Production of Raw Cotton Technology

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ABSTRACT: The article presents innovative technologies and technical means for basic tillage and pre-sowing preparation of soil for sowing cottonseeds, inter-row cultivation and protection of cotton, and harvesting raw cotton in Uzbekistan. And protection of cotton plants by biological method, resettling trichograms and developing adaptations for technical means for its resettlement.

KEYWORDS: Turnwrest plough, combined harrow-leveler, wide-width seeder, high-clearance tractor, wide-width cultivator, settler, trichogram, cotton harvester machine, two-time, disposable, harvesting, raw cotton, tests, programs, methods.

I. INTRODUCTION

Cotton growing as a branch of the national economy (Tashboltaev, 2018) occupies one of the leading places in the economies of countries involved in cultivation of cotton and production of raw cotton.

Cotton products used in many fields of industries: textile, chemical, aviation, automotive, food and others. About 100 countries are involved in production of raw cotton; total sown area is more than 30 million hectares. At the same time, cotton growing in Uzbekistan occupies an important place in agriculture, and sowing area of which is today more than 1.17 million hectares.

Obtaining high yields of any cultivated plant mainly depends on high-quality primary cultivation (Baymetov et al., 2017; Umbetaev et al., 2016) and pre-sowing preparation of soil, quality of sown seeds, inter-row tillage of plants (Sergienko, 1981), competent control of agricultural pests and diseases (Zakharenko, 1975; Ashurov et al., 1981; Andreev et al. 1977; Burd et al., 1986), and harvesting efficiently and on time. What research was directed at, the Scientific Research Institute of Agricultural Mechanization (SRIAM) together with the Uzbek State Center for Certification and Testing of Agricultural Technics and Technology (UzSCCTT), Joint-Stock Company of the Head Design Bureau for Agricultural Machines («BMKB-Agromash» JSC), LLC «Design and Technology Center for Agricultural Engineering» and the Research Institute for Plant Protection.

II. RESEARCH RATIONALE AND METHODS

A review and analysis of previous scientific research by a number of research institutes in direction of cotton production showed that one of the main factors for preparing soil for sowing cotton seeds is choice of agricultural background, high-quality primary and pre-sowing tillage (Baymetov et al., 2017), processing of sown seeds (Dudin et al., 1995; Aknazarov, 1990, Review of foreign literature, 1970), inter-row cultivation of cotton soil (Umbetaev et al., 2016), innovative control technology with agricultural pests and plant diseases (Ражабов et al., 2017), choice of the period for disclosure of cotton, high-quality and short-term harvesting of raw cotton.

The main tillage, i.e. plowing must be carried out in autumn after harvesting previous crops (Tashboltaev, 2018) and, if necessary, the roots of perennial weeds. If there is confidence that the previous culture does not have infectious

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International Journal of Advanced Research in Science, Engineering and Technology
Vol. 6, Issue 9 , September 2019

diseases, then it is recommended to grind them on spot and spread crushed mass across the field. This technology is called sideration, which in recent years has been widely practiced throughout the world.

III. DISCUSSIONS AND EXPERIMENTAL RESULTS

One of the most important part of the agricultural system is crop rotation, a scientifically based alternation of crops over time; their placement in the fields, contributing to restoration and improvement of soil fertility.

The next main valuable factor in the primary tillage is the smooth surface of soil without dumps or ramps, created by reversible, rotary or frontal plows. Domestic scientists (Baymetov et al., 2017) substantiated the technology of reverse plowing the soil for conditions of Uzbekistan.

Reversible plows of various designs (PDO-4-45, LEMKENT CHIRCHIQ, etc.) for various conditions were developed by domestic scientists and designers, which are currently produced by republic's industry. For example, the PDO-4-45 domestic reversible plow, as shown by technical characteristics and laboratory field tests, working width of one plow base is 45 cm, and total working width is 1.80 m, working speed is allowed within 6-8 km/h, plowing depth 30-40cm, with structural weight of 1800 kg and number of bases 4/4pcs. The revolving mechanism wraps plow frame for all 180^0.

The use of technology with reversible plow, as the studies of 2017-2018 showed, in areas of risky farming is the most effective, the field after such plowing has smooth surface, and this eliminates the planning operation (leveling out dumping or ramping).

Pre-sowing tillage after reversible plowing is recommended to be carried out by mounted small-leveling machine MT-3M. This small-leveling device was developed by SRIMA together with «BMKB-Agromash» JSC and the Center, which has a wide frame with three “troughs” for ballast (weight can be increased up to 500 kg). The width of MT-3M is 3 m, productivity in one hour reaches 1.5-2.1 ha at an operating speed of 5-7 km/h (Figure 1).

Figure 1. Experimental small-leveler MT-3M in preparing the field for sowing cotton

In country's farms, use of wide-row agricultural machines is gradually expanding. One of these examples is operation of wide-row seeder imported from abroad (an 8-row pneumatic seeder from CNH “America LLC” M1200) for sowing bare cotton seeds and other crops at 60 and 90 cm rows.

For inter-row cultivation of cotton crops sown with an 8-row seeder, developing an 8-row cultivator became a problem, for which Scientific-Research Institute for Mechanization of Agriculture together with «BMKB-Agromash» JSC and the Center based on cotton cultivator KHU-4B with redesigning of some working bodies, developed and experimental wide-row (8-row) cotton cultivator was made (Figure 2). An experimental cultivator undergoes laboratory and field tests on cotton field of test site of Center with an area of 6 hectares (Table).

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 6, Issue 9 , September 2019

The table shows that the agrotechnical indicators for agrotechnical requirements (ATT), for example, are the most important crumbling, while soil particles from 10 to 50 mm should be 10-60%. According to the first tests, it is already clear that experimental cultivator is crushing soil near the limits of ATT, 9.14-69.60 %.
The depth of treatment with an 8-row experimental cultivator is mainly ATT (8.0-18.0 cm), which is 6.7-18.0 cm.

Figure 2. Experimental 8-row cultivator (conditionally КХУ-8е) on cotton cultivation, 04.23.2019 at test site of the Center

Table: Characteristics of area and cotton, procedure and performance of cultivators

Name of indicators	Value of indicators	
Date	23.04.2019	
Machine model (tractor)	КХУ-4Б (series) (ТТЗ-811)	КХУ-8 experiment (Arion 630)
Type of work	1st cultivation	
Sort of cotton	«Sultan»	
Row spacing, cm	90	
Development phase	emergence of true leaves	
Plant density, thousand units/ha	57 777	59 999
Soil humidity is average,% in the 0-15cm layer	11,84	12,64
The soil hardness is average,% in the layer 0-15 cm	0,66	1,11
Speed, km/h	2,65	2,90
Working width, m	3,6	7,2
Depth of processing, cm: - blade, ATT 8-10 cm	7,88	6,7
- a cultivator (ripper), according to ATT 10-15cm	11,33	12,5
- lancet paw, 14-18cm	14,20	18,0
Crumbling (10-50mm) of soil, %, (at depths of 0-15 cm) ATT 60-10 %	86,29 – 5,43 (11,1)	69,60 – 9,14 (12,4)
Protection zone, actual, mm	12,1	8,01

One of the important activities in crop production is protection of plants from pests.
In practice, there are three ways to control agricultural pests, weeds and plant diseases, in particular cotton: chemical, mechanical and biological methods of plant protection.

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Vol. 6, Issue 9 , September 2019

The Scientific-Research Institute for Mechanization of Agriculture together with Scientific-Research Institute for Plant Protection and Test Center conduct research and tests on protection of cotton plants by biological method (purely ecological way), resettling trichograms and developing adaptations for technical means for its resettlement ().

Based on joint research with entomological scientists, method and technical tool for resettlement of trichogram pupae was developed (Razhabov et al., 2017).

Study of physicomechanical and aerodynamic properties made it possible to determine that for resettlement of trichogram pupae, application of ejector principle has positive results. The experimental design of high pressure ejector equipment that we developed consists of (Figure) confuser, mixing chamber, tank for trichogram pupae, flow tube and an air tube.

When trichograms are resettled by this device as part of aggregate, so that trichograms are retained on cotton leaves, before settling, they are moistened with water or nutrient fluids by sprayer during cultivation.

The productivity of unit is equal cultivator and can handle up to 15–20 hectares per day in shifts. It can be used simultaneously with inter-row cultivation of cotton and can be used either in a cultivator or in a wide-ranging sprayer used for leaf feeding.

The results of studies to determine quality indicators after the trichograms have been resettled, 3 samples of 100 trichograms eggs were taken from each batch of settled eggs, examined under microscope and set to fly. After processing obtained results of qualitative indicators of trichogram resettlement with this ejector device, the number of trichograms entomophages that fly out is on average 85%, and the number of deformed and injured on average 2%. In this case, air flow rate in the flow tube 4 of ejector unit is less than 3 m/s, and in outlet of mixing chamber an average of 7–11 m/s.

Studies are conducted on development of cotton plants, fight against diseases and pests of raw cotton, as well as on desiccation and defoliation of cotton plants for mechanized harvesting of cotton, instead of chemical method, using ultraviolet method of irradiation.

The mechanized harvesting of raw cotton in this innovative technology consists in development of four-row semitrailer vertically spindle cotton harvester (CH) with improved technical indicators for row spacing of 60 cm per one-time collection, while maintaining serial production of cotton harvester MX-1.8 in production followed by re-equipment on MX-2,4.

The hardest process in production of raw cotton is harvest.

The mechanized harvesting of raw cotton in this innovative technology consists in development of four-row semitrailer vertically spindle CH with improved technical indicators for row spacing of 60 cm for one-time collection, while maintaining in production mass-produced CH MX-1.8 with subsequent conversion to experimental MX-2.4.

Studies of domestic and foreign scientists and many years of experience show that soil fertility decreases due to over-compaction of tractor and tractor aggregates with its undercarriage systems (Тўхтабоев et al., 2016).

Studying reasons for occurrence of compacted soil layer, scientists drew attention to the sealing effect on soil of running gears of machines and came to the conclusion that the greater their impact on soil, stronger its compaction. This process is also strongly observed when cultivating cotton, namely with three-wheeled tractors (Тухтабаев, 2019).

However, at the same time, issues of the influence of soil compacted by tractor undercarriage systems on moisture supply in soil, on its structural composition, on damage to cotton and on crop losses require deep study (Тухтабаев, 2019).

Also required studies of the area with headlands at the ends of the heads during seeding and inter-row processing of cotton.

A long-term review and analysis of existing scientific and design work, as well as results of preliminary studies, showed that in order to solve above problems, it is necessary to select and evaluate impact parameters of designed 4-wheel tractor with steplessly adjustable ground clearance in order to preserve moisture in the soil after treatment and per plant in order to eliminate loss of flowers and fruit elements, increase productivity, as well as determine width of headland.

Based on above assumptions, on the basis of TTZ-1033 LLC «Design and Technology Center for Agricultural Engineering», SRIMA, UzSCCTT, JSC “BMKB-Agromash” and others developed an experimental universal row-crop four-wheeled tractor equipped with a rear axle with stepless adjustable clearance (Figure 3).

ISSN: 2350-0328
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Vol. 6, Issue 9 , September 2019

Figure 3. Experimental universal row-crop four-wheeled tractor equipped with a rear axle with stepless adjustment (in the field at factory test)

For each of above agricultural equipment, performers are developing new programs and test methods.
Field tests of proposed innovative technology and technical equipment for production of raw cotton are carried out on cotton with an area of 15 hectares at the test site of the Testing Center.

IV. CONCLUSIONS

The distribution of trichograms by developed devices in their pure form without filler during continuous uniform distribution along the cotton fields being processed reduces the costs and agronomic time of entomophagous resettlement. To mechanize resettlement of trichogram pupae during inter-row processing of cotton, it is recommended to install developed device on cultivators or boom sprayers.
According to the results of studies, it is seen that extensive research, development and implementation of innovative technology and technical means for production of raw cotton in Uzbekistan is being carried out taking into account resource-saving and ecology.

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ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 6, Issue 9 , September 2019

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