Peanut Responses to Imposed-Drought Conditions in Southern Ontario

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ABSTRACT

The effects of moisture stress on valencia peanut (hypogaea L.) yields were evaluated on Fox loamy-sand soils (Typic Hapudalf or Brunisolic Gray Brown Luvisols); of southwestern Ontario. Drought-imposed irrigation experiments were conducted in 1980 and 1981 by withholding water over all possible combinations of three peanut growth periods, as follows: Period 1, early and full flowering; Period 2, late flowering and pod formation; Period 3, pod filling. Generally, the results indicated that the period of late flowering and pod formation is most sensitive to moisture and that moisture stress in growth periods 2 and 3 reduced yields more than stress in periods 1 and 2. Year-to-year variations indicated that, at least in this short-season growing area, factors other than moisture stress alone were influencing peanut yield and quality.

Key Words: Growth period, drought periods, moisture stress, irrigation, yield.

Periodic dry spells during the growing season in southern Ontario (1, 2, 12), result in soil moisture levels less than the the optimum necessary to attain high yields of most crops, especially crops such as peanuts which are grown on coarse-textured soils. The dry spells usually lead to conditions that are conducive to high levels of potential evapotranspiration.

Klepper (6) described the period of vigorous flowering as the most sensitive to drought stress. Pallas *et al.* (9, 10) indicated that yield, percentage sound mature kernels (SMK) and leaf water potentials were decreased with an increase in the duration and/or the lateness of the drought. Martin and Cox (7) measured decreases in yield due to drought occurring 50-to-60 days after the onset of flowering. Drought periods during early pegging and pod formation at 40 to 80 days after planting reduced reproductive growth more than vegetative growth. Pahalwan and Tripathi (8) noted that the peanut crop required more water during pegging to pod formation than at other periods such as pod development to maturity or planting to flowering. Stansell and Pallas (15) indicated that a 35-day mid-season drought (from 70 to 105 days after planting) was most damaging. Reddy *et al.* (11), using the spanish cultivar Comet, observed that irrigation and inoculation each increased yield by about 27%, and the effect of each of these factors was greater in the presence of the other.

Boote and Hammond (3) also indicated that an early season drought followed by sufficient water would result in a later harvest. However, delaying harvest in southern Ontario may have a negative effect on yield as the average first fall frost date is October 1, and peanuts are extremely frost-prone (Table 1).

Table 1. Climatic data for Delhi*, Ontario, Canada, for 1980, 1981 and 45-year average.

	May	June	July	Aug.	Sept.	Oct.
			Temperature, C			
Minimum						
1980	7.9	9.9	15.1	16.7	10.8	3.5
1981	6.2	13.3	15.2	14.5	10.9	2.9
45-year ave.	5.6	12.0	14.5	13.8	9.9	4.5
Mean						
1980	14.1	15.9	21.0	21.7	16.1	7.3
1981	12.4	19.0	21.3	19.8	15.0	7.5
45-year ave.	13.0	18.3	20.9	20.0	16.0	10.0
Maximum						
1980	20.3	21.9	26.8	26.6	21.3	11.1
1981	18.5	24.7	27.4	25.0	19.1	12.0
45-year ave.	19.3	24.5	27.1	26.2	21.9	15.0

			Precipitation, mm				Annual
1980	60.1	92.8	91.5	103.6	109.2	106.8	564.0
1981	47.8	104.7	78.5	69.4	182.8	101.8	585.0
45-year ave.	78.7	75.8	76.8	83.6	81.4	72.4	468.3

	Frost-Free Period
1980	145 days - May 16 to October 10
1981	138 days - May 18 to October 4
45-year ave.	136 days - May 18 to October 1

	Daylight Length Hours
June 21	15.4
July 15	15.0
August 15	14.0
September 21	12.3

Source: Environment Canada, Atmospheric Environment Service, 25 St. Clair Avenue East, Toronto, Ontario, M4T 9Z9.

* Latitude 42° 50'N

The purpose of this study was to determine the effect of various drought periods on the yield of valencia type peanuts grown in an area having an average 136 frost-free days. It was hypothesized that early season dry spells would have a greater impact on yield than later season dry spells because there is no opportunity for extending the growing season.

Methods and Materials

The experiments were conducted on a Fox loamy-sand soil (sandy, mixed, calcareous, mesic, humid-Typic Hapudalf) at the Agriculture Canada, Research Station, Delhi, Ontario, Canada, during the 1980 and 1981 growing seasons (14). This type of soil is best suited to peanut production in Ontario (4), and is typically 85% sand, 7-to-8% each of silt and clay, 1-to-1.5% organic matter and has a pH of 5.8 to 6.2.

A randomized complete block design was used, with four plot replications for each of 10 treatments of imposed drought and natural conditions across three peanut growth periods. Each plot consisted of 7 rows of 7 m length. A 40 cm row width and seeding rate of 13 seeds/metre of row were used. Seeds of the valencia cultivar McRan were planted on May 8 and 20 in 1980 and 1981, respectively.

A 6-meter length of plants from the center row of all 40 plots was dug with a spade on September 26 and 23 in 1980 and 1981, respec-

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tively. The three rows on either side of the harvested center row acted as buffer rows. Because of the danger of frost occurring by October 1 in this part of Ontario (Table 1), there is no biological advantage to be gained by leaving plots with a preponderance of immature pods to reach optimum maturity, as would be the case in areas with a longer growing season. In fact, with a high probability of frost occurring, and because of the susceptibility of peanut to frost damage, it is imperative to complete the harvesting of peanuts before the onset of first frost. After digging, the pods were manually removed from the plant and artificially dried to 10% moisture with forced air at 30C. After curing, the pods were weighed and graded using standard procedures (16).

Because climatic variability in southern Ontario precludes the occurrence of natural drought conditions with any degree of certainty, plots were set up to impose drought during various peanut growth periods as follows: Period 1 - early and full flowering (June 15 to July 12); Period 2 - late flowering and early pod formation (July 13 to August 8); and Period 3 - pod filling (August 9 to September 7). Treatments 2 to 9 (Tables 2 and 3) included all possible combinations of the three imposed drought periods (C-covered during period denoted) and natural conditions (U-uncovered) across the three growth periods. Treatment 1 represented the natural growing conditions experienced during the year under study. Treatment 10 was included to provide additional data should irrigation water have been deemed necessary over and above that applied during, before and after the imposed periods outlined above. The sole criterion for providing additional irrigation water to any of the imposed-drought plots was that visible daytime wilting of the peanuts occur with no or incomplete overnight recovery. Such conditions were met on only one occasion in Period 2 around mid-July in 1980 (Table 2) and not at all during 1981 (Table 3).

Inter-year climatic variations led to differences in the length of the imposed-drought periods as well as the amount of rainfall and irrigation received in 1980 and 1981, (Tables 2 and 3). It is emphasized that adequate moisture was applied through irrigation or that rainfall was allowed to fall both before and after each imposed drought period in an attempt to minimize or avoid a "carryover" effect from one period to the next. Thus, most irrigation water was applied to eliminate any naturally occurring water deficits among peanut growth periods as unwanted influences on the experiment.

Movable canopies of transparent, plastic roofing stretched over wood frames (2 m wide x 8 m long x 1 m high) were used to impose drought by preventing the innermost five rows of each of the requisite plots from receiving rainfall. The imposed-drought plots were covered only during periods of rainfall. Thus sunlight penetration was not interfered with during non-rainy periods. Side and end panels prevented any rainfall from blowing laterally onto the rows under the canopies. Trenches, 10 cm deep between plots were constructed to collect and disperse run-off from the canopies during a rainfall period. The same trenches prevented any surface water from flowing onto the imposed-drought plots. No special measures were taken to prevent lateral growth of peanut roots from the harvested center row to absorb soil moisture from wet soil regions because of the presence of the three buffer rows on either side. Trickle irrigation lines were placed in each row of the plots to provide irrigation water if deemed necessary. A flow control was installed in the main line to control the amount of water applied.

Results and Discussion

Pod weight, kernel weight and sound mature kernel (SMK) weight data for peanut yields for the 10 treatments for each of 1980 and 1981 were collected. Only the data for SMK (shelled) yields are presented here, because all three measures parallel one another, and SMK yield is the economically relevant measure for Ontario peanut growers. Treatment comparisons are presented using Duncan's New Multiple Range Test, and, in order to provide greater detail of inter-treatment differences or similarities, orthogonal comparisons (13).

Table 2. Experimental treatments and amounts of rainfall and irrigation water received during the peanut growth periods in 1980, Delhi, Ontario.

Treat. ment #	Abbr. Name	Pre-treatment period (May 8 - June 14) Rainfall	Period 1 (June 15 - July 12) Irr.	Period 1 Rainf.	Period 2 (July 13 - August 8) Irr.	Period 2 Rainf.	Period 3 (August 9 - Sept. 7) Irr.	Period 3 Rainf.	Post-treatment period (Sept.8 - Sept.26) Rainfall	Total rain-fall	Total irrigation water applied	Total water (rainfall & irrigation) received by treatments
						(mm)						
1	Nat.	99.9	-	61.2	-	112.3	-	102.6	74.6	450.6	-	450.6
2	CCC*	99.9	-	-	-	22.2[1]	25.4[4]	27.2[2]	74.6	223.9	25.4	249.3
3	CCU	99.9	-	-	-	22.2[1]	25.4[5]	102.6	74.6	299.3	25.4	324.7
4	CUC	99.9	-	-	-	112.3	-	27.7[2]	74.6	314.0	-	314.0
5	UCC	99.9	-	61.2	-	22.2[1]	-	27.7[2]	74.6	285.1	-	285.1
6	UCU	99.9	-	61.2	-	22.2[1]	25.4[5]	102.6	74.6	360.5	25.4	385.9
7	UUC	99.9	-	61.2	-	112.3	-	27.2[2]	74.6	375.2	-	375.2
8	CUU	99.9	-	-	-	112.3	25.4[5]	102.6	74.6	389.4	25.4	414.8
9	UUU1	99.9	-	61.2	-	112.3	25.4[5]	102.6	74.6	450.6	25.4	476.0
10	UUU2	99.9	-	61.2	25.4[3]	112.3	25.4[4]	102.6	74.6	450.6	50.8	501.4

[1] Rainfall on July 21 and 22 (22.2 mm) was allowed to fall on these treatments to avoid "carryover" effects from period 1.

[2] Rainfall on August 14 (27.2 mm) was allowed to fall on these treatments to avoid "carryover" effects from period 2.

[3] Irrigated July 18.

[4] Irrigated August 28.

[5] Irrigated August 29.

* C - covered during period denoted
U - uncovered during period denoted.

Table 3. Experimental treatments and amount of rainfall and irrigation water received during the peanut growth periods in 1981, Delhi, Ontario.

Treat-ment #	Abbr. Name	Pre-treatment period (May 20 - June 14) Rainfall	Period 1 (June 13 - July 14) Irr.	Rainf.	Period 2 (July 15 - August 13) Irr.	Rainf.	Period 3 (August 14 - Sept. 10) Irr.	Rainf.	Post-treatment period (Sept.11- Sept.23) Rainfall	Total rain-fall	Total irrigation water applied	Total water (rainfall & irrigation) received by treatments
					(mm)							
1	Nat.	54.0	-	100.6	-	111.0	-	99.5	75.4	440.5	-	440.5
2	CCC*	54.0	-	-	25.4[1]	-	25.4[2]	-	75.4	129.4	50.8	180.2
3	CCU	54.0	-	-	25.4	-	25.4	99.5	75.4	228.9	50.8	279.7
4	CUC	54.0	-	-	25.4	111.0	-	-	75.4	240.4	25.4	265.8
5	UCC	54.0	-	100.6	25.4	-	25.4	-	75.4	230.0	50.8	280.8
6	UCU	54.0	-	100.6	25.4	-	25.4	99.5	75.4	329.5	50.8	380.3
7	UUC	54.0	-	100.6	25.4	111.0	-	-	75.4	341.0	25.4	366.4
8	CUU	54.0	-	-	25.4	111.0	-	99.5	75.4	339.9	25.4	365.3
9	UUU_1	54.0	-	100.6	25.4	111.0	-	99.5	75.4	440.5	25.4	465.9
10	UUU_2	54.0	-	100.6	25.4	111.0	-	99.5	75.4	440.5	25.4	465.9

[1] Irrigation applied July 14 to Treatments 2-10 to avoid "carryover" effects from period 1.

[2] Irrigation applied August 13 to Treatments 2,3,5 and 6 to avoid "carryover" effects from period 2; all other treatments had sufficient rainfall two days prior.

* C - covered during period denoted
U - uncovered during period denoted.

Duncan's New Multiple Range Test

The smallest SMK yields were found for the season-long imposed-drought treatment (#2) in both 1980 and 1981 with 840 and 960 kg/ha, respectively. Treatment 2 yields were significantly below those of the other treatments with the exception of treatments having drought imposed in two consecutive periods (Table 4).

For treatments in which two growth periods had drought imposed, the results indicate that yields were more adversely affected when imposed drought followed in consecutive periods (#3 and 5) than when drought-imposed periods were split (#4). At 1300 kg/ha in 1980, treatment #4 (CUC) yield was not significantly different from those treatments #3 (CCU) and 5 (UCC) (Table 4). However, in 1981, treatment #4 yield, was significantly higher than treatment #3 and 5 yields. These results demonstrated the effect of prolonged drought on yield, and that period 2 (late flowering and pod formation) is likely the most critical in which to avoid moisture stress. The latter is hypothesized to be more important because of the way in which long daylight hours during period 2 in Ontario contribute to overall photosynthetic activity, and therefore to the critical peanut reproductive activities during that period (Table 1). Comparable daylight length on latitude 30°N is 14.1 hours on June 21, 13.9 hours on July 15, 13.2 hours on August 15, and 12.2 hours on September 21 (5).

Support for the above observations can be found in the empirical results of Table 4 by comparing across treatments with a single imposed-drought period [treatments #6 (UCU), 7 (UUC) and 8 (CUU)]. Treatment #6, with drought imposed during period 2 resulted in yields of only 1670 kg/ha (1980) and 1470 kg/ha (1981), compared with yields in the 1900-to-2030 kg/ha range for treatments #7 and 8, with drought imposed in periods 3 and 1, respectively. Although not significantly different, the yield results for the 2 years consistently show that drought is most critical in period 2, and least critical in period 1. These results for Ontario concur with those of other researchers who have found the

Table 4. Sound mature kernel yields[1] of valencia peanuts grown in 1980 and 1981 at Delhi, Ontario, as affected by irrigation/dry spell-imposed treatments.

Treatment #	Abbreviated Name	1980	1981
		(kg/ha)	
1.	Natural	2100 abc[2]	1900 ab
2.	CCC	840 f	960 d
3.	CCU	1250 def	1270 cd
4.	CUC	1300 de	1880 ab
5.	UCC	950 ef	1260 cd
6.	UCU	1670 cd	1470 bc
7.	UUC	1920 bc	1900 ab
8.	CUU	2030 abc	1920 ab
9.	UUU_1	2210 ab	2040 a
10.	UUU_2	2370 a	2010 a

[1] Shelled weight basis, last digit rounded.

[2] Treatments within a column followed by the same letter are not significantly different according to the Duncan's NMRT at the 5% level.

early pegging and pod formation period to be the one in which drought affects yields the most (Pahalwan and Tripathi(8)).

Yields for the natural treatment (#1) were found in both 1980 and 1981 to be not significantly different from those for single-period, imposed-drought treatments (#6, 7 and 8) (Table 4). Similarly, the natural treatment (#1) yields are not significantly different from the yields for either of the supplementary irrigated treatments (#9 and 10). Treatment #1 yields are somewhat lower than those for treatments 9 and 10. Supplementary irrigation apparently had a positive, but non-significant effect on peanut yields, at the application levels shown in Tables 2 and 3.

peanuts were stressed in two growth periods, the yields were significantly different from those when stress occurred in only one growth period.

Further tests revealed that the mean yields obtained when all three growth periods were not stressed were significantly different from those when one or two growth periods were stressed. In 1980, for plots with two imposed-drought periods, it did not matter whether the stress periods were consecutive or separated by an "uncovered" period. Additionally, if in two growth periods adequate soil moisture were available, it did not matter statistically if those periods were consecutive or separated by a imposed-drought period. Tests showed that irrigation did not significantly increase peanut yields over those under natural rainfall conditions for Delhi in 1980.

Table 5. Results of orthogonal comparisons of treatments using SMK (shelled) weight from the 1980 experiment.

Source	DF	Sum of Squares	F Value	Hypothesis Tested	Decision
Treatment	9	645397.22	14.09	$U_1=U_2=U_3=U_4=U_5=U_6=U_7=U_8=U_9=U_{10}$	Rejected
CCC vs Rest	1	169190.72	33.24	$U_2 = U_1+U_3+U_4+U_5+U_6+U_7+U_8+U_9+U_{10})\ /9$	Rejected
CCU CUC UCC vs UCU UUC CUU	1	218027.34	42.83	$(U_3+U_4+U_5)\ /3 = (U_6+U_7+U_8)\ /3$	Rejected
CUC vs CCU UCC	1	11783.80	2.31	$U_4 = (U_3+U_5)\ /2$	Not Rejected
CCU vs UCC	1	2956.81	0.58	$U_3 = U_5$	Not Rejected
UCU vs UUC CUU	1	20504.26	4.03	$U_6 = (U_7+U_8)\ /2$	Not Rejected
UUC vs CUU	1	24.85	0.00	$U_7 = U_8$	Not Rejected
Natural UUU_1 UUU_2 vs Rest Excl CCC	1	217547.07	42.74	$(U_1+U_9+U_{10})\ /3 = (U_3+U_4+U_5+U_6+U_7=U_8)\ /6$	Rejected
Natural vs UUU_1 UUU_2	1	3735.02	0.73	$U_1 = (U_9+U_{10})\ /2$	Not Rejected
UUU_1 vs UUU_2	1	1627.35	0.32	$U_9 = U_{10}$	Not Rejected
Error	30	152714.96			
Corrected Total	39	798112.19			

The hypotheses were tested at the 5% level of significance; tabulated F value at 5% level, 1,30 d.f. = 4.17; 9,30 d.f. = 2.21

Sound mature kernels - those that ride a 0.6 x 1.9 cm oblong screen.

Orthogonal Comparisons

Embellishment of treatment comparisons obtained from applying Duncan's New Multiple Range Test can be provided by using orthogonal comparisons, through being able to compare any particular pair or any subsets of treatments with each other. The comparisons selected for this study are listed under the heading "Source" for 1980 (Table 5) and 1981 (Table 6). The null hypothesis tested in each case is that there is no statistically significant difference between treatments listed on either side of the equals sign. Rejection is based on whether or not the calculated F value exceeded the requisite tabulated F values footnoted in Tables 5 and 6.

The results for 1980 confirmed that moisture stress does affect peanut yields and that the yields obtained when all three growth periods were stressed were significantly different from the mean yields when at least one growth period was not stressed (Table 5). When

Results of the comparisons from the 1981 experimental treatments (Table 6) generally confirmed those for the 1980 treatments, however a number of important differences were observed. For example, 1981 tests indicated that the mean yields obtained when two growth periods were stressed and consecutive were different from those obtained when the two stress periods were separated by an "uncovered" period.

Another difference between the two years' results concerned treatments with a single imposed-drought period. In 1980, it made no difference in which period the drought was imposed, but in 1981, stress in the middle growth period was found to be more important than stress in either of the other periods. This finding concurs with the published literature on the growth period most sensitive to moisture stress for spanish-valencia type peanuts.

Table 6. Results of orthogonal comparisons of treatments using SMK (shelled) weight from the 1981 experiment.

Source	DF	Sum of Squares	F Value	Hypothesis Tested	Decision
Treatment	9	445645.03	5.98	$U_1=U_2=U_3=U_4=U_5=U_6=U_7=U_8=U_9=U_{10}$	Rejected
CCC vs Rest	1	118240.25	22.24	$U_2 = (U_1+U_3+U_4+U_5+U_6+U_7+U_8+U_9+U_{10})\ /9$	Rejected
CCU CUC UCC vs UCU UUC CUU	1	27459.14	5.17	$(U_3+U_4+U_5)\ /3 = (U_6+U_7+U_8)\ /3$	Rejected
CUC vs CCU UCC	1	53751.74	10.11	$U_4 = (U_3+U_5)\ /2$	Rejected
CCU vs UCC	1	8.00	0.00	$U_3 = U_5$	Not Rejected
UCU vs UUC CUU	1	26673.33	5.02	$U_6 = (U_7+U_8)\ /2$	Rejected
UUC vs CUU	1	39.16	0.01	$U_7 = U_8$	Not Rejected
Natural UUU_1 UUU_2 vs Rest Excl CCC	1	57483.10	10.81	$(U_1+U_9+U_{10})\ /3 = (U_3+U_4+U_5+U_6+U_7=U_8)\ /6$	Rejected
Natural vs UUU_1 UUU_2	1	2392.01	0.45	$U_1 = (U_9+U_{10})\ /2$	Not Rejected
UUU_1 vs UUU_2	1	129.61	0.02	$U_9 = U_{10}$	Not Rejected
Error	30	159468.70			
Corrected Total	39	445645.03			

The hypotheses were tested at the 5% level of significance; tabulated F value at 5% level, 1.30 d.f. = 4.17; 9,30 d.f. = 2.21

Sound mature kernels - those that ride a 0.6 x 1.9 cm oblong screen.

Conclusions

The initial belief that moisture stress early in the season would delay flowering and subsequently would result in the greatest yield reduction, was not supported by the empirical evidence. The data corroborated previous findings that moisture stress in late-flowering and early-pod-formation period had the greatest impacts on yields. However, alleviating moisture stress during the above critical period did not produce consistent year-to-year yield results. Factors over and above moisture stress apparently contribute to these variations. Further research is required to delineate these factors.

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Literature Cited

1. Brown, D. M., G. A. McKay and L. J. Chapman. 1968. The climate of southern Ontario. Climatological studies No. 5, Atmospheric Environment Service, Environment Canada, Downsview. Reprinted 1980.
2. Brown, F. M. and Wm. D. Wyllie. 1984. Growing season: dry spells in southern Ontario. Climatology Bulletin 18 (1):15-30.
3. Boote, K. J. and L. C. Hammond. 1981. Effect of drought on vegetation and reproductive development of peanut. Proc. Am. Peanut Res. Educ. Soc. 13:86. (Abstract).
4. Canadian Soil Survey Committee. 1978. Canadian system of soil classification. Publication No. 1646. Agriculture Canada, Ottawa.
5. Environment Canada, Atmospheric Environment Service. 1982. Canadian Climate Normals, 1951-80. Ottawa, Ontario.
6. Klepper, B. 1973. Water relations of peanut plants. p. 265-269. In: Peanut Culture and Uses. Amer. Peanut Res. and Educ. Assoc. Stillwater, Oklahoma.
7. Martin, C. K. and F. R. Cox. 1977. Effect of water stress at different stages of growth on peanut yields. Proc. Am. Peanut Res. Educ. Assoc. 9:91. (Abstract).
8. Pahalwan, D. K. and R. S. Tripathi. 1984. Irrigation scheduling based on evaporation and crop requirements for summer peanuts. Peanut Sci. 11:4-6.
9. Pallas, J. E. Jr., J. R. Stansell and T. J. Koske. 1977. Plant soil water relations of Florunner peanuts under drought conditions. Proc. Am. Peanut Res. Educ. Assoc. 9:89. (Abstract).
10. Pallas, J. E., Jr., J. R. Stansell and T. J. Koske. 1979. Effects of drought of Florunner peanuts. Agron. J. 71:853-858.
11. Reddy, V. M., J. W. Tanner, R. C. Roy and J. M. Elliot. 1981. The effects of irrigation, inoculants and fertilizer nitrogen on peanuts *Arachis hypogaea* L.). II. Yield. Peanut Sci. 8:125-128.
12. Sanderson, M. 1959. Moisture relations in Ontario. Scientific Agriculture. 30(6):235-55.
13. Snedecor, G. W. and W. G. Cochran. 1980. Statistical Methods 7th edition. The Iowa State University Press. Ames, Iowa.
14. Soil Survey Staff. 1975. Soil taxonomy. Agricultural Handbook No. 436. Soil Conservation Service, United States Department of Agriculture, Washington, D.C.
15. Stansell, J. R. and J. E. Pallas, Jr. 1985. Yield and quality response of Florunner peanut to applied drought at several growth stages. Peanut Sci. 12:70-72.
16. United States Department of Agriculture. 1972. Farmers' Stock Peanuts Inspection Instructions. Agricultural Marketing Service, Washington, D.C.

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