

Bird repellent on sea buckthorn harvest

Ganbold Dagvadorj¹, Tuvshinjargal Dorjsuren², Baatarkhuu Dorjsuren^{1*}

¹School of Engineering and Technology, Mongolian University of Life Sciences, Zaisan 17029, Ulaanbaatar, Mongolia

²School of Engineering and Economics, Mandakh University, Amarsanaa street 18/1, Bayangol District, 16040, Ulaanbaatar, Mongolia

*Corresponding author: elec_eng@mul.s.edu.mn

 <https://orcid.org/0000-0002-0081-9118>

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Abstract

Animals, especially birds cause yield loss that is substantial burden on farmers Therefore, the laser scarecrow bird repellent equipment was constructed with purpose to reduce sea buckthorn yield loss caused by bird and field tested. The preliminary results that support that use of bird repellent would retain the harvesting yield of sea buckthorn and could be used further in farming areas.

Keywords: Laser scarecrow, bird, light intensity, sea buckthorn

Introduction

Animal intrusion into fresh produce fields annually results in significant agricultural losses, as a result of eating and trampling crops. Additionally, the deposition of potentially contaminated feces can pose food safety risks. Especially, keeping birds out of agricultural fields is one of the most challenging tasks [1].

Depending on the crop, yield loss and economic effects might significantly burden producers [1], [2]. For instance, loss estimates for blueberries are between 10% and 20%, cherries are between 5% and 30%, and grapes are between 5% and 10%. Up to 50% of losses have been documented at certain vineyard areas. Blueberry losses were estimated at \$11.2 million in 2013, wine grape losses at \$2.7 million, and sweet cherry losses at \$3.3 million [2].

The most recent innovation in bird deterrence is the use of lasers, as avian eyesight is a major sensory channel and hence highly developed. Lasers are therefore used as a deterrent not just against birds that harm agricultural crops [3], but also to disperse nuisance birds at landfills, on oil rig platforms, and in recreation areas [4], [5]. According to electrophysiological analyses of the avian retina, birds are able to differentiate hues from the ultraviolet (350 nm) to the red (750 nm), which corresponds to the human visual spectrum (400-700 nm) [6].

Sea buckthorn berries and leaves are considered to be a rich source of bioactive substances and have beneficial effects on health [7].

In the Mongolian government's policy on food and agriculture, it is stated that the cultivation and variety of fruits and berries should be increased, and the National Program of Fruits and Berries states that by 2022, the cultivation of sea buckthorn will be increased up to 10,000 hectares. As reported by the Mongolian National Chamber of Commerce and Industry (MNCCI) on the "Mongolian sea buckthorn to the global market", the first forum of sea buckthorn cluster, fruits and berries are cultivated on around seven thousand hectares of area nationwide and sea buckthorn makes up over 90 percent of it. Sea buckthorn fruits freeze at temperatures above -16°C and this period usually occurs after mid-November, when losses of 25-35% of sea buckthorn due to birds as reported.

The objective of this study was to evaluate the efficacy of laser scarecrows use to prevent bird damage to sea buckthorn harvesting. The hypothesis tested was that sea buckthorn plots protected by laser scarecrows would have lower rates of harvest loss than plots which were not protected.

Methods

Design of bird deterrent system

The bird deterrent system constructed consists of laser, motor, solar panel, battery, and mainstay (Figure 1). When assembling the bird repelling equipment, the laser is fixed to the engine shaft. Power can be supplied power from solar panel and the system can work safely and stable. The laser rotates 360 degrees.

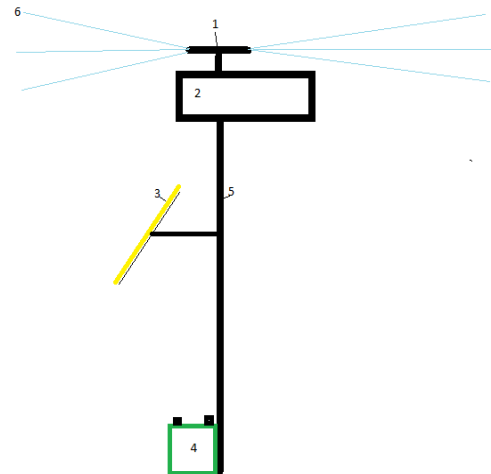


Fig.1. Modelling of bird repellent equipment (1. Laser, 2. Motor, 3. Solar panel, 4. Battery, 5. Mainstay, 6. Laser reflection)

Research farm trial

The research trial study was conducted in the sea buckthorn field of 2 ha in size located in the Nalaikh district of Ulaanbaatar city. A field was divided into two identical in terms of shrub amount (1ha each), age of shrubs (2 years old) and their fruiting.

In accordance with the guideline of counting the sea buckthorn harvest [8], ten shrubs from each

field, and ten fruiting branches from each chosen shrub were randomly selected and marked for further study. Then, number of the buds in one branch, number of possible fruits in one bud were counted, respectively.

The constructed laser scarecrow was placed in one field (Figure 3 and 4).

Results and Discussion

To define the application efficacy of bird repellent in the field with and without, the measurements of two fields, in accordance with

the guideline [8] carried out in September, 2022 respectively (Table 1).

Table 1

The counting of selected shrubs in the field with (+) and without (-) bird repellent

No. shrub	Counted fruits in each branch of the shrub																			
	1		2		3		4		5		6		7		8		9		10	
	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)	(+)	(-)
1	7	2	6	8	6	9	10	7	10	6	8	6	10	5	8	5	5	12	6	12
2	8	5	18	8	27	5	9	6	22	10	32	14	22	13	15	4	14	12	9	9
3	4	6	6	3	20	12	6	3	7	5	16	4	9	4	3	6	18	4	13	11
4	17	9	10	8	9	6	10	7	8	2	12	3	7	6	6	7	10	5	7	6
5	13	5	9	7	14	7	18	5	21	4	23	4	18	7	19	4	7	11	8	14
6	9	2	9	8	11	4	14	4	17	9	6	12	19	9	22	3	7	8	8	13
7	13	4	7	10	15	9	18	1	17	5	16	22	13	12	9	6	7	7	11	4
8	12	7	18	3	13	6	9	2	6	3	7	5	19	7	20	5	17	4	16	6
9	19	11	17	8	16	2	12	2	9	3	27	6	23	3	29	9	24	12	18	6
10	13	3	12	2	9	5	15	6	16	7	18	7	25	2	15	13	19	5	7	7

(+) -field with bird repellent

(-) -field without bird repellent

As counted, the average number of berries at the ten branches of one shrub from the field with bird repelling equipment was counted around 130, while the berries were calculated 66 from

the field without the equipment. The results showed that the total yield of sea buckthorn in the field with bird repellent was almost twice that of the field without the equipment.



Figure 3. Existing bird repellent equipment in the field



Figure 4. The installation of the bird repelling equipment

The amount of sea buckthorn harvested from one bush per hectare is shown in the Figure 5, based

on the weight of 100 sea buckthorn, fruit-bearing branches, and bush.

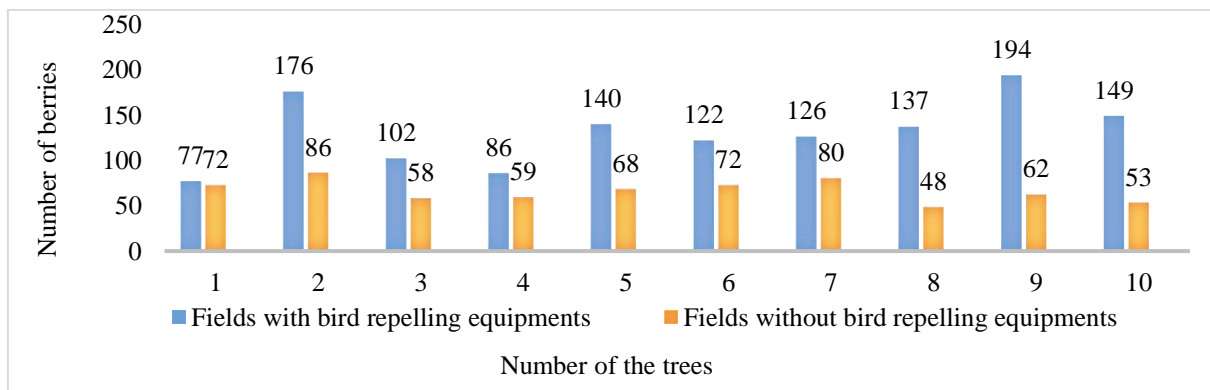


Figure 5. Number of fruits collected from the fields with and without bird repelling equipment

The experiment on to evaluate the efficacy of laser scarecrows use to reduce bird damage to sea buckthorn harvesting under field condition was completed in the last week of September, and approximately 602.5 kg of sea buckthorn

was harvested from 1 ha field with equipment. On the other hand, 306.5 kg of sea buckthorn harvested from the field without equipment which is considered to be causing almost twice the loss. Calculations are shown in Table 4.

Table 4

Comparative field study results

Field	The average amount of berries from one shrub, kg	The number of the berries in 1 shrub	Total harvest per ha, kg
With bird repelling equipment	0,598	1006	602,5
Without bird repelling equipment	0,294	1006	296

Normality was checked using the Shapiro-Wilk test since samples size was less than 50. The value calculation of the Shapiro and Wilka W criteria is more than the table value. The highest and lowest values of the measurement could be significantly different. The calculated values are shown in the Table 5. The calculated value $t_{T=1,96} [< t] _X=2.228$

$W_t=70.21 > W_x=0.842$. As a result, the value of the shrub branch is in a normal distribution. The value of the table criterion is accounted as follows: $W_x [P_D = 0.95, m = 10] = 0.842$. is not different compared to the table value. Thus, the amount of the harvest from one fruit shrub is predicted using the average value of measurement.

Table 5

The result of Shapiro-Wilk test

Number of the shrub	Mathematical average, \bar{M}	Dispersion, δ^2	Separation value			W value of Shapiro and Wilka		
			high	low	Table, t_x	Q	Calc W_t	Tab W_x
1	7.6	3.60	1.26	-1.37	2.228	5.39	72.52	0.842
2	17.6	66.04	1.77	-0.44	2.228	23.70	76.54	0.842
3	10.2	37.29	1.60	1.28	2.228	17.56	74.44	0.842
4	9.6	10.04	0.76	0.13	2.228	8.85	70.21	0.842
5	15	32.00	1.41	-1.41	2.228	16.52	76.79	0.842
6	12.2	30.40	1.78	-0.94	2.228	15.83	74.16	0.842
7	12.6	16.04	1.35	-1.40	2.228	11.63	75.87	0.842
8	13.7	25.79	1.24	0.65	2.228	14.78	76.20	0.842
9	19.4	40.71	1.50	0.72	2.228	18.91	79.05	0.842
10	14.9	26.54	1.96	0.80	2.228	15.18	78.14	0.842

The results of the experiment and measurement the value calculation of Shapiro and Wilka W criterion is higher than the table value $W_t=70.21 > W_x=0.842$ which means within the normal distribution. These preliminary findings may support that use of bird repellent would influence the sea buckthorn harvesting yield and can further be used in farming areas as the safe method.

Conflict of Interests

The authors declare no conflict of interests.

Authors' Contribution

G.D. carried out the experiment and constructed the equipment, drafted the manuscript; T.D. processed the experimental data; B.D. designed the study. All authors discussed the results and contributed to the final manuscript.

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