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Plant Population and Row Spacing for Corn

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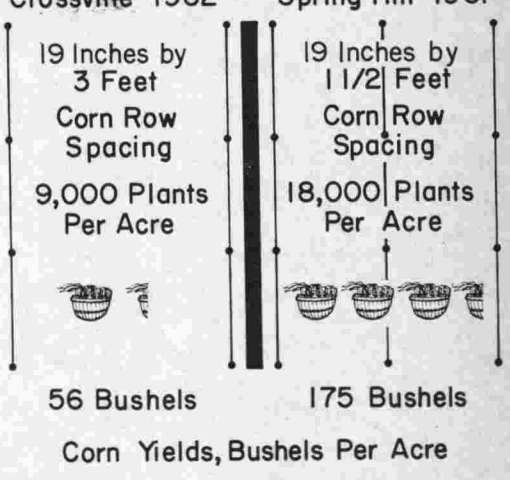

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Plant Population and Row Spacing for Corn

by

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Establishing the proper plant population is one of the factors essential for obtaining maximum corn yields. The distribution of plants over the soil area has also been suggested as a means for influencing yield, as evidenced by information in the Corn Belt on equidistant spacing in corn. To obtain information relative to the proper plant distribution for the best yields under Tennessee conditions, experiments have been conducted at Experiment Stations across the State over a 4-year period to determine the effect of spacing between rows and spacings within the row on yield of corn.

Locations of experiments

Experiments were conducted on a Hartsells fine sandy loam at the Plateau Experiment Station, Crossville, Memphis silt at the West Tennessee Experiment Station, Jackson, Sequatchie silt loam at the Main Station, Knoxville and a Huntington silt loam at the Middle Tennessee Experiment Station, Spring Hill. The Hartsells and Memphis are upland soils, the Sequatchie is a low terrace soil and the Huntington is an alluvial soil. All of the soils are productive and well-suited for corn production.

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Experimental procedures

A split-plot experimental design was used at all locations. The main plots were row spacings and the split plots were plant populations. The row spacings used in these studies were 3½, 3, 2½, 2, and 1½ feet between rows with the exception that the 3½-foot row spacing was not included in the experiment at Jackson.

The plant populations used were 9,000, 12,000, 15,000, and 18,000 plants per acre. Table 1 shows the within row spacings for each plant population at each row width studied.

Table 1. Plant spacing in rows for five row widths and four plant populations

Row width	Plants per acre			
	9,000	12,000	15,000	18,000
	Inches between plants			
3½ ft.	16.6	12.4	9.9	8.3
3 ft.	19.3	14.5	11.6	9.7
2½ ft.	23.2	17.4	13.9	11.6
2 ft.	29 0	21.8	17.4	14.5
1½ ft.	38.7	29.0	23.2	19.4

Phosphate and potash fertilization was based on soil tests and nitrogen was applied at the rate of 120 to 150 pounds per acre. All fertilizers were applied broadcast and disked into the soil prior to planting. Planting dates were around the middle of April at all locations except at Crossville where the planting date was around the first week of May. Dixie 29 hybrid was used in all experiments.

Rainfall

The April through August rainfall for each location each year as well as the 30-year average is shown in Table 2.

Table 2. The April through August rainfall and the 30-year average at the four experimental locations

KNOXVILLE

Month	1960	1961	1963	1964	30-year average
			Inches		
April	2.16	3.75	3.54	6.98	3.70
May	2.10	4.35	4.81	3.01	3.50
June	7.56	6.55	3.09	1.42	3.33
July	4.32	4.91	3.66	2.95	4.82
August	4.82	2.08	4.01	4.86	3.46
Total	20.96	21.64	19.11	19.22	18.81

CROSSVILLE

Month	1960	1961	1962	1963	30-year average
			Inches		
April	2.25	5.16	7.74	3.78	4.37
May	5.07	4.06	1.84	3.28	3.90
June	5.24	7.91	7.55	4.56	4.03
July	4.71	4.10	2.35	8.19	4.66
August	6.12	2.81	2.21	4.16	4.40
Total	23.39	24.04	21.69	23.97	21.36

SPRING HILL

Month	1960	1961	1962	1963	30-year average*
			Inches		
April	1.68	4.52	5.87	3.06	4.35
May	2.76	4.76	1.13	2.97	4.17
June	9.99	5.04	4.16	2.73	3.80
July	7.43	6.05	5.40	7.51	4.39
August	4.04	1.06	1.02	6.34	3.57
Total	25.90	21.43	17.58	22.61	20.28

JACKSON

Month	1960	1961	1962	1963	30-year average
			Inches		
April	2.81	4.76	3.22	3.89	4.60
May	2.62	4.67	2.33	4.75	4.03
June	3.68	4.75	2.49	2.23	4.18
July	5.35	3.80	2.16	3.56	4.56
August	2.13	3.66	1.19	1.17	3.36
Total	16.59	21.64	11.39	15.60	20.73

* Ashwood, Tennessee.

Above average rainfall was received at Knoxville during each of the four years of the test. However, some moisture stress was encountered in May of 1960 and in June and July in 1964. Moisture conditions at Crossville were above normal during each of the four years of the test and in only two months—May and July—of 1962 was there any noticeable moisture stress during the growing season. Moisture conditions at Spring Hill were above average during three of the four years. The rainfall was below average during the 1962 season. Conditions of moisture stress were evident in June of 1963 and May of 1960 and 1962. July rainfall during each of the four years of the experiment was about 2 inches above average at this location. At Jackson the rainfall during the growing season was above average in only one year of the four years of the experiment. In 1962, rainfall was considerably below average, the total being only 11.4 inches during the April-August period. Due to the rainfall distribution pattern, moisture stress was encountered only in June and late August in 1960 but the drouth days indicate that considerable moisture stress occurred during July-August in 1961 and the June-July-August periods of 1962 and 1963.

Corn yields

A summary of the yields at the different row spacings and different plant populations at the four locations and the average for the four locations is shown in Table 3. The yields from the individual treatments at each of the locations are shown in Tables 6, 7, 8 and 9.

In examining the data for the row spacing width at each of the locations it is evident that the row spacing had little influence on yield at Knoxville, Crossville, or Jackson, and a moderate influence at Spring Hill. Moisture conditions for corn production were more favorable at Spring Hill, so it is apparent that under optimum moisture conditions placing the rows closer together may result in small increases in corn yields. In this particular instance the yields went from 120 bushels per acre with 3½-foot rows to 138 bushels per acre with 1½-foot rows. The average for all experiments showed a slight increase for the very narrow row spacing, but in general the row spacings had a small effect upon the resultant corn yields in the tests conducted.

In examining the yields obtained from the various plant populations at all row spacings used, it is evident that the highest yield

Table 3. Average corn yields for different row spacings and different plant populations at four locations over a 4-year period

Row spacing	Knoxville	Crossville	Spring Hill	Jackson	Average for four locations
			Bushels per acre (15.5% moisture)		
3½ ft.	99	112	120	...	110
3 ft.	103	105	126	100	108
2½ ft.	105	107	128	107	112
2 ft.	105	110	130	107	113
1½ ft.	111	112	138	111	118

Plants per acre	Knoxville	Crossville	Spring Hill	Jackson	Average for four locations
			Bushels per acre (15.5% moisture)		
9,000	93	94	114	102	101
12,000	102	108	126	107	111
15,000	110	116	135	107	117
18,000	113	119	138	109	120

at each location was obtained where 18,000 plants per acre were used. Likewise, the lowest yield at each location was obtained where 9,000 plants per acre were used, giving an average of 101 bushels per acre for this particular plant population. Increasing the plant population from 9,000 to 12,000 plants per acre gave a 10-bushel average increase for all experiments. Increasing the plant population from 12,000 to 15,000 plants per acre brought about a further average increase of 6 bushels per acre. Increasing the plant population from 15,000 to 18,000 plants per acre resulted in only an additional 3 bushel per acre average increase. Thus, sizable increases in yield were obtained from increasing the plant population up to 15,000 plants per acre and only a small increase from the plant population increase from 15,000 to 18,000 plants per acre. This trend generally held true for all places except Jackson where the moisture conditions were less favorable for corn than at any of the other experimental areas. It was evident at this location that the higher plant populations did not decrease corn yields. The lowest yield obtained during the course of the experiments from any given treatment occurred in 1962 at Crossville where a 3-foot row width and a 9,000 plant population produced only 56 bushels per acre. The highest yield obtained from any given treatment during the course of the experiments occurred in 1961

at Spring Hill where 18,000 plants per acre in 1½-foot rows produced a yield of 175 bushels per acre.

Prolificacy

The number of ears per stalk at each of the locations is presented in Table 4. These data indicate that the width of row had little influence upon the number of ears per stalk at any location or for the State average. The results generally showed that about half the stalks had two ears and about half had one ear regardless of row spacing.

Table 4. Average number of ears per stalk for different row spacings and different plant populations at four locations over a 4-year period

Row spacing	Knoxville	Crossville	Spring Hill	Jackson	Average for four locations
			Ears per stalk		
3½ ft.	1.36	1.47	1.51	. . .	1.45
3 ft.	1.39	1.47	1.54	1.33	1.43
2½ ft.	1.39	1.52	1.56	1.34	1.45
2 ft.	1.34	1.54	1.54	1.34	1.44
1½ ft.	1.38	1.53	1.55	1.34	1.45

Plants per acre	Knoxville	Crossville	Spring Hill	Jackson	Average for four locations
			Ears per stalk		
9,000	1.50	1.62	1.77	1.59	1.62
12,000	1.44	1.56	1.63	1.39	1.51
15,000	1.38	1.49	1.49	1.24	1.40
18,000	1.23	1.40	1.33	1.16	1.28

In terms of plant population it is expected that the highest number of the ears per stalk would occur at the low plant population of 9,000 plants per acre. This was true for all locations and the average was 1.62 ears per stalk. Each 3,000 increase in the plant population resulted in an average decrease of 0.1 ear per stalk and the highest plant population of 18,000 plants per acre had an average of 1.28 ears per stalk.

Average ear weight

At the time of harvest the ears for each plot were weighed and counted. These figures were used to arrive at the average ear weight for a given treatment with no corrections made for the moisture content of the ear at time of harvest. Consequently, the comparison of data from location to location (Table 5) and from year to year may not be entirely justified due to moisture content variations at the time the determinations were made. The width of row had little influence on ear size while higher plant populations produced smaller ears.

Table 5. Average ear weight for different row spacings and different plant populations at four locations over a 4-year period

Row spacing	Knoxville	Crossville	Spring Hill	Jackson	Average for four locations
			Average ear weight (lb.)		
3½ ft.	.49	.50	.49	. .	.49
3 ft.	.49	.49	.47	.41	.46
2½ ft.	.49	.50	.50	.41	.48
2 ft.	.48	.49	.48	.41	.46
1½ ft.	.50	.50	.48	.41	.47

Plants per acre	Knoxville	Crossville	Spring Hill	Jackson	Average for four locations
			Average ear weight (lb.)		
9,000	.51	.53	.52	.43	.50
12,000	.49	.51	.48	.42	.48
15,000	.48	.49	.47	.40	.46
18,000	.48	.46	.46	.39	.45

Table 6. Corn yields for different row spacings and different plant populations over a 4-year period at Knoxville

Tmt. No.	Row spacing	Plants per acre	1960	1961	1963	1964	4-yr. average
			Bushels per acre (15.5% moisture)				
1	3½ ft.	9,000	79	117	81	91	92
2	3½ ft.	12,000	82	119	86	97	96
3	3½ ft.	15,000	95	145	87	84	103
4	3½ ft.	18,000	98	140	88	101	107
5	3 ft.	9,000	84	111	76	93	91
6	3 ft.	12,000	82	129	89	105	101
7	3 ft.	15,000	96	144	99	105	111
8	3 ft.	18,000	87	144	95	112	110
9	2½ ft.	9,000	70	116	90	93	92
10	2½ ft.	12,000	84	141	89	99	103
11	2½ ft.	15,000	102	143	94	96	109
12	2½ ft.	18,000	97	157	103	104	115
13	2 ft.	9,000	70	108	85	97	90
14	2 ft.	12,000	90	130	97	98	104
15	2 ft.	15,000	105	140	96	110	113
16	2 ft.	18,000	98	144	99	110	113
17	1½ ft.	9,000	83	120	102	102	102
18	1½ ft.	12,000	89	141	91	106	107
19	1½ ft.	15,000	107	154	94	107	116
20	1½ ft.	18,000	96	158	101	125	120
	Average for row spacings across all plant populations						
	3½ ft.		88	130	86	93	99
	3 ft.		87	132	90	104	103
	2½ ft.		88	139	94	98	105
	2 ft.		91	130	94	104	105
	1½ ft.		94	143	97	110	111
	L. S. D. (5%)		N.S.	N.S.	5	N.S.	...
	Average for plant populations across all row spacings						
	9,000		77	114	87	95	93
	12,000		86	132	90	101	102
	15,000		101	145	94	100	110
	18,000		95	148	97	110	113
	L. S. D. (5%)		6	7	7	6	...

Table 7. Corn yields for different row spacings and different plant populations over a 4-year period at Crossville

Tmt. No.	Row spacing	Plants per acre	1960	1961	1962	1963	4-yr. average
			Bushels per acre (15.5% moisture)				
1	3½ ft.	9,000	92	102	74	115	96
2	3½ ft.	12,000	90	140	74	136	110
3	3½ ft.	15,000	85	146	90	157	120
4	3½ ft.	18,000	88	151	87	159	121
5	3 ft.	9,000	73	116	56	112	89
6	3 ft.	12,000	78	130	68	140	104
7	3 ft.	15,000	82	156	75	153	117
8	3 ft.	18,000	71	156	62	161	113
9	2½ ft.	9,000	74	109	68	113	91
10	2½ ft.	12,000	82	131	68	137	105
11	2½ ft.	15,000	90	137	86	150	116
12	2½ ft.	18,000	87	150	77	160	119
13	2 ft.	9,000	79	104	77	117	94
14	2 ft.	12,000	90	127	78	141	109
15	2 ft.	15,000	80	141	90	150	115
16	2 ft.	18,000	86	151	84	161	121
17	1½ ft.	9,000	94	109	73	114	98
18	1½ ft.	12,000	99	128	81	143	113
19	1½ ft.	15,000	86	133	82	158	115
20	1½ ft.	18,000	85	148	85	168	122
		Average for row spacings across all plant populations					
	3½ ft.		88	135	82	142	112
	3 ft.		76	139	65	141	105
	2½ ft.		83	131	75	140	107
	2 ft.		84	131	82	142	110
	1½ ft.		91	130	80	146	112
	L. S. D. (5%)		N.S.	N.S.	12	N.S.	...
		Average for plant populations across all row spacings					
	9,000		82	108	70	114	94
	12,000		88	131	74	139	108
	15,000		84	143	84	153	116
	18,000		83	151	79	162	119
	L. S. D. (5%)		N.S.	6	5	5	...

Table 8. Corn yields for different row spacings and different plant populations over a 4-year period at Spring Hill

Tmt. No.	Row spacing	Plants per acre	1960	1961	1962	1963	4-yr. average
			Bushels per acre (15.5% moisture)				
1	3½ ft.	9,000	104	129	105	101	110
2	3½ ft.	12,000	107	121	118	112	115
3	3½ ft.	15,000	106	134	129	130	125
4	3½ ft.	18,000	115	147	136	128	132
5	3 ft.	9,000	104	115	132	106	114
6	3 ft.	12,000	102	137	127	120	122
7	3 ft.	15,000	112	149	146	124	133
8	3 ft.	18,000	105	149	153	133	135
9	2½ ft.	9,000	107	122	114	100	111
10	2½ ft.	12,000	122	146	141	120	132
11	2½ ft.	15,000	122	136	154	125	134
12	2½ ft.	18,000	117	141	153	126	134
13	2 ft.	9,000	94	123	116	106	110
14	2 ft.	12,000	115	144	140	109	127
15	2 ft.	15,000	134	155	140	129	140
16	2 ft.	18,000	126	154	156	131	142
17	1½ ft.	9,000	109	146	131	116	126
18	1½ ft.	12,000	106	158	140	136	135
19	1½ ft.	15,000	114	161	154	137	142
20	1½ ft.	18,000	114	175	160	146	149
		Average for row spacings across all plant populations					
	3½ ft.		108	133	122	118	120
	3 ft.		106	137	139	121	126
	2½ ft.		117	136	140	118	128
	2 ft.		117	144	138	119	130
	1½ ft.		111	160	146	134	138
	L. S. D. (5%)		N.S.	15	8	N.S.	...
		Average for plant populations across all row spacings					
	9,000		104	127	120	106	114
	12,000		111	141	133	119	126
	15,000		118	147	145	129	135
	18,000		116	153	152	133	138
	L. S. D. (5%)		9	8	8	6	...

Table 9. Corn yields for different row spacings and different plant populations over a 4-year period at Jackson

Tmt. No.	Row spacing	Plants per acre	1960	1961	1962	1963	4-yr. average
			Bushels per acre (15.5% moisture)				
1	3 ft.	9,000	86	136	61	88	93
2	3 ft.	12,000	93	142	67	109	103
3	3 ft.	15,000	90	149	68	110	104
4	3 ft.	18,000	85	148	69	103	101
5	2½ ft.	9,000	100	149	64	105	104
6	2½ ft.	12,000	90	164	64	105	106
7	2½ ft.	15,000	97	154	66	111	108
8	2½ ft.	18,000	85	160	71	125	110
9	2 ft.	9,000	100	157	60	95	103
10	2 ft.	12,000	94	153	61	97	101
11	2 ft.	15,000	91	158	71	112	108
12	2 ft.	18,000	95	167	75	122	115
13	1½ ft.	9,000	92	151	78	113	108
14	1½ ft.	12,000	105	164	79	122	118
15	1½ ft.	15,000	101	158	62	109	107
16	1½ ft.	18,000	104	153	71	118	112
		Average for row spacings across all plant populations					
	3 ft.		88	144	66	103	100
	2½ ft.		93	156	67	112	107
	2 ft.		95	159	67	107	107
	1½ ft.		101	156	72	115	111
	L. S. D. (5%)		N.S.	N.S.	N.S.	N.S	...
		Average for plant populations across all row spacings					
	9,000		95	148	66	100	102
	12,000		96	156	68	108	107
	15,000		95	155	67	110	107
	18,000		92	157	71	117	109
	L. S. D. (5%)		N.S.	N.S.	N.S.	11	...

SUMMARY

Dixie 29 corn hybrid was grown at five row widths and four plant populations at four locations across the State over a 4-year period. Row width had only a small influence upon corn yields while plant population had a much greater effect. Ear weights and prolificacy were affected very little by width of row; however, increasing plant population resulted in lower ear weights and fewer ears per stalk.

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