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Response of Vegetable Crops to Nitrogen Rates in Tillage Systems With and Without Vetch and Ryegrass

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Abstract. **Direct-seeded bush beans, sweet corn, summer squash, and transplanted tomato and cabbage were grown under varying tillage and cropping systems in 1982 and 1983. Cultural treatments were conventional tillage (CT), no-tillage without cover crop (NT − CC), and no-tillage with a cover crop (NT + CC) of hairy vetch (*Vicia villosa*) in 1982 and perennial ryegrass (*Lolium multiflorum*) in 1983. Split applications of N were 56 and 112 kg·ha^{-1} in CT plots and 0, 56, and 112 kg·ha^{-1} in NT plots. Plant stand and yields of bush beans and sweet corn were highest in CT plots in both years. Plant stand of squash was less for CT in 1982, but greater for CT than for NT + CC in 1983. Yields of squash were similar, but plant dry weight was greater in CT than in NT + CC. Plant stand of tomato and cabbage for NT + CC was similar to CT in 1982, but cabbage stand was greatest for CT in 1983. Total tomato yields were greater for NT − CC in 1982 and similar to those for CT in 1983, but yields were greatly reduced for NT + CC in 1983. Only in 1982 were cabbage heads of certain treatments marketable and they were greatest for CT. Sidedressing bush bean, sweet corn, cabbage, and summer squash plants with N in NT − CC plots increased yields linearly in 1982. Of the crops grown by NT + CC, only yields of bush beans and cabbage in 1982 and green fruit of tomato in 1982 showed a linear increase by sidedressing with N. Sidedressing with N increased N contents of all crops linearly in 1982, but not in 1983. Weed control was excellent in CT sweet corn and satisfactory in CT and NT − CC plots of the other crops. For the other crops in NT + CC plots, most of the weed and/or cover crop growth was the regrowth of vetch in 1982 and perennial ryegrass in 1983 after weed control chemicals were applied.**

The use of cover crops and grasses in no-tillage systems has increased yields mostly by the mulch produced that aids retention of soil moisture (1, 5, 8, 13). However, high soil moisture is not conducive to early planting of vegetable crops because of the cooler soil temperatures associated with the higher moisture in no-till soils as compared to conventional tillage (12) and the poor soil to root contact as observed in early plantings (9). It was previously shown (9) that plant stands of no-tilled tomato and pepper were equal, but yields were lower than those in conventional tillage. It was later observed that spring cabbage planted into a killed cover crop of fall-seeded winter wheat yielded less than conventionally tilled plants, even at double the plant population. These studies suggested that it was not economically feasible to produce early cabbage by no-till methods in Kentucky. Furthermore, there was little benefit gained from the limited amount of cover crop (straw) produced prior to the time cabbage needed to be planted for early marketing.

Various living mulches have been evaluated (4, 6, 7, 11) and the suppression by herbicides makes it possible for crop plants to compete for nutrients and water (6). The use of Kentucky bluegrass, Chewing's fescue, and white clover had not affected sweet corn and cabbage yields (11), whereas planting sweet corn into established legumes of clover and alfalfa reduced yields (14). These studies were initiated to evaluate the effects of cover crops and N rates on crop yields, weed growth, and growth of several vegetable crops in a no-tillage system.

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Materials and Methods

Studies were conducted during 2 spring seasons on a Maury silt-loam soil at the Univ. of Kentucky South Research Farm near Lexington. The 1982 experiment was conducted in no-tillage (NT), with and without hairy vetch, and conventional-tillage plots (CT). The vetch was sown into one-half of the NT plots in Fall 1981. In early Aug. 1982, all plant residues were plowed under with a mowboard plow. In October, perennial ryegrass seed was broadcast and lightly cultivated in only the plots that were previously in vetch for the 1983 experiments.

In order to determine the effects of cover crop residues in NT culture, the NT without and NT with vetch (1982) and subsequent ryegrass plots (1983) were sprayed with glyphosate at the rate of 2.2 kg·ha^{-1} about 2 weeks before planting. In the spring of each year, the CT plots were plowed with a mowboard plow to a depth of 20 cm and followed by disking at the same time the NT plots were sprayed.

Ammonium nitrate was used as the source of nitrogen in split applications each year. To plots receiving N, one-half of the total N was broadcast prior to planting and the other one-half was sidedressed about one month after planting. The total N rates were 0, 56, and 112 kg·ha^{-1}.

Soil tests in both years indicated a pH of 6.0 and about 112 and 380 kg of P and K, respectively. Subsequently, 310 and 225 kg·ha^{-1} of P and K were broadcast on all plots prior to planting each year, but disked in the CT plots only.

A complete block design was used. The vegetable crops were planted within N rates for CT, NT without a cover crop (NT − CC), and NT with a cover crop (NT + CC). Each tillage system, N-rate treatment, and crop was randomized with 3 replications.

Bush bean ('Blue Lake Bush'), sweet corn ('Gold Cup'), and summer squash ('Ingot') were direct-seeded with a NT seeder.

Table 1. Effect of tillage system on weeds and/.or cover crop growth ratings in 1982 and dry weights in 1983 for vegetable plots.

Tillage system	13 July 1982		11 July 1983	
	Rating[z]	Major weeds or cover crop growth	Dry wt ($1000\ kg\cdot ha^{-1}$)	Major weeds or cover crop growth
			Bush bean	
CT	1.8 a[y]	FT[x]	3.2 a	FT
NT−CC	1.5 a	FT > PW > LQ	3.6 a	FT > LQ
NT+CC	3.7 b	V > FT > PW > LQ	5.1 b	PR > SW
			Sweet corn	
CT	9.3 b	FT > BW	0.4 a	FT
NT−CC	5.4 a	FT > BW > PW	1.9 b	FT > BW
NT+CC	6.2 a	FT > BW > PW	4.0 c	FT
			Summer squash	
CT	6.3 a	FT > LQ	1.3 a	FT > BW
NT−CC	7.8 b	LQ	2.7 b	BW > LQ
NT+CC	9.3 c	V > LQ	2.9 b	PR > BW
			Tomato	
CT	8.1 a	FT	3.6 b	FT
NT−CC	7.6 a	FT>PW	2.0 a	FT>LQ
NT+CC	8.3 a	FT > PW	4.5 b	PR > SW
			Cabbage	
CT	7.0 b	PW = LQ	0.9 a	SW
NT−CC	5.2 a	PW = LQ	2.4 b	FT
NT+CC	5.9 a	V > PW = LQ	4.5 c	PR

[z]Rating on a scale of 1–10 (10 = excellent control of weeds); ratings ranked prior to statistical analysis.
[y]Mean separation within column within crop by Duncan's multiple range test, 5% level.
[x]Key to cover crop, weeds, and grasses: V = vetch; PR = perennial ryegrass; FT = foxtails; PW = pigweed; LQ = lambs quarter; BW = bindweed; and SW = smartweed.

Table 2. Effects of tillage system on plant stand and total yield of vegetable crops.

Tillage system	Plant stand ($1000\cdot ha^{-1}$) 1982	1983	Total yield ($1000\ kg\cdot ha^{-1}$) 1982	1983
		Bush bean		
CT	111 c[z]	133 c	10.3 c	3.3 c
NT−CC	88 b	99 b	7.6 b	1.7 b
NT+CC	69 a	66 a	5.0 a	1.1 a
		Sweet corn		
CT	56 ab	44 b	10.0 c	6.5 b
NT−CC	59 b	42 b	8.4 b	4.1 a
NT+CC	53 a	38 a	6.3 a	4.0 a
		Summer squash		
CT	18 a	21 b	45 ab	---[y]
NT−CC	25 b	18 ab	53 b	---
NT+CC	24 b	15 a	39 a	---
		Tomato		
CT	23 a	23 b	18.6 a[x]	9.6 b
NT−CC	22 a	20 a	30.2 b	10.6 b
NT+CC	21 a	21 a	20.2 a	3.6 a
		Cabbage		
CT	22 a	26 b	25.3 c	0.5 b[w]
NT−CC	25 b	23 a	22.1 b	0.6 b
NT+CC	22 a	22 a	11.5 a	0.3 a

[z]Mean separation within columns by Duncan's multiple range test, 5% level.
[y]Yield data not recorded because of drought.
[x]Total of ripe and mature-green fruit.
[w]All heads nonmarketable because of drought.

Tomato ('San Marzano') and cabbage ('Market Prize', 'Histona', and 'Minicole' in 1982 and 'Market Prize' in 1983) were transplanted with a NT transplanter. All crops were seeded or transplanted between 1 and 10 May in both years. Herbicides applied immediately after seeding or transplanting at recommended rates (2) were: 2-(2-methylpropyl)-4,6-dinitrophenol (dinoseb) on bush beans; 2-(4-chloro-6-ethylamino-*s*-triazin-2-ylamino-2-methylpropionitrile (cyanazine) and 2-chloro-*N*-(2-6-diethylphenyl)-*N*-(methoxymethyl)acetamide (alachlor) on sweet corn; 3-amino-2,5-dichlorobenzoic acid (chloramben) on summer squash; 4-amino-6-(1,1-dimethylethyl)-3-(methylthio)-1,2,4-triazin-5-(4*H*)-one (metribuzin) on tomato; and dimethyl tetrachloroterephthalate (DCPA) on cabbage. Each crop consisted of 3-row plots with data being recorded on the middle row. The row spacings were 91 cm and the plot length within N rate was 10.2 m for each crop.

The laminae of newly matured leaves were sampled for elemental N analysis at the end of harvest for each crop except cabbage, of which the head wrapper leaves were sampled. Leaves were washed in deionized water, dried at 60°C, ground, and analyzed for total N by micro-Kjeldahl.

Results and Discussion

The rainfall pattern for May 1983 was different from that in 1982. Total amounts of rainfall in 1982 were 1.3 and 5.0 cm from 1 to 15 May and 16 to 31 May, respectively. Total amounts of rainfall in 1983 were 7.6 and 3.5 from 1 to 15 May and 16 to 31 May, respectively. Rainfall was below normal by 7.6 and 8.7 cm from 1 May to 31 July for 1982 and 1983, respectively, and most of the deficiency in 1983 (6.4 cm) occurred during

Table 3. Effects of tillage system and N rate on yield of vegetable crops.

Tillage system	N rate ($kg \cdot ha^{-1}$)	Bush bean pod wt ($g \cdot plant^{-1}$)	Sweet corn No. ears ($1000 \cdot ha^{-1}$)	Summer Squash Fruit/plant[z] No.	Summer Squash Fruit/plant[z] Wt (kg)	Tomato Fruit wt ($g \cdot plant^{-1}$) Ripe	Tomato Fruit wt ($g \cdot plant^{-1}$) Green
				1982			
CT		93 c[yx]	63 b	5.8 a	2.5 b	414 b	396 a
NT − CC		87 b	55 b	5.2 a	2.1 ab	338 b	1036 c
NT + CC		73 a	44 a	4.0 a	1.6 a	210 a	753 b
NT − CC	0	22	23	2.0	0.6	500	372
	56	80	53	5.0	2.1	348	1075
	112	93	60	5.3	2.1	324	997
Linear		*	*	*	*	NS	**
Quadratic		NS	NS	NS	NS	NS	**
NT + CC	0	17	28	1.8	0.5	209	308
	56	59	43	3.9	1.6	177	637
	112	86	45	4.1	1.6	242	868
Linear		**	NS	*	*	NS	*
Quadratic		NS	NS	NS	NS	NS	NS
				1983			
CT		27 b	33 b	---[v]	---	154 b	338 ab
NT − CC		17 a	27 b	---	---	112 b	418 b
NT + CC		20 a	21 a	---	---	50 a	125 a
NT − CC	0	19	25	---	---	169	251
	56	14	22	---	---	85	440
	112	20	31	---	---	138	395
Linear		NS	NS			NS	NS
Quadratic		*	**			*	NS
NT + CC	0	14	10	---	---	123	160
	56	14	21	---	---	47	107
	112	25	21	---	---	52	142
Linear		NS	NS			*	NS
Quadratic		NS	NS			NS	*

[z]Total of 11 harvests from 23 June to 14 July.
[y]Means for added N rates only.
[x]Mean separation within column by Duncan's multiple range test, 5% level.
[v]Not recorded because of drought effects.
*,**,NS Significant at 5%, 1%, and nonsignificant, respectively.

Table 4. Effects of tillage system and N rate on head weight and percentage[z] of heads developed for 3 cultivars in 1982.

Tillage system	N rate ($kg \cdot ha^{-1}$)	Market Prize Wt ($kg \cdot head^{-1}$)	Market Prize (%)	Histona Wt ($kg \cdot head^{-1}$)	Histona (%)	Minicole Wt ($kg \cdot head^{-1}$)	Minicole (%)
CT		1.15 b[zy]	70.1 b	1.39 b	70.6 b	0.62 b	60.8 b
NT − CC		0.90 b	56.3 ab	0.86 a	66.4 ab	0.70 c	62.9 b
NT + CC		0.55 a	41.9 a	0.86 a	52.0 a	0.54 a	26.6 a
NT − CC	0	0.36	32.9	0.35	42.6	0.35	54.8
	56	0.76	50.3	0.66	70.4	0.63	64.4
	112	1.02	62.3	1.06	62.4	0.83	61.3
Linear		**	NS	**	NS	**	NS
Quadratic		NS	NS	NS	NS	NS	NS
NT + CC	0	0.36	34.4	0.27	22.4	0.25	50.7
	56	0.48	42.5	0.76	59.2	0.50	20.6
	112	0.56	41.2	0.96	44.7	0.57	32.6
Linear		NS	NS	*	NS	**	NS
Quadratic		NS	NS	NS	NS	NS	NS

[z]Actual percentages (transformed for statistical analysis).
[y]Means for added N rates only.
[x]Mean separation within column by Duncan's multiple range test, 5% level.
*,**,NS Significant at 5%, 1%, and nonsignificant, respectively.

Table 5. Effects of tillage system and nitrogen rates on dry weight[z] of vegetable crop plants.

Tillage system	N rate ($kg \cdot ha^{-1}$)	Bush bean	Sweet corn	Summer squash	Tomato	Cabbage[y]
				1982		
CT		17.8 b[xw]	179 a	740 b	281 b	1910 b
NT − CC		14.7 a	184 a	552 a	204 a	1265 a
NT + CC		14.3 a	174 a	471 a	209 a	1185 a
NT − CC	0	6.5	111	290	103	770
	56	13.2	197	514	187	953
	112	16.2	172	590	221	1583
Linear		*	NS	*	*	*
Quadratic		NS	NS	NS	NS	NS
NT + CC	0	3.1	146	282	118	767
	56	12.8	182	442	168	1103
	112	15.5	167	499	250	1263
Linear		*	NS	*	*	NS
Quadratic		NS	NS	NS	NS	NS
				1983		
CT		13.7 a	72 b	---[v]	27 b	540 b
NT − CC		14.9 a	50 a	---	29 b	491 ab
NT + CC		11.2 a	86 b	---	15 a	335 a
NT − CC	0	11.3	43	---	21	279
	56	16.0	49	---	26	458
	112	13.8	50	---	31	523
Linear		NS	NS	---	NS	*
Quadratic		NS	NS	---	NS	NS
NT + CC	0	8.3	42	---	22	159
	56	10.9	68	---	13	321
	112	11.4	103	---	16	349
Linear		NS	*	---	NS	NS
Quadratic		NS	NS	---	*	NS

[z]Except for cabbage which is fresh weight minus head weight.
[y]'Market Prize'.
[x]Means for added N rates only.
[w]Mean separation within column by Duncan's multiple range test, 5% level.
[v]Not recorded because of drought effects.
*,**,NS Significant at 5%, 1%, and nonsignificant, respectively.

Table 6. Effects of tillage system and N rate on concentrations of N in plant leaves of vegetable crops at harvest.

Tillage system	N rate ($kg \cdot ha^{-1}$)	Bush bean		Sweet corn		Summer squash		tomato		Cab-bage
		1982	1983	1982	1983	1982	1983	1982	1983	1982
CT		4.02 b[yx]	3.28 b	2.58 a	2.42 b	3.72 b	4.95 a	4.07 b	3.00 b	3.43 c
NT − CC		3.69 a	3.01 b	2.58 a	1.97 a	3.24 a	4.83 a	3.73 a	3.17 b	3.13 b
NT + CC		4.14 c	2.68 a	2.61 a	2.25 b	3.95 b	4.68 a	3.62 a	2.56 a	2.84 a
NT − CC	0	1.57	2.50	1.58	1.75	1.23	4.50	1.60	2.31	1.18
	56	3.35	2.90	2.35	1.89	2.62	4.96	3.10	2.89	2.70
	112	4.02	3.12	2.75	2.05	3.85	4.70	4.35	3.44	3.55
Linear		**	NS	**	NS	**	NS	**	NS	**
Quadratic		NS	NS	NS	NS	NS	NS	NS	NS	NS
NT + CC	0	1.98	2.42	1.60	1.81	1.72	3.95	1.52	1.99	2.17
	56	3.92	2.65	2.37	2.35	3.12	4.78	2.70	2.50	2.60
	112	4.35	2.70	2.85	2.14	4.77	4.57	4.53	2.61	3.07
Linear		**	NS	**	NS	**	NS	**	NS	*
Quadratic		NS	NS	NS	NS	NS	NS	NS	NS	NS

[z]'Market Prize' only.
[y]Means for added N rates only.
[x]Mean separation within column by Duncan's multiple range test, 5% level.
*,**,NS Significant at 5%, 1%, and nonsignificant, respectively.

July. Because of drought conditions in 1983, yields of summer squash and cabbage were not recorded.

Effect of tillage system on weeds and cover crops. The drought effect in 1983 was further compounded by the revived ryegrass—especially for beans, tomato, and cabbage. Perennial ryegrass made up most of the dry weights recorded for weeds and/or cover crop growth and was the predominant plant growing in the NT + CC plots, except in sweet corn plots (Table 1). In 1982, weed control was best in NT + CC plots of bush beans and summer squash and CT plots of cabbage and sweet corn. Weed growth ratings for NT + CC plots in 1982, except for sweet corn and tomato, were mostly on regrowth of vetch from dormant or hard seeds following spraying with glyphosate and their respective preemergence herbicides. The use of cyanazine and alachlor on sweet corn was very effective in controlling regrowth of vetch in 1982 and perennial ryegrass in 1983. Metribuzin on tomato also controlled vetch in 1982, but had no effect on ryegrass in 1983. The most common grasses in all plots were the foxtails. The most common broadleaf weed was pigweed.

Effect of tillage system on plant stand and total yield. Plant stand and total yield of bush beans and sweet corn were greater in CT plots than in NT plots in both years (Table 2). Planting into top-killed cover crop residues (NT + CC) reduced plant stand and yield for both crops in 1982 and bush beans in 1983. Plant stand of summer squash was greater in NT than in CT in 1982, but less in NT + CC than in CT in 1983. Reductions in plant stand of these direct-seeded crops were due mostly to poor soil coverage of seed in vetch and ryegrass residue plots.

Of the transplanted crops (Table 2), plant survival in NT plots was better or equal to CT plots in 1982, but less than in CT plots in 1983. Total tomato yields were highest in NT − CC plots in 1982 and similar to those in CT plots in 1983. Cabbage yields of CT plants were higher than those of the other plots in 1982, but no better than for plants of NT − CC plots in 1983.

Effect of tillage system on plant yields. In both years, yields of sweet corn and ripe tomato fruits for plants in NT − CC plots were similar to those of CT plants (Table 3). In 1982, tomato plants in NT − CC plots had higher green fruit weight than those in other tillages, thus the potential for sustaining production. Summer squash plants in NT − CC plots also yielded as well as CT plants in 1982. Bean yields were highest in CT plots in both years. The cabbage cultivars differed in their response to tillage with 'Histona' heads largest in CT and 'Minicole' heads largest in NT − CC plots (Table 4). 'Market Prize' and 'Minicole' heads were smallest in NT + CC plots. The most remarkable heads were produced in CT plots.

Effect of N rates on yields. Adding N in 1982 increased yields linearly for all crops, except ripe fruit of tomato in both NT plots, and sweet corn and 'Market Prize' cabbage in NT + CC plots (Tables 3 and 4). In 1983, added N produced a quadratic effect on yields of bean, corn, and ripe tomato fruit in NT − CC plots (Table 3). There was also a quadratic effect on green tomato fruit in NT + CC plots, but a linear reduction of ripe fruit with added N.

Effect of tillage system on plant weight. In 1982, plant dry weight of CT plants, except for sweet corn, was greater than for plants in NT plots (Table 5). In 1983, tillage system had no effect on dry weight of bean plants, but the lowest weighing tomato and cabbage plants were obtained from NT + CC plots.

Effect of N rates on plant weight. In 1982, adding N to NT plots increased dry plant weight linearly for bean, squash, and tomato. In both years, added N to NT − CC plots had no effect on sweet corn dry weight, but produced a linear increase in cabbage plant weight. In comparison, in 1983, added N to NT + CC plots produced a linear increase in sweet corn dry weight and a quadratic effect on tomato dry weight.

Effect of tillage system and N rates on leaf content of N. Even though yields were generally lower in NT than in CT plots, especially at low N rates, the N contents (Table 6) of leaves from NT + CC-grown sweet corn and squash plants in both years and bean plants in 1982 were as high or higher than for plants in other plots. In contrast, cabbage in 1982 and bean and tomato plants in 1983 grown in NT + CC plots contained less N than those from other plots. Sidedressing with N increased N contents of plants linearly in both NT plots in 1982, but not in 1983. The extreme drought probably limited N availability and uptake by plants in 1983. Since bush bean and tomato leaves contained less N for plants grown in NT + CC plots in 1983, plowing under the hairy vetch in Fall 1982 apparently had not added additional carry-over N to those crops. However, this does not account for the possibility that the turnip crop and the ryegrass, replanted to these plots in Fall 1982, may have used part of the N that may have been provided by the plowed-under vetch. Mitchell and Teel (10) reported that plowed-under hairy vetch and clover plots, without added N, produced yields of corn equivalent to those for plants fertilized with N at 112 $kg \cdot ha^{-1}$ without cover crops. However, Ebelhar et al. (3) reported that plowed-under hairy vetch had little effect on N levels in corn the first 2 years.

Low yields in plots with cover crops were not due to competition for N (except where N was not sidedressed), but due mostly to competition from vetch and/or weeds in 1982 and the combination of drought and the perennial ryegrass in 1983. The weeds and cover crops apparently competed for soil moisture and the stress reduced both yield and plant weight. Nicholson and Wien (11) reported that the most vigorous living mulches competed with cabbage for soil moisture and reduced plant and head size. Thus, it is concluded that the regrowth of cover crops (such as hairy vetch and perennial ryegrass) in a NT system can have a detrimental effect on crop plants in moisture-stressed soils.

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Influence of Seed Harvesting and Handling Procedures on Germination of Cucumber Seeds

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Additional index words. *Cucumis sativus*, cucumber, seed quality, dormancy, fermentation, germination

Abstract. **Three cucumber (*Cucumis sativus* L.) populations were evaluated to determine the effects of several seed harvesting and handling procedures on seed quality. Fruit maturity at seed harvest, fermentation duration in seed extraction, seed storage time, and germination temperature all significantly influenced germination percentage and rate. About 30% of the observed variation in germination percentage was due to interactions between handling factors rather than to main effects of factors. Although germination in excess of 90% was observed for some combinations of factors with as little as 28 days of fruit maturity (post-pollination), the advantages of greater seed maturity at harvest were evident for rate of germination and tolerance to long fermentation times. Positive responses to short fermentation durations (≤4 days) occasionally were observed, but longer fermentation durations were markedly deleterious under some conditions. Six months of seed storage were effective in improving germination of seed at 15° and 20°C, but had little effect on germination at 25°. The 3 cucumber populations were markedly different in response to some seed handling factors.**

A number of seed harvesting and handling factors have been shown to influence seed quality significantly. Seed maturity at harvest is important to subsequent germination in many crops (5, 9, 11, 17, 24). Seed storage may be required to overcome dormancies (4, 20), but it has also been associated with membrane deterioration (12, 13), genetic deterioration (14, 19), and less-efficient physiological function (1, 2). Seed from fleshy fruit are often fermented to assist in their extraction from the surrounding pulp. This process has been shown to influence aspects of germination in strawberries (6) and tomatoes (22).

Freshly harvested cucumber seed generally exhibit satisfactory germination under optimum conditions. However, seed dormancies or after-ripening requirements have been reported for 'Baroda' and 'Black Diamond' (21, 25). Nienhuis and Lower (15) reported a dormancy of fresh seedlots that diminished with seed age when seeds from a heterogeneous cucumber population were germinated at 15°C. Such responses to seed aging were not observed at 25°. They also reported that fermentation of seeds and fruit pulp for up to 4 days enhanced germination of seeds at 25°, but further fermentation decreased the germination percentage.

The purpose of this investigation was to study the effects of seed maturity at harvest, fermentation duration, seed storage time, and germination temperature on germination of several cucumber populations. Of particular interest was the comparison between a population of compact plant types, *cp/cp*, and a similar population of vining plant types, *Cp/−*. Compact plant types produce small seeds that exhibit poorer seed germinability than those of conventional vining plant types (8).

Materials and Methods

Three genetically different cucumber populations were evaluated in this study: 1) a vining population of 25 individual gynoecious breeding lines and hybrids from the USDA cucumber breeding program (USDA *Cp/−*); 2) a heterogeneous population of 25 F_2 families of vining genotypes from the Wisconsin Agricultural Experiment Station breeding program (WI *Cp/−*); 3) a heterogeneous population of 25 F_2 families similar to the WI vining population in origin, but homozygous for the compact gene (WI *cp/cp*). Lines comprising the USDA *Cp/−* population had been developed by selecting for disease resistance in the greenhouse. In their development, fruit were harvested routinely 30 days after pollination and seed fermentation was seldom practiced. The WI populations were developed in the field; fruit were harvested at plant senescence, and fermentation durations of 2 to 4 days commonly were employed in the seed extraction procedure.

All seed evaluated in this investigation was harvested from plants grown in the field at the Hancock Experimental Farm, Hancock, Wisc., in Summer 1981. Each of the 3 populations was comprised of 25 plots. The USDA *Cp/−* population of breeding lines and hybrids was direct-seeded into the field on 27 May. Plots of the 2 WI populations were either *cp/cp* or *Cp/−* F_2 segregants from each of 25 random F_2 families seg-

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