Yield Compensation in Soft Red Winter Wheat and Soybean in Relation to Controlled Tramline and Un-controlled Non-Tramline Field Traffic

Tyler K. Black[1]; David L. Holshouser[2]; Wade E. Thomason[1]; Mark M. Alley; Bee Khim Chim[1]
[1]Virginia Tech Blacksburg, VA [2]Virginia Tech Tidewater Agricultural Research and Extension Center Suffolk, VA

Introduction

To produce consistently high yielding wheat (*Triticum aestivum* L.*)* and soybeans (*Glycine max* L.), high input, intensive management is generally necessary. Late season crop protection is an important part of intensive management, but this often leads to increased traffic in the field. In both wheat and soybean, the amount of yield lost due to wheel traffic may be offset by higher yield because of the crop protection.[1] Application of these products late in the growing season will result in driving over plant rows when planted in narrow rows (<38 cm) unless tramlines or intentionally unplanted traffic lanes are installed at planting. [2]

Objectives

Determine wheat and soybean yield compensation in tramline and non-tramline management systems when field traffic occurs at various crop growth stages.

Materials and Methods

Field experiments were conducted near Warsaw, Virginia at the Eastern Virginia Agricultural Research and Extension Center (EVAREC) and near Blacksburg, Virginia at Kentland Farm in 2013-14. Both wheat and soybean were seeded using a no-till drill at both sites, this being the predominant tillage and planting method for wheat and soybean in the Mid-Atlantic region.[3,4] Layout was a randomized complete block layout with 9 treatments in wheat and 16 treatments in soybean. Treatments in each crop were divided into two managements, tram and no tram. Treatments were applied using a standard 380mm ag tire that affected 2 rows. At maturity 1 meter of row from rows adjacent to the tire track were collected, 2 rows and 4 in wheat and soybean respectively. From each sample the following measurements were collected:

Wheat

-Total weight (g)
-Total number of heads
-Head weight (g)
-Grain weight (g)
-250 kernel weight (g)

Soybean

-Plant height
-Number of plants
-Number of nodes
-Number of fertile nodes
-Number of branches
-Number of branch pods
-Number of main stem pods
-Total seed weight (g)
-100 seed weight (g)

Treatment Structure

Wheat

TRT	Type	Timing	Trips
1	TRAM	none	0
2	TRAM	GS 45	1
3	TRAM	GS 54	1
4	TRAM	GS 45+54	2
5	NO TRAM	none	0
6	NO TRAM	GS 45	1
7	NO TRAM	GS 54	1
8	NO TRAM	GS 45+54	2
9	NO TRAM	GS 32	1

Timing	Rationale
GS 32	Growers in South Eastern Virginia are delaying nitrogen application to incorporate with fungicide treatment at GS 32 .
GS 45	Insecticide application for cereal leaf beetles and armyworm to protect the flag leaf
GS 54	Fungicide application primarily to prevent Fusarium Head Blight

Soybean

TRT	Type	Timing	Trips
1	TRAM	None	0
2	TRAM	V5	1
3	TRAM	R3	1
4	TRAM	R5	1
5	TRAM	V5 + R3	2
6	TRAM	V5+ R5	2
7	TRAM	V5 + R3+R5	3
8	TRAM	R3+R5	2
9	NO TRAM	None	0
10	NO TRAM	V5	1
11	NO TRAM	R3	1
12	NO TRAM	R5	1
13	NO TRAM	V5 + R3	2
14	NO TRAM	V5+ R5	2
15	NO TRAM	V5 + R3+R5	3
16	NO TRAM	R3+R5	2

Timing	Rationale
V5	Early post emergence herbicide application
R3	Late season fungicide/insecticide application
R5	Late season fungicide/insecticide application

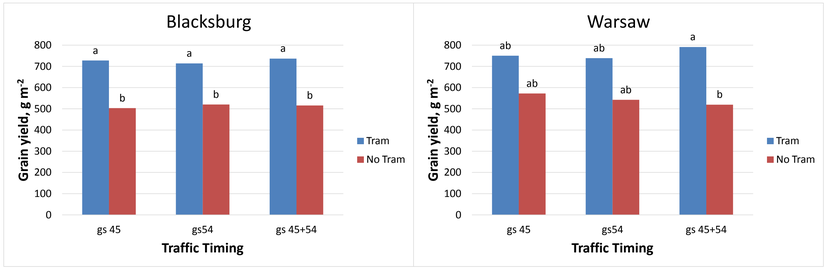
Statistical Analysis

•ANOVA performed by location
•Overall plot yield (g-m^2)
•Individual row yield components
•Tukey's mean separation
•Non linear regression was used to develop linear plateau model for compensation by distance and boom width optimization.

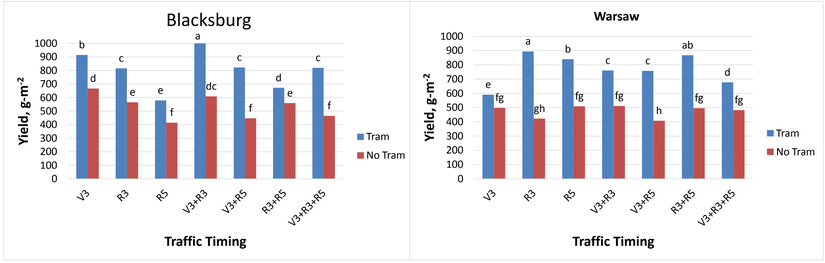
Results

Research Results

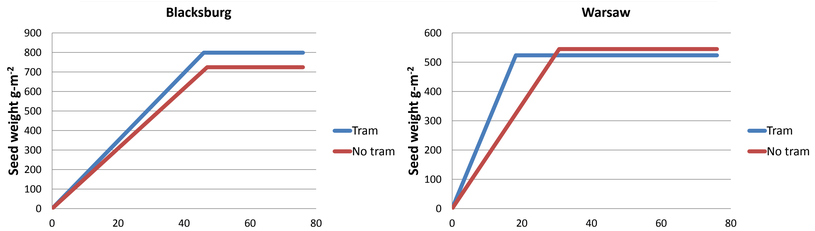
2013-14 Wheat grain yield



2014 Soybean yield



Soybean yield compensation by distance from wheel traffic

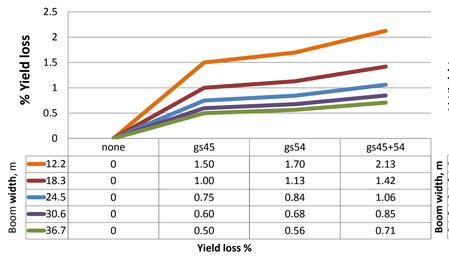


	Plateau	Slope	Joint
Tram	798.86	21.25	45.96
No Tram	724.12	13.21	46.99

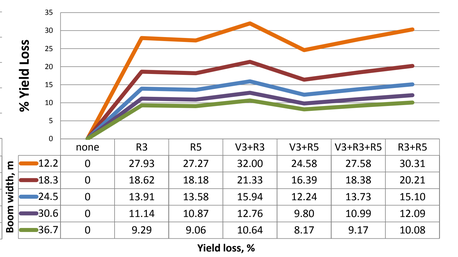
	Plateau	Slope	Joint
Tram	523.47	29.53	18.27
No Tram	544.70	17.33	30.71

Extension Results

Percent yield loss with boom width (without tram)

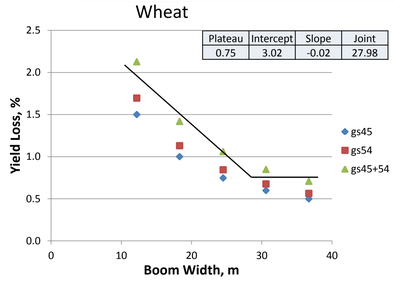


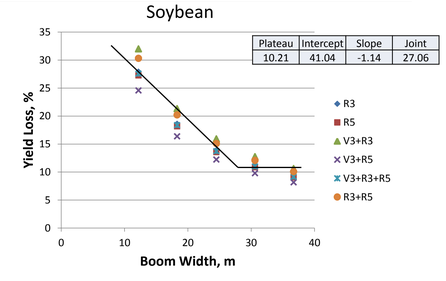
Boom width, m	none	gs45	gs54	gs45+54
12.2	0	1.50	1.70	2.13
18.3	0	1.00	1.13	1.42
24.5	0	0.75	0.84	1.06
30.6	0	0.60	0.68	0.85
36.7	0	0.50	0.56	0.71



Boom width, m	none	R3	R5	V3+R3	V3+R5	V3+R3+R5	R3+R5
12.2	0	27.93	27.27	32.00	24.58	27.58	30.31
18.3	0	18.62	18.18	21.33	16.39	18.38	20.21
24.5	0	13.91	13.58	15.94	12.24	13.73	15.10
30.6	0	11.14	10.87	12.76	9.80	10.99	12.09
36.7	0	9.29	9.06	10.64	8.17	9.17	10.08

Minimum sprayer boom width to optimize yield loss (without tram)





Further analysis of the data was conducted to analyze the relationship between the traffic timing and yield loss as a percentage in relation to standard sprayer boom widths in both wheat and soybean. This was achieved by comparing the affected areas (two and four rows athwart both tire tracks in wheat and soybean respectively) against the un affected area using the equation below. Thus assuming the un trafficked check plots were representative of yields that would exist in the inter-trafficked areas.

$$\%\ yield\ loss = \left[1 - \left\{\left(\left(1 - \frac{sampled\ area}{boom\ width}\right)\right) + \left(\left(\frac{sampled\ area}{boom\ width}\right) \times \left(\frac{seed\ wt.g - m^{-2}\ of\ trt}{seed\ wt.g - m^{-2}\ of\ check}\right)\right)\right\}\right] \times 100$$

Using this derived data, a linear plateau function was used to determine the minimum boom width to minimize losses from affected rows.

Conclusions

Wheat

1. At Blacksburg, 2014, grain yield (g m^{-2}) was higher when tramlines were used than when crops were trafficked (no tramline) and at any timing.
2. At Warsaw, 2014, grain yield (g m^{-2}) was higher when tramlines were used only at the gs45+54 timing.

Soybean

1. Yields were higher with tramlines installed, in all instances, compared to no tramlines.

Both crops

1. As the distance between traffic passes or tramline increases, proportionally less of the crop is damaged so less yield loss occurs.
2. Spray boom width should be at least 27.5 m in order to minimize yield losses due to field traffic.

References

1) Holshouser, D. L. 2008. Wheel traffic to narrow-now reproductive-stage soybean lowers yield. Crop Management, doi:10.1094/CM-2008-0317-02-RS. (accessed 2 Oct. 2014).
2) Herbert, D.A. 2014. Field crops pest management guide. Virginia Cooperative Extension, Blacksburg, VA.
3) Joseph, M. 1984. Row spacing, seeding rate and planting date effects on yield and yield components of soft red winter wheat (*Triticum aestivum* L.) M.S. Thesis, Agronomy Department, Virginia Polytechnic and State University, Blacksburg, VA.
4) Pedersen, P. 2008. Row Spacing in Soybean. State University, Ames, IA.

Acknowledgements

Wade Thomason, David Holshouser, Mark Alley, Bee Chim, Liz Rucker, Tri Nguyen, Mike Ellis, Bob Pittman, Tom Pridgen, Andy Jensen, EVAREC, TAREC, Dan Brann, Paul Davis, Bryan Dillehay, Bruce Beahm, Jon Wooge, Kimberly Pittard, Evan Harver, Emmy Bender, Logan Holland, Caroline Lancaster, Hunter Blake, Baker Cox