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MAIN TRENDS IN THE PRODUCTION OF SUNFLOWER HARVESTING MACHINES

Sunflower harvesting consists of several operations to harvest seeds, collect thrashed heads and free the field from stubble. These operations are performed by harvesting and soil tilling machines and by transport means.

The specific features of sunflower plants making special demands on harvesting machinery are the great height of plants (two metres and more), the weight of vegetative mass, reaching 1000-2500 kg/ha, and the stalks' high resistance to cutting. The effort involved in cutting a stalk by a harvester-type machine is 40-100 kg, depending on the stalk's diameter. These features make it necessary to build special machines for sunflower harvesting. Two trends have now taken shape in the harvesting technology: (1) to collect oilseeds and leave the non-grain part of the harvest in the field, and (2) to collect the whole biological mass during one passage in the field.

The basic trend in harvesting seeds is the creation of special appliances to grain harvester combines. This country has for more than 20 years used an appliance to the harvester of a grain combine which cuts off and feeds into the tresher only the productive part of plants, i.e. sunflower heads. Its main units are lifters, feed pan and reel. As the combine is moving the stalk is leaning over until the head penetrates into the slit between the feeding pan and the lifter. The head is then cut off together with a small portion of stalk (15 to 30 cm) regardless of the plant's height. The appliances are designed in several variants (the lifters' width can be from 255 to 640 cm and the feed pan can be whole or netted). To harvest high stature plants the

harvester's relative height can be further increased by changing the lifting gear. Wide lifters, set on the row spacing width, have proved more effective. Seed losses in the performance of this harvester are 50% less than in using narrow lifters, though they are more comprehensive as they make it possible to harvest sunflower with differing row spacings. A beater threshing machine completely thrashes seeds at the drum's 300-500 r/min. Lower velocities are set at threshing dry sunflower to exclude seed fragmentation. In our experiments seed fragmentation was 5% at the seed moisture of 6-8% and the drum velocity of 450 r/min. The dependence of the seeds' impairment on the velocity of the drum is expressed by the demonstrative function $Y-ae^{kn}$, where n is the number of the drum's revolutions per minute (Table 1). The stubble left after the harvesting of heads is ground by other machines and is ploughed over.

Table 1

Fragmentation of Sunflower Seeds During Threshing (at 6-8% of moisture)

Drum's revolutions per minute	300	330	360	400	450
Impaired seeds, %	1.06	1.27	2.03	3.09	4.94
Of which dehulled seeds, %	0.26	0.33	0.47	1.08	2.06

Through simple in design this machine has failed to meet the up-to-date stringent demands. Increased working velocities on

field jobs have resulted in greater losses of oilseeds. At the velocity of 4 km/hr the losses are 2.5-3%, but when the velocity goes up to 6-8 km/hr the losses also grow to 6-7% and more. When the new machine was designed and built the task was set to reduce losses and combine all operations in the harvesting of seeds and the non-grain mass just in one unit. The new appliance PSP-1.5 is based on a special harvester with a conveyer to feed stalks and with lifters which are to cutch seeds. The reel and the feed pan are eliminated. As in the former appliance, the cut-off heads come into the tresher. Thrashed and cleaned seeds are gathered in a bunker while heads go into the grinder after which they are collected into a 44-45 cu m cart coupled to the combine harvester. Roll-type grinders are set behind the harvester on a special bar. These cut off stalks, grind them into pieces of 10-15 cm long and strew them along the field. Such chops are easy to incorporate into the soil during the subsequent tillage. This technological scheme makes it possible to perform the whole complex of harvesting operations during one passage of the machine at a velocity of up to 10 km/hr. Seed losses reduce 3-5 times, labour productivity increases 2-7-fold and seed yield grows by 10-15 kg/ha (Table 2).

Both heads and stalks are used as feed in several regions of the country. The experiments conducted by the South-Eastern Agriculture Institute (the city of Saratov) have shown that the processing of the whole non-grain mass can yield flour containing up to 0.6 feed units in 1 kg. Studies of harvesting sunflower stalks are conducted in the following directions. According to the scheme worked out by the South-Eastern Institute, stalk pieces are fed by conveyer from the grinder PSP-1.5 to the head grinder where they are further ground and sent into the cart

together with the heads. One positive feature of this scheme is that it enables one to harvest leafy plants. Production testing of the appliances in the Saratov region where sunflower does not have large vegetative mass revealed a high reliability of the technological process concerned.

According to the pattern designed at the All Union Research Institute of Oil Crops, plants are cut off at a height of 15-20 cm and fed intact into the combine's thresher. The Institute has conducted research into the determination of the optimal parameters of the harvester with gear working organs to feed plants into the cutting device. The Institute's workers also defined the constructive and kinematic parameters of the feeder which makes it possible to harvest sunflower at increased velocities, and tested threshing machines during work with whole plants. It has been established that a beater threshing machine is unsuitable for this purpose owing to its low productivity. It decreases the combine's performance 1.5-2 times during work with whole plants and has a low operation reliability. Better performance was demonstrated by the planet-type threshing mashine with an active deck, designed at the Institute. It has the same dimensions of working organs and performs well during the thrashing of whole sunflower plants with the productivity of up to 12 kg/s.

The Ukrainian Research Institute for the Mechanization and Electrification of Farming Operations conducts research into a separate collection of thrashed heads and stalks. Such a technology would permit the use of heads for feed and stalks for the needs of the chemical industry. It is more comprehensive but has not so far been thoroughly elaborated on.

Thus the ultimate aim defined in the mechanization of sunflower harvesting was to use the total biological mass of this crop. The solution to the technological problems involved in the

collection and processing of the non-grain part of the harvest will permit a more effective use of sunflower as a major oil and feed crop.

Table 2

Effectivity of the PSP-1.5 Appliance

	Appliance PSP-1.5	Appliance 34-103
Productivity, ha/hr	3.24	2.30
Crop losses, %	1.28	5.80
Labour inputs per whole complex of harvesting operations, man-hr/ha . . .	2.5	6.8
Operation costs, rouble/ha	13.82	19.04