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HARVESTING OF SEA BUCKTHORN FRUITS BY CUTTING

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The paper describes the principle and variants of a manual cutter of sea buckthorn fruits, the manual harvesting which is difficult due to the number of thorns on the shrub, and the productivity of the harvest is problematic. Variants of the manual cutter based on the principle of a cutting comb with massive conical mandrels have been designed and tested. Harvesting tests proved the designed cutter to be suitable, provided the harvest is undertaken during the appropriate period, i.e. at the beginning of the botanic ripeness of the fruits. Experienced works using this manual cutter may achieve a performance of over 5 kg of fruits per hour.

sea buckthorn; manual cutter; evaluation of the harvest with manual cutter

The research of the physical properties of sea buckthorn (*Hippophae rhamnoides*) fruits, a shrub of the Eleagnaceae family, necessarily led to the problems of its harvesting (Blahovec et al., 1995). Anybody who grows this thorny, 1.5 to 2-metre high shrub soon finds out how difficult it is to harvest its fruits.

The principle benefit of the buckthorn is high vitamin content of its fruits and, as regards to vitamin C, it is one of the vitamin's most significant natural sources (Hlava, Valíček, 1992). Due to its taste and aroma, it is mainly harvested by the inhabitants of eastern and western Siberia, and its stimulating effects have already been exploited in the past. The curative, tonical and bactericidal effects of the fruits and leaves, and the phytocidal effect of the plant as a whole were already known in old Tibetan, Mongolian and Indian medicine. The sea buckthorn is now one of the plants important for the pharmaceutical and cosmetics industry, as well as in producing juices of high vitamin content.

Most of the varieties now grown have their origin in the former USSR, viz. Novost' Altaya, Zolotoy pochatok, Dar Katuni, Maslichnaya, Vitaminnaya, Oranzhevaya, Velikan, Zolotistaya, Yantarnaya, and the German varieties Frugana, Hergo, Leikora, Dorana, or the male variety Pollmix.

As opposed to the previous paper which concentrated on the physical properties of the buckthorn fruit (Blahovec et al., 1995) we have devoted

out attention to the harvesting technique itself. The fruits are harvested at the beginning of their botanical ripeness, in our region at the end of August and in the first half of September, when the fruits are still hard. When fully ripe the fruits become soft and tend to squash when harvested by hand or harvesting tool. Manual harvesting, which inconsiderable to the hands of the picker, can only be considered by small-scale growers and amateur gardeners, but they would also welcome the use of various harvesting tools.

With older plants (6–7 years) a third to one half of the fruit-bearing twigs can be cut, frozen, and the fruits can then be shaken free. This method is, however, very inconsiderate to the plants themselves, and results in alternating fertility and, consequently, also lower yield, although the shaping of the shrubs (as regards height) is also necessary. On a large scale, waiting for the frost and then shaking the fruits into sheets is quite problematic under central European conditions. We have therefore turned our attention to harvesting tools which can be used at the time of the beginning of the fruits' ripeness, and which are acceptable technically and as regards harvesting.

Previous experimental studies have shown that a possible and relatively easier way of harvesting buckthorn fruits is by applying a cut parallel to the branch being harvested. This study is in fact a continuation of these experiments towards the design and testing of simple tools for harvesting the fruits by cutting.

MATERIAL AND METHOD

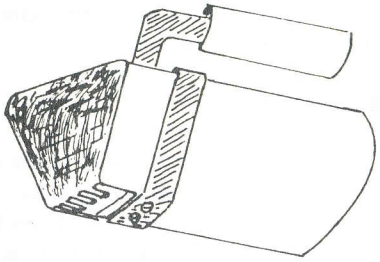
The fundamental part of the cutter is a cutting device in the shape of a comb with a built-in knife which cuts of the fruit-bearing brachyblasts, and is also capable of cutting some of the fruit-bearing twigs. The fruits, once cut off, fall into a container which is fixed directly to the cutting comb (Fig. 1). After the container is full, the fruits are tipped into transport containers. The cutting device, shown in Fig. 2, consists of a conical comb with massive rounded mandrels. The comb has two parts: the upper and the lower, with the cutting knife fixed in between, the knife blade rising in the gap between the mandrels. The two parts of the comb are joined together firmly by screws which enable disassembly and replacement, or sharpening of the blade. The front part of the comb is bevelled to one side. The bevelled face, *K*, moves along the fruit-bearing twig, the fruits or fruit-bearing brachyblasts enter the gaps, the fruit stalks are stretched by the comb until they are cut off on making contact with the knife's blade (Fig. 2b) and directed to the container.

The basic type of cutting comb (I/1) is 35 mm wide, it has seven teeth 2 mm wide and separated by gaps 4 mm wide. The distance between the blade of the cutting knife and the head of the comb is 10 mm. In the plane perpendicular to the comb head, the shape of the teeth in this type is conical with an apex angle of 15 degrees. The other type of the cutting comb (I/2) which was tested, has a recess on the upper side of the comb (for detail refer to Fig. 2c), which changes the cutting angle (below 10 degrees) and the fruits are plucked rather than cut off during the harvesting.

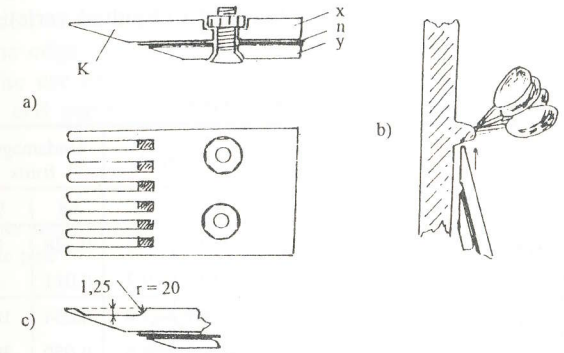
The performance tests of the designed cutters were carried out in the first half of September 1995 in the ADAVO gardening in Velký Osek near Poděbrady. Grown, 5–6 year old shrubs of the sea buckthorn, varieties HERGO and LEIKORA, together with the male variety POLLMIX, grew on the testing field. It should be mentioned that the Leikora variety was already fully ripe, which enabled us to compare the harvest at the beginning of botanical ripeness and at the stage of full ripeness.

The harvesting tests were repeated several times at intervals of 4–6 minutes with both fruit-bearing varieties. The harvested fruits were sorted and weighed in order to determine the mean performance of the picker with the appropriate cutter, as well as the quality of the product harvested. The percentage of fruits damaged by rupture of the skin and the percentage of impu-

1. Drawing of the type I manual cutter



2. The cutting comb of the type I/1 manual cutter; *K* – bevelled edge of the comb teeth, *x* – upper side of the comb, *y* – bottom side of the comb, *n* – cutting knife
2b. Fruit-bearing twig and positioning of the cutting comb
2c. Tooth recess of the cutting comb in type I/2



rities (leaves, twigs and other admixtures in the harvested product were determined.

RESULTS

The results of the field tests are compiled in Tab. I. The comparison of the results achieved indicates that cutter type I/1 has advantages over type I/2. This conclusion was drawn on the basis of the quality of the fruits harvested, as well as on the performance achieved in harvesting with both types of cutters. Nevertheless, systematic differences between the two cutter types were also observed even between individual varieties.

I. Results of harvesting tests (mean values)

Variety		Undamaged fruits		Impurities		Undamaged fruits		Fruits harvested total		Performance
DM (%)		kg	%	kg	%	kg	%	kg	%	kg/hour
HERGO 16.5	I/1	0.28	86.8	0.015	4.5	0.028	8.7	0.32	100	4.2
	I/2	0.16	84.6	0.019	9.7	0.011	5.7	0.19	100	2.4
LEIKORA 16.3	I/1	0.23	79.3	0.007	2.4	0.054	18.4	0.29	100	2.6
	I/2	0.11	65.9	0.007	4.0	0.050	30.1	0.17	100	1.2

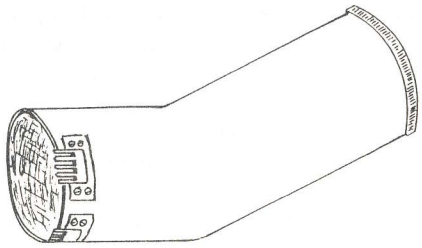
DISCUSSION

The different results achieved in the harvesting tests of buckthorn fruits of both varieties are very probably related to the different stages of their biological ripeness. Much more damage to the very soft fruits of the Leikora variety as compared to the fruits of the Hergo variety could be seen at first glance, without accurate weighing of the sorted fruits. Evidently, emphasis must be put on the correct time of harvesting which is clearly at the beginning of the botanical ripeness of the fruits. When harvested at full ripeness, the percentage od damaged fruits increases appreciably, and the overall weight of the fruits harvest over the given time interval decreases. The soft fruits, together with the damaged, clog the cutting comb which must then be cleaned manually, and this leads to lower quality of the fruits and loss of yield of the undamaged fruits. The performance of the picker is clearly affected by his dexterity and experience, nevertheless, the table indicates that experienced workers may harvest from 5 to 8 kg undamaged fruits per hour, provided the fruits are harvested in correct time.

An inspection of parts of the fruit-bearing twigs, cut last year, showed that the damage to the fruit bearing twings harvested by cutting is very little, and in view of the high regeneration ability of the buckthorn, negligible.

Experience with both types of manual buckthorn-fruit cutter have led to its further improvement. The endeavour to give even more preference to cutting the fruits, rather than plucking them, led to "refining" the cutting comb, formed by six teeth 2 mm wide and a gap only 2 mm wide. The bevelling of the teeth was reduced from 15 to 10 degrees. The very frequent bifurcation of the fruit-bearing branches often forms an obstacle to rational harvesting techniques; therefore, the harvesting combs (2 each at the circumference of the edge, placed at an angle of 90 degrees with respect to one another) were fitted at the edge of a sufficiently rigid cranked pipe of Novodur plastic (Fig. 3). The use of two combs and the cranking of the pipe itself enables the setting and correct cutting of the fruits to be carried out very easily.

3. Type II of the manual cutter with two cutting combs in the plastic pipe



CONCLUSIONS

In view of the difficult manual harvesting of sea buckthorn fruits, the manual cutter described is an undoubtful benefit, although work on improving the tool will be continued on the basis of the principle mentioned. Provided that the time of harvesting is suitable, i.e. at the beginning of the botanical ripeness of the fruits, and provided that the workers harvesting the buckthorn fruits with the manual cutter in question are experienced, a yield of over 5 kg of fruits per hour may be expected.

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Sklizeň plodu rakytníku řešetlákového seřezáváním.

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V práci je uveden princip a prototypové varianty ručního seřezávače plodů rakytníku, jehož ruční sklizeň je vzhledem k trnitosti keře nesnadná a produktivita sklizně problematická. Byly navrženy a vyzkoušeny varianty ručního seřezávače na principu seřezávacího hřebene s kónickými masivními trny. Sklizňové zkoušky potvrdily vhodnost navrženého seřezávače při dodržení vhodné doby sklizně, tj. na počátku botanické zralosti plodů. U zapracovaných pracovníků lze s uvedeným ručním seřezávačem předpokládat dosažení výkonnosti vyšší než 5 kg plodů za hodinu.

rakytník řešetlákový; ruční seřezávač; hodnocení sklizně navrženým seřezávačem

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