nificantly increased in tops and roots of the citrus seedlings supplied with low concentrations of soil oxygen. The roots in general contained significantly higher concentrations of zinc and copper than the tops. Manganese concentration was higher in the roots of plants grown in the two lower oxygen treatments, and was highest in the tops of plants grown in the lowest treatment. This increase in manganese concentration in the roots of plants supplied with low soil-oxygen levels is perhaps due to the fact that in poorly aerated soils, there is an increase in soluble manganese ions due to reduction from manganic to the more readily available manganous manganese. Boron concentration in the tops of plants decreased slightly with decreasing soil-oxygen supply to the roots. Tops of the citrus seedlings contained higher boron concentrations than the roots. Translocation of this nutrient from roots to tops does not seem to be dependent on oxygen.

Iron concentration in the roots of the seedlings was not affected by differential levels of soil-oxygen supply. The reason may be that, regardless of how carefully roots are cleaned, there always is some doubt that all soil particles have been removed from the feeder roots. Iron concentration in the tops of the seedlings decreased with a decreasing soil-oxygen supply. In general, the roots contained 20 times higher iron concentration than the tops. However, concentrations of nutrients in vegetative parts of plants do not always represent a true picture of nutrient uptake and translocation as influenced by soil-oxygen supply, particularly if the total amount of dry weight of plant is affected.

TABLE 1.—INFLUENCE OF OXYGEN DIFFUSION RATES ON DRY WEIGHT AND NUTRIENT CONCENTRATIONS IN DRY MATTER OF TOPS AND ROOTS OF CITRUS SEEDLINGS

Unit			Soil-oxygen treatments Per cent of oxygen in the gas[a] 21	1.8	0	F	C.V. %
Dry wt./grs.		tops	16.60b	17.10b	11.00a	**	17
		roots	10.30c	7.60b	4.10a	**	16
%	N	tops	2.13b	1.84a	1.75a	**	8
		roots	1.79b	1.84b	1.58a	**	9
%	P	tops	.10b	.09ab	.08a	**	4
		roots	.08	.07	.08	NS	8
%	K	tops	1.45b	1.15a	1.29ab	**	8
		roots	1.71b	1.79b	.80a	**	17
%	Ca	tops	2.21b	1.87a	1.88a	**	3
		roots	.56ab	.50a	.62b	**	11
%	Mg	tops	.17b	.14a	.17b	**	7
		roots	.17b	.15b	.14a	**	9
ppm	Zn	tops	12	14	14	NS	42
		roots	28	30	27	NS	15
ppm	Cu	tops	8a	12a	25b	**	
		roots	18a	18a	22b	*	
ppm	Mn	tops	32a	27a	43b	**	16
		roots	208a	292b	254ab	**	18
ppm	B	tops	39b	35a	35a	*	6
		roots	15	14	13	NS	16
ppm	Fe	tops	83b	60a	69ab	**	15
		roots	1523	1370	1594	NS	16

[a] Each value is a mean of 8 internal replications obtained in each of 2 sampling dates. Subscript letters a, b, and c after values indicate statistical populations. Mean values are statistically significant from each other only if they do not have a common subscript letter in a column. (Read horizontally.)
* = F value significant at the 5% level.
** = F value significant at the 1% level.
NS indicates that differences between means are not significant.
C.V.—coefficient of variability expressed in per cent.

TABLE 2.—INFLUENCE OF SOIL-OXYGEN ON TOTAL DRY WEIGHT AND TOTAL NUTRIENT CONTENT IN CITRUS SEEDLING

Unit per plant		Soil-oxygen partial Pressures in flowing gas[a] 21	1.8	0	F	C.V.%
Dry wt. g.		27y	25y	15x	**	9
mg.	N	536z	451y	254x	**	14
mg.	P	25y	21y	12x	**	16
mg.	K	420y	340y	175x	**	16
mg.	Ca	422y	350y	224x	**	16
mg.	Mg	46z	36y	24x	**	16
mg.	Cl	91y	77y	58x	**	15
mg.	Na	18xy	22y	15x	**	29
mg.	Zn	0.50y	0.44xy	.25x	**	31
mg.	Cu	0.28y	0.22xy	.16x	**	33
mg.	Mn	2.67y	2.64y	1.52x	**	20
mg.	B	0.80y	0.71y	0.43x	**	16
mg.	Fe	17.29y	11.60x	7.42x	**	22

[a] Each value is a mean of 8 internal replications obtained on each of 2 sampling dates. Letters x, y, and z after values indicate statistical populations. Mean values are statistically significant from each other only if they do not have a common subscript letter in a column. (Read horizontally.)
** = F value significant at the 1% level or more.
C.V. is coefficient of variability expressed in per cent.

Nutrient comparisons

The absolute amounts of nutrients were calculated in the whole plant for comparison with concentrations of the same nutrients found in tops and roots of citrus seedling plants. Data presented in table 1 show that soil aeration has a substantial influence on the dry weight and nutrient concentrations in the tops and roots of citrus seedlings. The concentrations of nitrogen, phosphorus, potassium, calcium, magnesium, boron, and iron decreased while sodium, chloride, manganese, and copper increased in the tops of citrus seedlings with decreasing soil-oxygen supply to the roots.

The decreasing soil-oxygen supply decreased dry weight of roots, nitrogen, potassium, magnesium, chloride, sodium, and increased calcium, copper, and manganese concentrations in the roots. However, the data presented in table 2 show that the absolute amounts of nitrogen, phosphorus, potassium, calcium, magnesium, chloride, sodium, zinc, copper, manganese, boron, and iron decreased in the citrus seedlings with decreasing soil-oxygen supply to the roots.

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Live Performance Carcass Trait Of Crossbred Hereford and

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Angus bulls generally produced smaller but meatier and higher-conditioned animals with more palatable meat than did Hereford bulls in these limited comparisons of crossbreds with each of the breeds separately (using four presumably representative bulls of each breed).

THIS TESTING PROGRAM is aimed at determining the amount of hybrid vigor or hybrid advantage resulting from crosses of the British beef breeds under temperate climatic conditions. Experiments reported here are being conducted at the University of California, Davis, but similar tests are also in progress at several other state and federal experiment stations including: Fort Robinson, Nebraska; Miles City, Montana; and Front Royal, Virginia. Results of all the current experiments are expected to be compiled in about five years; it is hoped that they can be used by cattlemen and the industry as a whole to better evaluate the relative costs and expected returns from crossbreeding as compared with grading up, or straightbreeding.

This experiment was designed to compare the average performance of the reciprocal crossbred calves, Hereford × Angus and Angus × Hereford, with the performance of the straightbred calves averaged over both breeds. This design has the virtue that each bull contributes both crossbred and straightbred offspring to the comparisons. Thus the effect of non-

and Comparisons with Straightbred Angus Calves

F. D. CARROLL

ESTIMATES OF HYBRID VIGOR OR HYBRID ADVANTAGE IN LIVE ANIMAL AND CARCASS TRAITS

Trait	Average (A)	Measure of hybrid advantage (C)[a]	Standard error (C)[b]	C/A%
Initial weight on feed (lb.)	599	41	10	6.8
Feeder fleshing score[f]	2.82	.23	.12	8.2
Average daily gain (lb.)	2.26	.08	.06	3.5
Final weight (lb.)	901	52	13	5.8
Efficiency of feed utilization (lb. feed/lb. gain)	8.30	.14	.16	1.7
Hot carcass weight (lb.)	554	37	9	6.7
Percent fat in carcass	23.1	1.5	.5	6.5
Marbling score	5.63	–.06	.15	–1.1
USDA carcass grade	18.9[c]	.51	.22	2.7
Cuttability[d]	50.6	–.45	.24	–.9
Fat thickness over rib eye (in.)	.386	.071	.028	18.4
Kidney fat[e]	2.05	.05	.10	2.4
Rib eye area (sq. in.)	10.9	.43	.20	3.9

[a] If positive, crossbreds exceed straightbreds.
[b] Based on 75 d.f.
[c] *Coded so that choice = 20, low choice = 19, high good = 18, good = 17, etc.*
[d] An estimate, after the USDA dual grading formula, of the per cent of carcass weight in boneless, closely trimmed retail cuts from round, loin, rib and chuck.
[e] Coded so that 1 = below normal, 2 = normal, 3 = above normal.
[f] 2 = slightly thin, 3 = average.

representative quality differences between the bulls of the two breeds (the Hereford bulls used being better than Hereford bulls in general and the Angus bulls being poorer than Angus bulls in general, or vice versa) does not become confused with the comparison of the results of crossbreeding with straightbreeding as such.

Calf crops in two consecutive years were produced in two cooperator range herds, one of Angus and the other of Hereford breeding. The calves were brought to Davis at weaning (eight months of age). Data on growth, feed efficiency, carcass and meat quality traits were obtained and are presented in the table.

Heavier carcass

The table shows crossbred superiority in heavier carcass weights. This is due not only to higher finish but also to a greater amount of lean meat, if rib eye area is taken as an indicator. Since cuttability grade is lower for the crossbreds than for the straightbreds—despite the larger rib eyes in the crossbreds—it would appear that the crossbreds are penalized for being overly fat. If the crossbreds had been marketed at the same weight as the straightbreds, this would have occurred about 24 days earlier (estimate obtained by dividing the average daily gain of crossbreds in feedlot into weight difference between crossbreds and straightbreds). The crossbreds would not have been in as high condition, but would have had a higher cuttability and would have consumed less feed in the feedlot.

A simple approximate calculation can be made on feed consumption: for the two years in which animals were fed, the average length of time in the feedlot was 140 days. Within year and sex, each animal was fed for the same period. The ratio of the hypothetical decrease of time of the crossbreds in the feedlot to the times actually fed is 24×100 divided by 140 which equals 17%, the percentage decrease in feed consumed in the feedlot to produce crossbreds of the same market weight (and presumably at least as high a finish as the straightbreds). This decrease would represent about 440 pounds of feed (80% concentrates) per animal.

Taste panel

A taste panel judging tenderness, juiciness, and flavor found no significant differences in comparing ribs, rounds, and steaks from crossbred carcasses with those from straightbred carcasses. In comparing the crossbreds with each breed separately, there is a possibility of bias in this type of experiment since the few bulls used might not adequately represent their respective breeds. This limitation should be borne in mind in evaluating the following summary statements:

For initial weight on feed, slaughter weight, carcass weight, percentage of fat in the carcass, fat thickness over the rib eye and rib eye area, the crossbreds exceeded the straightbreds of each breed separately. For the liveweights and carcass weight, the crossbreds exceeded the Angus more than they exceeded the Herefords, while for percentage of fat in the carcass and rib eye area, the reverse was true. Each breed had a higher cuttability than the crossbreds, with the Herefords exceeding the crossbreds more than did the Angus (once again the interpretation is that this is related to differences in condition). The crossbreds exceeded the Herefords and equaled the Angus in feeder grade. For amount of kidney fat, marbling, and carcass grade, the Angus exceeded the crossbreds, but the crossbreds exceeded the Herefords.

Taste panel results indicated that for ribs, the Angus exceeded the crossbreds in tenderness and juiciness with flavor a standoff, and the crossbreds exceeded the Herefords in tenderness, juiciness, and flavor. For rounds, there was no definite pattern of results. For steaks, the Angus tended to exceed the crossbreds in tenderness, juiciness, and flavor, with the crossbreds and Herefords being about equal.

In these comparisons of crossbreds with each of the breeds separately, the overall pattern suggests that the Angus bulls generally produced smaller but meatier and higher conditioned animals with more palatable meat than did the Hereford bulls.

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