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Effects of Planting Speed, Downforce, Vacuum, and Planter Platform on Peanut Stand Establishment, Spacing Uniformity, and Yield

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Supplementary Materials

Supplementary Tables S1–S16 report site-year ANOVA results and treatment means for each response variable and for the 2025 Precision Planting increased-vacuum comparison. Supplementary Table S17 summarizes residual-diagnostic screening for those models. *Analysis note:* Supplementary Tables S1–S16 were regenerated directly from the archived workbook using site-year factorial ANOVA with the plot-segment replication term representing the four alley-delimited sections within each treatment strip. Perfect-spacing percentages were recalculated from raw plant-position data after excluding the first interval within each measured row and then aggregating category percentages at the replicate level. *Unit note:* Achieved population is reported as $\times 10^3$ plants ha^{-1}, yield is reported in kg ha^{-1}, and perfect spacing is reported as percent. In the 2025 Tifton planter × speed × vacuum trial, the MS planter at 5 km h^{-1} with high vacuum is absent from the treatment-means tables because that pass was excluded post hoc after direct field observation of loss of full drive-wheel contact and meter rotation, which indicated an incomplete planting event rather than a valid treatment outcome.

Supplementary Table S1. 2022 Midville — achieved population

A. ANOVA results.

Term	df	Sum of squares	F	p
Speed	2	1659.953	14.016	<0.0001
Downforce	2	163.966	1.384	0.2698
Replication	3	230.727	1.299	0.2977
Speed × Downforce	4	100.409	0.424	0.7898
Residual	24	1421.214	–	–

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B. Treatment means.

Speed (km h^{-1})	Downforce	Mean ($\times 10^3$ plants ha^{-1})	SD ($\times 10^3$ plants ha^{-1})	*n*
5	low	186.173	1.462	4
5	medium	182.145	7.647	4
5	high	191.096	10.678	4
7	low	174.537	8.072	4
7	medium	171.404	3.690	4
7	high	178.565	6.093	4
10	low	170.509	6.434	4
10	medium	170.509	14.199	4
10	high	170.062	4.134	4

Supplementary Table S2. 2022 Plains — achieved population

A. ANOVA results.

Term	df	Sum of squares	F	p
Speed	2	2441.861	19.880	<0.0001
Downforce	2	9.747	0.079	0.9240
Replication	3	284.937	1.547	0.2282
Speed × Downforce	4	130.852	0.533	0.7130
Residual	24	1473.956	–	–

B. Treatment means.

Speed (km h^{-1})	Downforce	Mean ($\times 10^3$ plants ha^{-1})	SD ($\times 10^3$ plants ha^{-1})	*n*
5	low	131.574	8.333	4
5	medium	135.154	3.797	4
5	high	137.392	3.901	4
7	low	135.602	10.451	4
7	medium	131.127	8.815	4
7	high	134.707	3.143	4
10	low	116.358	7.123	4
10	medium	118.819	11.068	4
10	high	115.239	10.824	4

Supplementary Table S3. 2022 Midville — yield

A. ANOVA results.

Term	df	Sum of squares	F	p
Speed	2	2104469.538	4.206	0.0277
Downforce	2	3561821.182	7.119	0.0039
Replication	3	2151785.460	2.867	0.0586
Speed × Downforce	4	958027.896	0.957	0.4494
Residual	23	5753942.423	–	–

B. Treatment means.

Speed (km h^{-1})	Downforce	Mean (kg ha^{-1})	SD (kg ha^{-1})	*n*
5	low	5256.778	327.250	4
5	medium	6462.744	847.216	4
5	high	5751.533	658.384	4
7	low	5411.389	498.606	4
7	medium	5566.000	618.444	3
7	high	5411.389	369.345	4
10	low	5844.300	355.269	4
10	medium	6617.356	717.680	4
10	high	5906.144	309.222	4

Supplementary Table S4. 2023 Midville — achieved population

A. ANOVA results.

Term	df	Sum of squares	F	p
Speed	2	2798.099	12.132	0.0002
Downforce	2	1050.437	4.554	0.0210
Replication	3	1884.854	5.448	0.0053
Speed × Downforce	4	4126.501	8.946	0.0001
Residual	24	2767.696	–	–

B. Treatment means.

Speed (km h^{-1})	Downforce	Mean ($\times 10^3$ plants ha^{-1})	SD ($\times 10^3$ plants ha^{-1})	*n*
5	low	143.657	18.593	4
5	medium	143.956	6.507	4
5	high	165.885	10.596	4
8	low	139.033	17.802	4
8	medium	163.796	18.904	4
8	high	158.277	12.746	4
11	low	135.900	10.013	4
11	medium	150.520	6.378	4
11	high	115.165	8.537	4

Supplementary Table S5. 2023 Midville — yield

A. ANOVA results.

Term	df	Sum of squares	F	p
Speed	2	8314116.619	5.065	0.0166
Downforce	2	7650036.785	4.660	0.0218
Replication	3	11233221.973	4.562	0.0136
Speed × Downforce	4	10864471.320	3.309	0.0310
Residual	20	16415399.294	–	–

B. Treatment means.

Speed (km h^{-1})	Downforce	Mean (kg ha^{-1})	SD (kg ha^{-1})	*n*
5	low	5327.457	1103.057	4
5	medium	6643.860	721.657	3
5	high	5831.048	1105.178	4
8	low	6202.114	583.907	4
8	medium	6228.619	614.392	4
8	high	6732.210	2110.640	4
11	low	6096.095	639.052	4
11	medium	9011.619	599.734	2
11	high	6431.822	1045.959	3

Supplementary Table S6. 2024 Midville — achieved population

A. ANOVA results.

Term	df	Sum of squares	F	p
Planter	2	18501.997	73.404	<0.0001
Speed	1	20138.786	159.796	<0.0001
Vacuum	2	10902.366	43.254	<0.0001
Replication	3	412.140	1.090	0.3618
Planter × Speed	2	23688.607	93.982	<0.0001
Planter × Vacuum	4	6316.231	12.529	<0.0001
Speed × Vacuum	2	460.781	1.828	0.1711
Planter × Speed × Vacuum	4	1165.939	2.313	0.0701
Residual	51	6427.421	–	–

B. Treatment means.

Planter	Speed (km h^{-1})	Vacuum	Mean (×10^3 plants ha^{-1})	SD (×10^3 plants ha^{-1})	*n*
MS	5	low	103.529	17.924	4
MS	5	medium	120.833	10.421	4
MS	5	high	157.531	13.037	4
MS	8	low	10.442	1.790	4
MS	8	medium	40.576	8.439	4
MS	8	high	79.362	22.252	4
JD	5	low	114.270	10.097	4
JD	5	medium	112.181	3.513	4
JD	5	high	137.840	11.384	4
JD	8	low	121.728	11.488	4
JD	8	medium	119.640	11.627	4
JD	8	high	123.220	2.038	4
PP	5	low	113.076	10.467	4
PP	5	medium	122.623	9.566	4
PP	5	high	139.630	12.326	4
PP	8	low	110.689	2.460	4
PP	8	medium	104.126	9.365	4
PP	8	high	110.689	12.185	4

Supplementary Table S7. 2024 Midville — perfect spacing (%)

A. ANOVA results.

Term	df	Sum of squares	F	p
Planter	2	756.255	12.550	<0.0001
Speed	1	289.236	9.600	0.0032
Vacuum	2	1362.463	22.610	<0.0001
Replication	3	65.316	0.723	0.5431
Planter × Speed	2	1435.344	23.819	<0.0001
Planter × Vacuum	4	658.572	5.464	0.0010
Speed × Vacuum	2	669.094	11.103	<0.0001
Planter × Speed × Vacuum	4	46.649	0.387	0.8169
Residual	51	1536.627	–	–

B. Treatment means.

Planter	Speed (km h^{-1})	Vacuum	Mean (%)	SD (%)	*n*
MS	5	low	11.857	6.950	4
MS	5	medium	17.772	8.992	4
MS	5	high	36.323	4.320	4
MS	8	low	2.500	5.000	4
MS	8	medium	5.222	4.616	4
MS	8	high	16.006	4.729	4
JD	5	low	14.837	8.935	4
JD	5	medium	15.689	6.914	4
JD	5	high	26.498	3.689	4
JD	8	low	28.969	2.847	4
JD	8	medium	25.593	5.787	4
JD	8	high	25.349	6.057	4
PP	5	low	16.570	2.363	4
PP	5	medium	16.667	7.011	4
PP	5	high	29.200	1.889	4
PP	8	low	20.719	5.596	4
PP	8	medium	9.951	2.459	4
PP	8	high	15.025	1.507	4

Supplementary Table S8. 2024 Midville — yield

A. ANOVA results.

Term	df	Sum of squares	F	p
Planter	2	15122153.469	14.084	<0.0001
Speed	1	9460057.815	17.622	0.0001
Vacuum	2	8720821.474	8.122	0.0009
Replication	3	6795067.246	4.219	0.0097
Planter × Speed	2	15341438.294	14.289	<0.0001
Planter × Vacuum	4	4502563.399	2.097	0.0948
Speed × Vacuum	2	12137585.017	11.305	<0.0001
Planter × Speed × Vacuum	4	13273956.374	6.182	0.0004
Residual	51	27378942.736	–	–

B. Treatment means.

Planter	Speed (km h^{-1})	Vacuum	Mean (kg ha^{-1})	SD (kg ha^{-1})	*n*
MS	5	low	8410.844	936.557	4
MS	5	medium	7545.022	662.246	4
MS	5	high	7483.178	499.883	4
MS	8	low	3586.978	1757.949	4
MS	8	medium	6710.122	938.597	4
MS	8	high	7050.267	880.424	4
JD	5	low	7514.100	309.222	4
JD	5	medium	7699.633	355.269	4
JD	5	high	7761.478	508.731	4
JD	8	low	7514.100	369.345	4
JD	8	medium	7699.633	565.688	4
JD	8	high	7545.022	484.338	4
PP	5	low	7761.478	1345.028	4
PP	5	medium	8287.156	440.212	4
PP	5	high	7668.711	775.731	4
PP	8	low	6926.578	605.949	4
PP	8	medium	8689.144	498.606	4
PP	8	high	7885.167	828.962	4

Supplementary Table S9. 2025 Midville — achieved population

A. ANOVA results.

Term	df	Sum of squares	F	p
Planter	2	17832.817	57.457	<0.0001
Speed	1	8535.813	55.004	<0.0001
Vacuum	2	12743.781	41.060	<0.0001
Replication	3	55.780	0.120	0.9480
Planter × Speed	2	6467.679	20.839	<0.0001
Planter × Vacuum	4	6828.566	11.001	<0.0001
Speed × Vacuum	2	1347.398	4.341	0.0182
Planter × Speed × Vacuum	4	295.771	0.476	0.7528
Residual	51	7914.423	–	–

B. Treatment means.

Planter	Speed (km h^{-1})	Vacuum	Mean ($\times 10^3$ plants ha^{-1})	SD ($\times 10^3$ plants ha^{-1})	*n*
MS	5	low	93.210	13.162	4
MS	5	medium	134.568	12.469	4
MS	5	high	145.988	6.715	4
MS	8	low	33.951	6.799	4
MS	8	medium	89.506	2.570	4
MS	8	high	106.173	8.251	4
JD	5	low	131.173	12.524	4
JD	5	medium	129.012	5.189	4
JD	5	high	132.716	9.902	4
JD	8	low	106.173	6.375	4
JD	8	medium	122.222	12.054	4
JD	8	high	124.691	5.878	4
PP	5	low	133.333	31.620	4
PP	5	medium	148.765	17.181	4
PP	5	high	140.123	7.163	4
PP	8	low	118.827	9.896	4
PP	8	medium	138.889	9.536	4
PP	8	high	152.469	11.157	4

Supplementary Table S10. 2025 Midville — perfect spacing (%)

A. ANOVA results.

Term	df	Sum of squares	F	p
Planter	2	1182.760	18.017	<0.0001
Speed	1	918.545	27.984	<0.0001
Vacuum	2	1089.119	16.590	<0.0001
Replication	3	27.406	0.278	0.8408
Planter × Speed	2	289.219	4.406	0.0172
Planter × Vacuum	4	273.338	2.082	0.0968
Speed × Vacuum	2	33.805	0.515	0.6006
Planter × Speed × Vacuum	4	219.884	1.675	0.1702
Residual	51	1674.031	–	–

B. Treatment means.

Planter	Speed (km h^{-1})	Vacuum	Mean (%)	SD (%)	*n*
MS	5	low	15.359	2.970	4
MS	5	medium	27.264	8.364	4
MS	5	high	32.651	2.772	4
MS	8	low	8.594	11.797	4
MS	8	medium	8.487	3.319	4
MS	8	high	20.583	2.056	4
JD	5	low	24.989	7.759	4
JD	5	medium	23.628	3.582	4
JD	5	high	29.771	2.744	4
JD	8	low	19.270	3.971	4
JD	8	medium	19.650	4.997	4
JD	8	high	21.590	4.088	4
PP	5	low	26.803	6.191	4
PP	5	medium	31.384	7.615	4
PP	5	high	32.390	3.860	4
PP	8	low	20.029	5.579	4
PP	8	medium	26.951	4.257	4
PP	8	high	34.792	5.273	4

Supplementary Table S11. 2025 Midville — yield

A. ANOVA results.

Term	df	Sum of squares	F	p
Planter	2	3674598.893	13.252	<0.0001
Speed	1	1006570.582	7.260	0.0095
Vacuum	2	3260466.996	11.759	<0.0001
Replication	3	287591.595	0.691	0.5615
Planter × Speed	2	80525.647	0.290	0.7492
Planter × Vacuum	4	2887419.613	5.207	0.0014
Speed × Vacuum	2	228429.895	0.824	0.4445
Planter × Speed × Vacuum	4	1783067.889	3.215	0.0198
Residual	51	7070644.784	–	–

B. Treatment means.

Planter	Speed (km h^{-1})	Vacuum	Mean (kg ha^{-1})	SD (kg ha^{-1})	*n*
MS	5	low	5715.947	749.691	4
MS	5	medium	6293.622	376.486	4
MS	5	high	6172.006	459.090	4
MS	8	low	4743.020	496.495	4
MS	8	medium	6172.006	182.424	4
MS	8	high	6293.622	319.844	4
JD	5	low	6384.834	157.005	4
JD	5	medium	6597.662	207.699	4
JD	5	high	6476.046	459.090	4
JD	8	low	6445.642	99.299	4
JD	8	medium	6050.391	250.718	4
JD	8	high	6476.046	182.424	4
PP	5	low	6080.795	297.897	4
PP	5	medium	6597.662	250.718	4
PP	5	high	6688.874	314.011	4
PP	8	low	6141.602	253.164	4
PP	8	medium	6232.814	556.207	4
PP	8	high	6324.026	384.583	4

Supplementary Table S12. 2025 Tifton — achieved population

A. ANOVA results.

Term	df	Sum of squares	F	p
Planter	2	23473.107	123.540	<0.0001
Speed	1	37604.608	395.829	<0.0001
Vacuum	2	44011.640	231.635	<0.0001
Replication	3	391.507	1.374	0.2621
Planter × Speed	2	3613.667	19.019	<0.0001
Planter × Vacuum	4	6269.288	16.498	<0.0001
Speed × Vacuum	2	2540.482	13.371	<0.0001
Planter × Speed × Vacuum	4	3942.346	10.374	<0.0001
Residual	48	4560.101	–	–

B. Treatment means.

Planter	Speed (km h^{-1})	Vacuum	Mean ($\times 10^3$ plants ha^{-1})	SD ($\times 10^3$ plants ha^{-1})	*n*
MS	5	low	88.889	8.064	4
MS	5	medium	139.198	7.011	4
MS	8	low	20.370	7.710	4
MS	8	medium	62.963	4.834	4
MS	8	high	91.975	6.415	4
JD	5	low	54.630	6.244	4
JD	5	medium	87.037	8.817	4
JD	5	high	112.037	9.896	4
JD	8	low	26.852	4.437	4
JD	8	medium	60.185	7.832	4
JD	8	high	89.198	1.182	4
PP	5	low	124.691	10.996	4
PP	5	medium	147.222	18.155	4
PP	5	high	162.963	14.849	4
PP	8	low	33.025	4.550	4
PP	8	medium	116.975	18.922	4
PP	8	high	125.309	8.096	4

Supplementary Table S13. 2025 Tifton — perfect spacing (%)

A. ANOVA results.

Term	df	Sum of squares	F	p
Planter	2	793.159	10.613	0.0002
Speed	1	1845.364	49.384	<0.0001
Vacuum	2	2398.789	32.097	<0.0001
Replication	3	5.445	0.049	0.9857
Planter × Speed	2	384.314	5.142	0.0095
Planter × Vacuum	4	498.514	3.335	0.0173
Speed × Vacuum	2	120.438	1.612	0.2102
Planter × Speed × Vacuum	4	253.443	1.696	0.1665
Residual	48	1793.649	–	–

B. Treatment means.

Planter	Speed (km h^{-1})	Vacuum	Mean (%)	SD (%)	*n*
MS	5	low	18.555	5.678	4
MS	5	medium	30.055	6.390	4
MS	8	low	1.562	3.125	4
MS	8	medium	10.904	5.734	4
MS	8	high	20.716	7.367	4
JD	5	low	7.612	2.345	4
JD	5	medium	16.435	2.059	4
JD	5	high	18.989	4.336	4
JD	8	low	3.316	3.988	4
JD	8	medium	14.124	9.148	4
JD	8	high	17.401	6.946	4
PP	5	low	21.975	5.292	4
PP	5	medium	29.681	10.993	4
PP	5	high	37.324	3.558	4
PP	8	low	6.224	4.344	4
PP	8	medium	15.570	7.504	4
PP	8	high	24.494	4.081	4

Supplementary Table S14. 2025 Tifton — yield

A. ANOVA results.

Term	df	Sum of squares	F	p
Planter	2	3435701.790	2.060	0.1386
Speed	1	3666781.322	4.397	0.0413
Vacuum	2	37222221.358	22.318	<0.0001
Replication	3	91574384.959	36.605	<0.0001
Planter × Speed	2	2841369.676	1.704	0.1928
Planter × Vacuum	4	605865.425	0.182	0.9468
Speed × Vacuum	2	13416515.237	8.045	0.0010
Planter × Speed × Vacuum	4	8112837.740	2.432	0.0601
Residual	48	40026858.774	–	–

B. Treatment means.

Planter	Speed (km h^{-1})	Vacuum	Mean (kg ha^{-1})	SD (kg ha^{-1})	*n*
MS	5	low	2809.258	1785.156	4
MS	5	medium	3406.972	2298.417	4
MS	8	low	866.686	394.974	4
MS	8	medium	2988.572	1477.052	4
MS	8	high	3855.258	2125.881	4
JD	5	low	2390.858	1732.341	4
JD	5	medium	3556.401	2034.279	4
JD	5	high	3705.830	1726.833	4
JD	8	low	1374.743	316.281	4
JD	8	medium	2958.687	901.869	4
JD	8	high	2988.572	1211.263	4
PP	5	low	2988.572	1046.712	4
PP	5	medium	4154.116	1938.353	4
PP	5	high	2480.515	2022.537	4
PP	8	low	1554.058	910.412	4
PP	8	medium	3616.173	1232.220	4
PP	8	high	4931.144	2178.995	4

Supplementary Table S15. 2025 Midville — PP high-vacuum comparison (achieved population)

A. ANOVA results.

Term	df	Sum of squares	F	p
Speed	1	732.358	2.363	0.1392
Vacuum	3	2954.199	3.178	0.0452
Replication	3	747.980	0.805	0.5054
Speed × Vacuum	3	1564.929	1.683	0.2011
Residual	21	6507.773	–	–

B. Treatment means.

Speed (km h^{-1})	Vacuum	Mean (×10^3 plants ha^{-1})	SD (×10^3 plants ha^{-1})	*n*
5	low	133.333	31.620	4
5	medium	148.765	17.181	4
5	high	140.123	7.163	4
5	very high	138.889	6.255	4
8	low	118.827	9.896	4
8	medium	138.889	9.536	4
8	high	152.469	11.157	4
8	very high	112.654	26.829	4

Supplementary Table S16. 2025 Tifton — PP high-vacuum comparison (achieved population)

A. ANOVA results.

Term	df	Sum of squares	F	p
Speed	1	16692.577	163.870	<0.0001
Vacuum	3	22609.739	73.986	<0.0001
Replication	3	1593.507	5.214	0.0076
Speed × Vacuum	3	5850.099	19.143	<0.0001
Residual	21	2139.156	–	–

B. Treatment means.

Speed (km h^{-1})	Vacuum	Mean ($\times 10^3$ plants ha^{-1})	SD ($\times 10^3$ plants ha^{-1})	*n*
5	low	124.691	10.996	4
5	medium	147.222	18.155	4
5	high	162.963	14.849	4
5	very high	153.395	9.688	4
8	low	33.025	4.550	4
8	medium	116.975	18.922	4
8	high	125.309	8.096	4
8	very high	130.247	5.921	4

Supplementary Table S17. Model diagnostics summary

Year	Location	Response	*n*	Shapiro *p*	BP *p*	R^2	Residual normality	Heteroscedasticity
2022	Midville	Achieved population	36	0.3988	0.3979	0.6026	no strong departure	no strong signal
2022	Plains	Achieved population	36	0.3628	0.1849	0.6605	no strong departure	no strong signal
2022	Midville	Yield	35	0.8444	0.1909	0.6150	no strong departure	no strong signal
2023	Midville	Achieved population	36	0.3583	0.4091	0.7808	no strong departure	no strong signal
2023	Midville	Yield	32	0.0268	0.2736	0.6604	possible departure	no strong signal
2024	Midville	Achieved population	72	0.2000	0.1009	0.9270	no strong departure	no strong signal
2024	Midville	Perfect spacing (%)	72	0.8828	0.0964	0.7747	no strong departure	no strong signal
2024	Midville	Yield	72	0.8968	0.0503	0.7571	no strong departure	borderline only
2025	Midville	Achieved population	72	0.0018	0.0848	0.8724	possible departure	no strong signal
2025	Midville	Perfect spacing (%)	72	0.2845	0.0911	0.7067	no strong departure	no strong signal
2025	Midville	Yield	72	0.9288	0.0752	0.6513	no strong departure	no strong signal
2025	Tifton	Achieved population	68	0.6007	0.1991	0.9631	no strong departure	no strong signal
2025	Tifton	Perfect spacing (%)	68	0.9972	0.1442	0.7725	no strong departure	no strong signal
2025	Tifton	Yield	68	0.1385	0.3660	0.7999	no strong departure	no strong signal
2025	Midville	PP high-vacuum population	32	0.3207	0.0745	0.4797	no strong departure	no strong signal
2025	Tifton	PP high-vacuum population	32	0.8376	0.2471	0.9562	no strong departure	no strong signal

Interpretation: Shapiro $p < 0.05$ indicates a possible departure from normal residuals. BP $p < 0.05$ indicates possible heteroscedasticity. The two site-year models that warrant the clearest caution in the manuscript are 2023 Midville yield and 2025 Midville achieved population, because those are the only models with a clear Shapiro *p*-value below 0.05; 2024 Midville yield is borderline only on the Breusch–Pagan screen.