Effect of Fruit Characteristics on Berry Losses During Wild blueberry Harvesting

Jameel, M. W.[1], Q. U. Zaman[1], A. W. Schumann[2], T. Nguyen-Quang[1], G. Brewster[1], A. A. Farooque[1] and H. S. Chattha[1]

[1]Dalhousie University, Canada [2]University of Florida, USA

INTRODUCTION

- Wild blueberry is an important horticultural crop in North Eastern North America.
- Improved management practices have increased fruit yield and plant health, over the past few decades.
- Wild blueberry fields have substantial variability in fruit characteristics (fruit zone, fruit size and fruit yield) within and between fields.
- Currently, wild blueberry industry is facing increased harvesting losses (15-25%) due to changes in crop conditions and fruit characteristics.
- Therefore, this study was designed to examine the effect of fruit characteristics on the picking efficiency of the harvester during wild blueberry harvesting.

Figure 1. Wild Blueberry Harvester

MATERIALS AND METHODS

- Four wild blueberry fields were selected in Atlantic Provinces of Canada to examine the effect of fruit yield (FY) and fruit zone (FZ) on berry losses during mechanical harvesting.
- Yield plots (0.91×3 m) were selected randomly within the fields to collect berry losses and fruit characteristics data.
- Collected data of FZ and FY were divided into two groups, i.e. low FZ ≤ 17 cm and high FZ > 17 cm , low fruit yield ≤ 3000 kg ha^{-1} and high fruit yield > 3000 kg ha^{-1}.
- The harvester was operated at three different levels of ground speed (1.20, 1.6 and 2.0 km h^{-1}) and header's revolutions (26, 28 and 30 rpm) for four different combination of FZ and FY.
- The treatment combinations were assigned randomly to selected yield plots.
- Fruit diameter was used as a covariate.

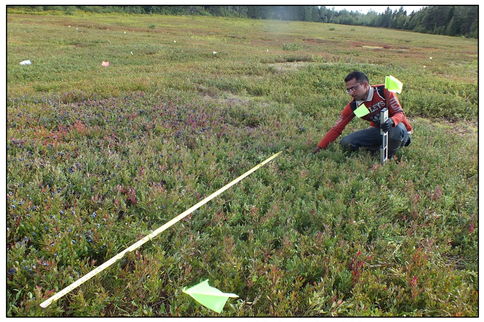

Figure 2. Setting up Yield Plot in the Field

Figure 3. Recording Fruit Characteristics Data

RESULTS AND DISCUSSION

- Results indicated that the plants having low FZ (FZ ≤ 17 cm) resulted more berry losses as compared to plants with high FZ (FZ > 17 cm) (Fig. 4).
- Berry losses were more in both FZ classes caused by increase in ground speed and header RPM of the harvester.

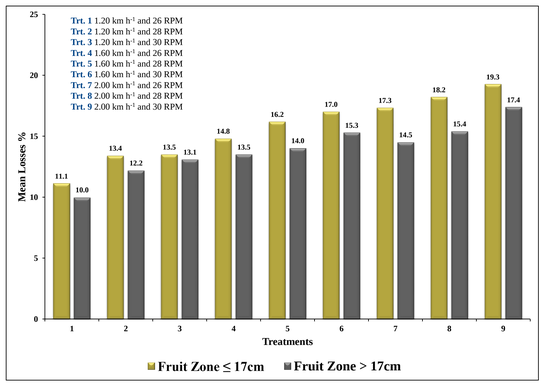

Figure 4. Fruit Zone vs Berry Losses at Different Treatment Combinations

- Wild blueberry harvester picked the berries more efficiently in high yielding plots (FY > 3000 kg ha^{-1}) at lower speed and different combinations of RPM as compared to plants with less FY (Fig. 5).
- Increase in ground speed and header RPM induced more berry losses in high fruit yield plots (Fig. 5).

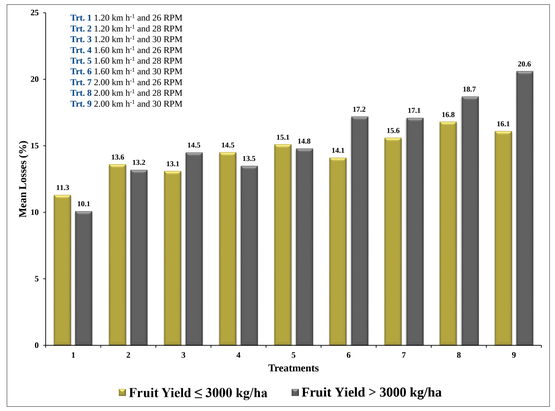

Figure 5. Fruit Yield vs Berry Losses at Different Treatment Combinations

- Multiple means comparison results showed mixed trend of berry losses in different categories of fruit characteristics (Table 1).
- Results also indicated that Treatment 1 through Treatment 4 resulted in less berry losses for selected categories fruit characteristics whereas all other treatment indicated increased berry losses during mechanical harvesting (Table 1).

Table 1. Multiple Means Comparison of Berry Losses at Different Combination of Ground Speed and Header RPM of Harvester

Treat.	Speed (kmh^{-1})	RPM	Mean Berry Loss (%)			
			*HFZ-LFY	HFZ-HFY	LFZ-LFY	LFZ-HFY
1	1.20	26	8.26 c	10.65 e	11.96 b	11.32 e
2	1.20	28	11.24 bc	12.26 de	9.92 c	13.80 de
3	1.20	30	13.42 b	14.17 d	12.63 b	16.41 c
4	1.60	26	9.08 c	15.34 d	14.16 bc	17.08 d
5	1.60	28	13.86 b	16.81 c	13.08 bc	18.72 cd
6	1.60	30	16.38 ab	18.92 bc	16.35 ab	20.86 b
7	2.00	26	14.40 b	17.15 c	18.75 a	18.21 c
8	2.00	28	15.18 b	19.38 b	17.42 b	20.12 bc
9	2.00	30	17.32 a	21.16 a	19.22 a	22.65 a

* HFZ (high fruit zone), LFZ (low fruit zone), HFY (high fruit yield) and LFY (low fruit yield)

- The collected data was processed using Artificial Neural Network modeling and categorized into four classes of berry losses (< 10%, 10-15%, 15-20% and > 20%), to find an optimum combination of crop characteristics and machine parameters for effective berry recovery during mechanical harvesting (Table 2).
- Results showed that the berry losses were less (< 10%) in high FY (FY > 3000 kg ha^{-1}), short plants (PH ≤ 25 cm), high PD (PD > 12 plants/0.0225 m^2) and higher FZ (FZ > 17 cm) plots. The best operating combination for this category was 1.2 km h^{-1} and 26 header RPM (Table 2).

Table 2. Summary Statistics of Training and Validation Dataset to Configure Optimal Operating Parameters During Harvesting

Training

Class	Speed (km h^{-1})	RPM	FY (kg ha^{-1})	PH (cm)	PD (*)	FZ (cm)	Mean Loss (%)
<10%	1.2	26	4326	23.46	13.53	21.13	7.8
10-15%	1.2	28	5918	23.92	10.78	22.28	12.47
15-20%	1.6	28	6546	29.23	12.70	27.81	17.26
>20%	2	30	5521	17.24	9.92	15.43	23.13

Validation

Class	Speed (km h^{-1})	RPM	FY (kg ha^{-1})	PH (cm)	PD (*)	FZ (cm)	Mean Loss (%)
<10%	1.2	26	4543	22.85	12.90	21.16	8.29
10-15%	1.2	28	5879	21.11	10.91	20.27	12.06
15-20%	1.6	28	6477	28.65	12.22	26.92	17.02
>20%	2	30	5436	17.93	11.79	14.08	22.56

CONCLUSION

- Based on the results of this study it is concluded that the picking efficiency of the wild blueberry harvester was better in both selected categories of fruit yield and fruit zone at lower treatment combinations of ground speed and header RPM.
- Results also suggested that the lower level of ground speed (1.20 km h^{-1}) and header revolution (26 RPM) of the harvester with proper head adjustment during harvesting can be reduced the berry losses and improve farm profitability.

ACKNOWLEDGEMENT

- Authors would like to acknowledge the precision agriculture research team, Dalhousie University, Truro, Nova Scotia, Canada for their technical support during experiment.
- Thanks to Carl Bragg, President DBE and Peter Swinkle, Engineer and Director General DBE for their continuous help in this study.

CONTACT INFORMATION

Muhammad Waqas Jameel
(Graduate Student)
Tel: 902-896-2424
E-mail: waqas.jameel@dal.ca