UNIVERSITY OF CALIFORNIA
SIERRA FOOTHILL RANGE
FIELD STATION
BEEF & RANGE FIELD DAY

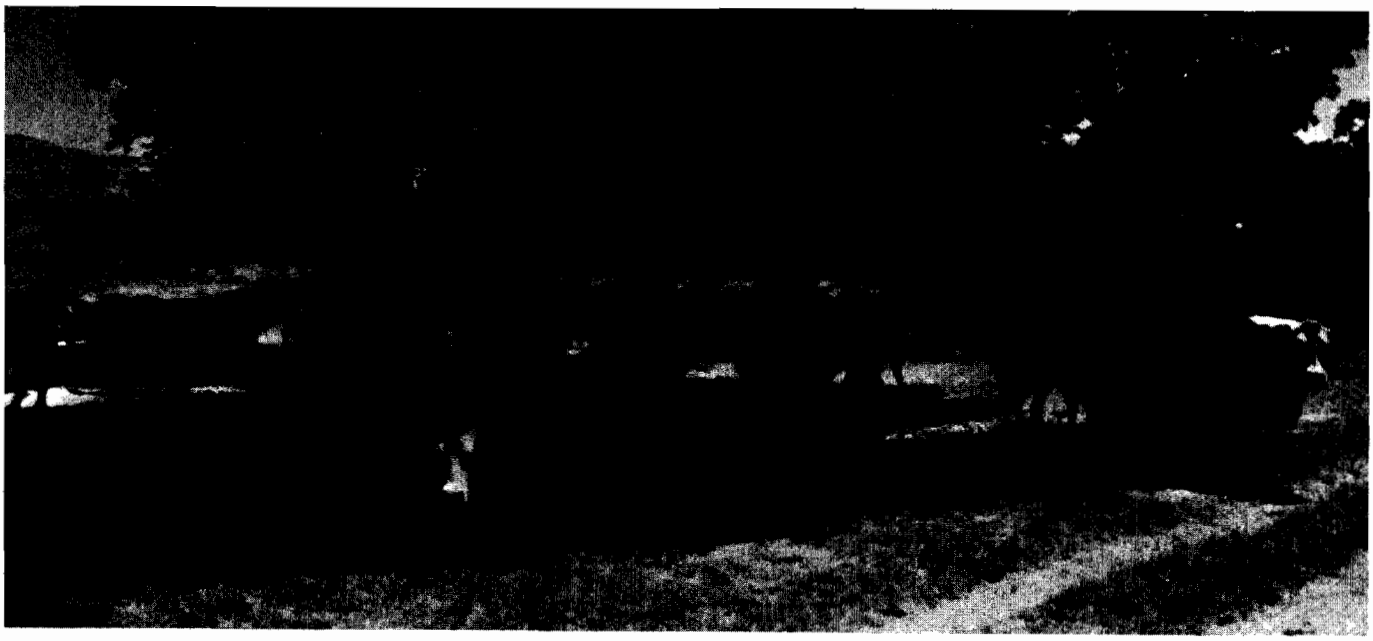

Photo by C.A. Raguse

APRIL 21, 1988
BROWNS VALLEY, CALIFORNIA

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Sierra Foothill Range Field Station Field Day
April 21, 1988

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BYPASS PROTEIN FOR GROWING RANGE CALVES

J. R. Dunbar, J. M. Connor, C. B. Wilson,
C. A. Raguse, T. R. Famula, C. A. Daley and M. R. George

Introduction

The ruminant animal has a unique symbiotic relationship with a wide variety of anaerobic bacteria, protozoa, and even fungi that thrive in the rumen. This relationship allows the ruminant animal to use large quantities of fibrous feeds and a variety of non-protein nitrogen compounds that are of little nutritional value to nonruminant animals.

Approximately 75-85% of the carbohydrates digested by ruminants is fermented by microbes in the rumen. During fermentation, volatile fatty acids, ammonia, methane and CO_2 are released and energy is produced for microbial growth and multiplication.

Bacteria are the most active microbes in protein digestion and the synthesis of microbial proteins. Bacteria breakdown dietary protein in the rumen to simpler nitrogen compounds like ammonia, amino acids, and peptides, and incorporate these materials into cellular protein. Ammonia also is derived from dietary nonprotein (NPN) sources such as urea. Ammonia is the nitrogen preferred by bacteria in the rumen for cellular protein synthesis.

Dietary protein is either digested to a variable degree in the rumen or escapes undegraded and passes to the omasum and abomasum (NRC, 1984). If it is not digested in the rumen, it is described as bypass or escape protein. Bypass protein is digested either postruminally or excreted in the feces. The supply of protein to the small intestine is the sum of the dietary protein that escapes or bypasses ruminal degradation and the microbial protein synthesized within the rumen.

After the rumen becomes functional, the protein needs are two-fold: 1) The need for nitrogen for microbial fermentation in the reticulo rumen and 2) the need for postruminal amino acids for tissue of the host ruminant.

Increased bypass or escape protein does not ensure increased animal production since:

1) Bypass protein may be poorly digested in the small intestine.

2) The balance of amino acids in the postruminal protein may be poor.

3) Energy supply or other nutrients may limit production.

California annual rangeland pasture is generally of poor quality in the fall and in short supply during the winter months. To correct these deficiencies, supplemental nutrients are typically provided to wintering calves in the latter portion of the dry season (July to October) and the inadequate green season (October to February) to maintain adequate performance.

Supplemental nutrients may be provided in many forms; the most common being meals, liquids, and blocks. Supplements are usually high in nonprotein nitrogen which aids fiber digestion and microbial synthesis. However, in many situations the protein requirements of growing calves may not be met. Calves fed supplements that contain bypass protein may gain weight faster and more economically compared to cattle supplemented with urea (Klopfenstein and Goedeken, 1985).

In the past few years liquid supplements have been based on urea and molasses. Now xanthan gums and clay are being used to suspend small particles such as minerals, natural protein supplements, and other desirable materials in liquid supplements.

Materials and Methods

Because of the potential need of bypass protein in supplements for stocker calves on annual grasslands, a study was undertaken to evaluate liquid supplements as outlined in Table 1.

Table 1. Experimental design.

	Animal Treatment	
Treatment Groups	Low Stocking Density	High Stocking Density
Control	6	12
Liquid Supplements, Urea	6	12
Liquid Supplements, Bypass Protein	6	12
Liquid Supplements, Urea plus Bypass Protein	6	12

One hundred forty-four English-bred steers averaging 496 pounds were used in the study. Commercially-formulated liquid supplement mixtures containing urea, bypass protein, and urea plus bypass protein were used in the study. Corn gluten meal was the bypass protein used in the study. Superimposed on supplemental treatment were two levels of stocking density. Six steers were randomly assigned to low stocking rate (5.33 acres/steer) and 12 steers were assigned to the high stocking density (2.67 acres/steer). The experimental range was divided into 4 blocks of 4 fields per block and experimental animals were rotated to a new field every weigh day (approximately every 28 days). Supplement tanks were checked weekly and consumption measured. Supplements were fed at the rate of 2 pounds per head daily.

Results

Initially the supplements were not consumed at the desired level. It required considerable effort and patience on the part of the UC Sierra Field Station staff to get the calves to eat the supplements. The all urea-based supplement was the least palatable of all the supplements (Table 2). Some severe settling problems occurred in the lick storage tank containing the all-bypass protein supplement. This problem was corrected by improved mixing techniques in later batches. During the initial phases of the trial, the bypass plus urea supplement was consumed at levels higher

than desired. Therefore, only enough supplement was placed in the tank each week to allow a daily consumption of 2 pounds per head.

Stocking density had no significant effect on supplement consumption, but had a highly significant effect ($P < 0.0001$) on average daily gain. Cattle in the heavily stocked pastures gained 0.63 lb per day compared to 0.93 in the moderately grazed fields.

Table 2. Supplement consumption (pounds per head per day).

Item	Consumption
Urea	1.50[a]
Bypass Protein	1.88[b]
Bypass + Urea	2.03[b]

[a,b] Means in the same column with different letters are significantly different ($P < 0.05$).

Performance of the steers during the supplemental feeding period is summarized in Table 3. The rate of gain was significantly higher ($P < 0.05$) for the bypass plus urea treatment than all other treatments. This level indicates that NPN may have been needed to maintain adequate ruminal ammonia levels for microbial protein synthesis.

Table 3. Supplementation of growing calves (average daily gain in pounds).

Supplement	ADG
Control	.59[a]
Urea	.68[ab]
Bypass	.74[b]
Urea + Bypass	.91[c]

[a,b,c] Means in the same column with different letters are significantly different ($P < 0.05$).

Average daily gain by month was significantly ($P < 0.0001$) different from each other (Table 4).

Table 4. Average daily gain by month.

Month	ADG
November	.86[a]
December	.55[b]
January	.33[c]
February	1.37[d]

[a,b,c,d] Means in the same column with different letters are significantly different ($P < 0.0001$).

Tables 5 and 6 show the overall performance and economics of the experiment.

Table 5. Performance of supplemental calves.

	Control	Urea	Bypass	Urea + Bypass
Initial Weight (lb)	494	499	496	494
Final Weight (lb)	561	576	581	598
Total Gain (lb)	67	77	85	104
Daily Gain (lb)	.59	.68	.75	.91
Daily Supplement Consumption (lb)	--	1.50	1.88	2.03
Lb Supplement/ lb Gain	---	2.21	2.51	2.23

Table 6. Economics of supplemental calves.

	Control	Urea	Bypass	Urea + Bypass
Gain Value $/hd	57	66	72	88
Supplement Consumption lb/hd	--	171	214	231
Cost of Supplement $/hd	--	12	21	22
Profit over Supplement Cost $/hd	57	54	51	66

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a Price of calves valued at $85/cwt

b Urea supplement $136.60, bypass supplement $195.80, and urea/bypass supplement at $193.20 per ton.

Calves consumed more supplement and gained more weight in the urea and corn gluten meal mix group than the other supplement groups. They also returned the most profit over supplement cost per dollar per head.

Conclusions

A 114-day supplemental feeding trial involving a total of 144 English-bred steers averaging 496 pounds was conducted to evaluate urea, bypass protein, and urea plus bypass as range supplements. The urea-based supplement appeared not to be as palatable as the bypass and urea plus bypass supplements. The major bypass ingredient in the bypass and bypass plus urea supplements was corn gluten meal. Steers consuming the bypass plus urea supplement gained the most weight and returned more dollars over supplement cost.

The low palatability of the urea based supplements was indicated by the reduced intake and average daily gain.

Data from this study indicates that bypass proteins can be successfully suspended in liquid supplement. Variations in calf performance is probably a reflection of the amounts of consumed supplements from the lick tank. In the initial phases of the study, intake from the lick tank was not consistent and varied from field to field.

The experimental animals involved in this study may exhibit compensatory growth during subsequent growth and finishing which may cancel the gains made during the supplemental feeding period.

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BODY CONDITION SCORING BEEF COWS

ROGER INGRAM, JOHN DUNBAR, BOB WILLOUGHBY,
CHUCK WILSON, AND MIKE CONNER

People often ask themselves, "Are we doing things right?" Management expert Peter Drucker says the more important question is, "Are we doing the right things?" In today's world, cattlemen need to spend the majority of their time doing the right things. One of these things is utilizing body condition scoring techniques to determine nutritional status of the cow.

Body condition is a more reliable guide for evaluating nutritional status than live weight. Live weight is sometimes mistakenly used as an indication of body condition and fat reserves, but gut fill and the products of pregnancy prevent weight from being an accurate indicator of condition. Two animals can have markedly different live weights and have similar body condition scores. Conversely, animals of similar live weight may differ in condition score. One example would be an 1100 pound cow. This cow may actually be a 1000 pound animal carrying an extra 100 pounds of body reserves, or a 1200 pound cow which has lost 100 pounds of body reserves. These two animals would differ markedly in both biological and economic responses if they were put on the same management and feeding regime.

As a practical tool, body condition scoring is easy to learn and useful when practiced by the same person in the same herd over several years. An important guideline is to keep the program simple. A thin cow looks very sharp, angular, and skinny. On the other hand, a fat cow looks smooth, boxy, and has its bone structure hidden from sight or feel. All others will fall somewhat in between. A description of body condition scores is given in Table 1.

Condition is assessed by feeling with finger pressure along the top, and side of the backbone, in the loin area immediately behind the last rib and above the kidneys. Figure 1 illustrates the important handling points which are assessed in the following order:

1. The sharpness or roundness of the spinous processes of the lumbar vertebrae (the bone protruding from each side of the backbone).

2. The prominence and degrees of cover of the transverse processes of the vertebrae (the bone protruding from each side of the backbone).

3. The extent of muscular and fatty tissues underneath the transverse processes (judged by the ease with which the fingers pass under the ends of the bones).

4. The fullness and fat cover of the eye muscle (judged by pressing between the spinous and transverse processes).

TABLE 1. DESCRIPTION OF BODY CONDITION SCORES.

1.	Very Thin	Bone structure of shoulder, ribs, back, hooks and pins sharp to touch and easily visible. Little evidence of fat deposits or muscling.
2.	Thin	Beginning of fat cover over the loin, back, and foreribs. Backbone still highly visible. Processes of the spine can be identified individually by touch and may still be visible. Spaces between the processes are less pronounced.
3.	Normal	12th and 13th ribs not visible to the eye unless animal has been shrunk. The transverse spinous processes can only be felt with firm pressure to feel rounded - not noticeable to the eye. Spaces between the processes are not visible and only distinguishable with firm pressure. Areas on each side of the tail head are fairly well filled but not mounded.
4.	Fat	Ends of the spinous processes can only be felt with very firm pressure. Spaces between processes can barely be distinguished at all. Abundant fat cover on either side of tail head with some patchiness evident.
5.	Very Fat	Bone structure not seen or easily felt. Tail head buried in fat. Animal's mobility may actually be impaired by excess amount of fat.

It is recommended that cattle be assessed to the nearest half score. So the range becomes 1, 1-1/2, 2, 2-1/2, 3, 3-1/2, 4, 4-1/2 and 5.

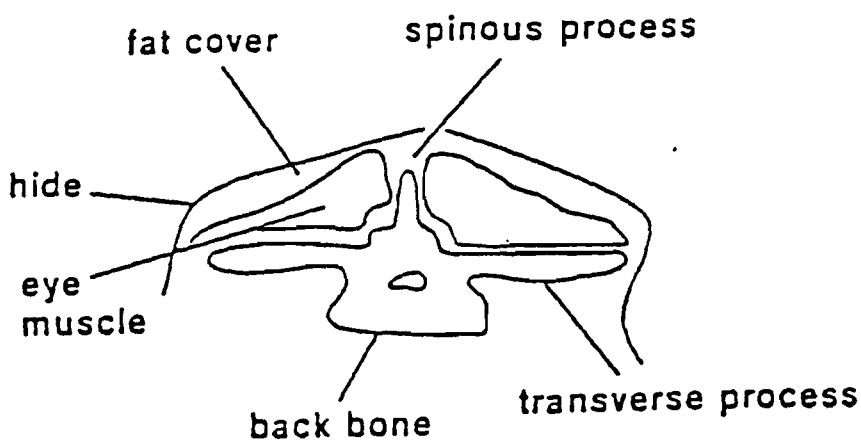

FIGURE 1. CROSS SECTION THROUGH LUMBER REGION.

There is controversy about whether one needs to feel the cattle to determine fatness, or simply look at them to assess condition scores. For cattle with long hair, handling is probably not necessary. You should keep in mind that shrink can alter looks and feel of cattle as much as one score. Animals in late pregnancy also tend to look fuller and fatter.

One can utilize information derived from body condition scoring to plan a supplemental feeding program for your cows. This plan will enable your cows to be maintained in satisfactory condition for optimum performance at calving and breeding. Body condition scores do not have any implications as to quality or merit. Any cow would vary in condition over the scoring range depending on health, lactational status, and feed supply.

Nutritional status of the cow can have a direct effect on calving interval (period from the birth of one calf to the next). In order to have a 12 month calving interval, a cow must rebreed within 80 days after the birth of her calf. Table 2 illustrates the effect condition can have on calving interval.

In Trial 1, the percent of cows that had been in heat within 80 days after calving was lower for cows with a body condition of 2+ or lower. A much higher percentage came into heat with a body condition score of 3 or higher.

Low body condition can lead to low pregnancy rates as evidenced in the other four trials. In all instances, cows scoring less than 3 at calving time had the lowest pregnancy rates indicating that thin condition at calving time is undesirable.

Nutrition and reproduction decisions, so important to profitibility, are made with more precision and accuracy where a body condition scoring system is routinely used. Today's cattlemen must use available management tools in order to say, "We are doing the right things."

TABLE 2. Effect of body condition at calving on subsequent reproductive performance.

	Body Condition at Calving		
	2+ or less	3	3+ or more
Trial 1			
Number of cows	272	364	50
Percent in heat within 80 days after calving	62	88	98
Trial 2			
Number of cows	78	10	0
Percent pregnant after 60 days	69	80	--
Trial 3			
Number of cows	25	139	23
Percent pregnant after 60 days	24	60	87
Trial 4			
Number of cows	32	60	32
Percent pregnant after 180 days	12	50	90
Trial 5			
Number of cows	168	274	197
Percent pregnant after 60 days	70	90	92

Adapted from Whitman, 1975 (Trial 1) and Sprott, 1985 (Trials 2-5)

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Herd, D.B. and L.R. Sprott. 1986. Body Condition, Nutrition & Reproduction of Beef Cows. Texas Agricultural Extension Service, B1526.

Most of the material in the text was derived from the above publication. This can be ordered by writing to:

Texas Agricultural Extension Service
Department of Agricultural Commission
Room 101, Reed Mc Donald Building
TAMU
College Station, Texas 77843

Single copy price is .40 cents (includes postage)
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THE EFFECT OF PELVIC AREA ON CALVING DIFFICULTY IN BEEF HEIFERS

S.L. Berry, J.M. Connor, C.B. Wilson, C. Daley

Recent research indicates that calf mortality in beef heifers was 6.7% over a 14 year period at Miles City, Montana, and that a majority (61%) of the calf mortality during the first 3 days were due to calving difficulty (Bellows, 1984). The two most important factors influencing dystocia (calving difficulty) in that study were calf birth weight and pelvic area (Figure 1). Most dystocia, especially in heifers, is due to a disproportion between the size of the calf and the birth canal. Other studies indicated a medium to high heritability for pelvic area (Green et al., 1986; Morrison et al., 1985a) and a negative relationship between dystocia and pelvic area in heifers (Bellows et al., 1971; Morrison et al., 1985ab; Rice and Wiltbank, 1972). These studies would suggest that heifers could be selected for larger pelvic area at breeding without an undue increase in body size. The rationale being that if heifers had a larger pelvic area they should experience less dystocia, hence lower calf mortality.

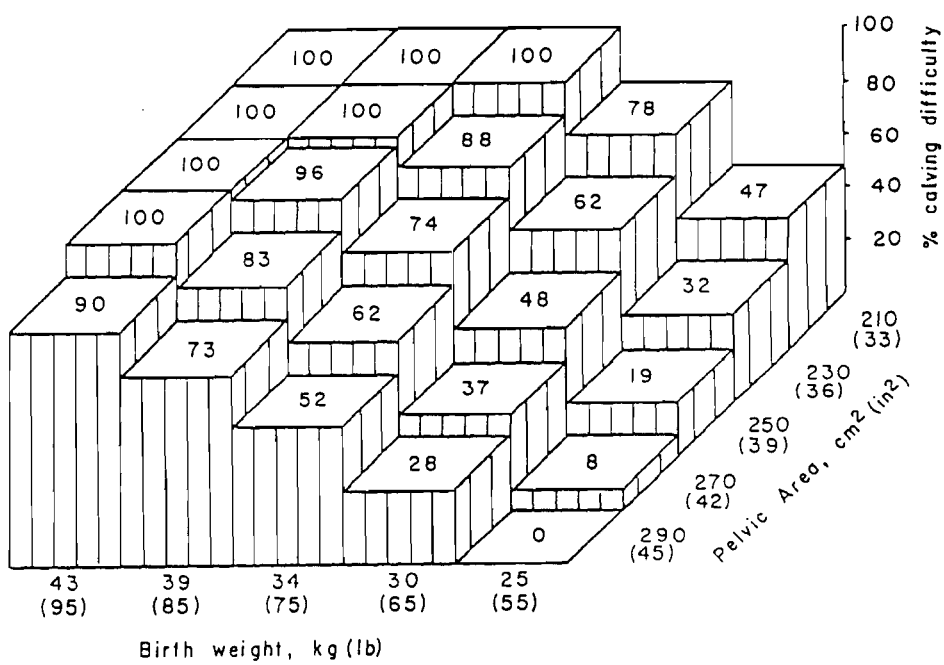

Figure 1. Relationships among pelvic area, birth weight and percent calving difficulty (Bellows, 1984).

The present study was undertaken as part of a heifer management trial that involves crossbreeding Hereford heifers with Angus, Gelbvieh and Longhorn sires. The objective of measuring pelvic areas was to ascertain whether pelvic measurements taken at

different times had any relationship to the incidence of dystocia. Heifers were measured prior to breeding, at pregnancy check (~50 days post breeding), and at approximately 7 months of pregnancy. Heifers were bred for 60 days. In 1987, 101 heifers were exposed to bulls, of which, 72 calved. Pelvic opening measurements were taken via rectally using a Rice pelvimeter (Lane Manufacturing, CO). Height and width measurements were multiplied together to estimate the pelvic area in square centimeters. Heifers were weighed at the same time pelvic measurements were taken (Table 1). The heifers were gaining adequate weight during breeding and gestation.

Table 1. Average weight and pelvic areas of heifers

Time	Weight (lbs)	Pelvic area (cm^2)
Pre-breeding	672	192
Pregnancy check	748	218
7 months pregnant	911	246
Precalving	925	---

Calving data have been collected for the 2nd year of the project (1987) and are being analyzed. Preliminary analysis indicates that there is no relationship of heifer body weight or pelvic area to calving difficulty at any of the times measured during this year of the trial (Table 2). The same results were noted during the 1986 calving season. Thus far, our results would indicate that heifer weight and/or pelvic area were poor predictors of dystocia in these heifers. This is in disagreement with other studies (Bellows,1984; Bellows et al., 1971; Morrison et al., 1985ab; Rice and Wiltbank, 1972). This study involved only yearling heifers which were adequate size and body condition for breeding and should have had adequate pelvic size and yet these heifers experienced 28% dystocia in 1987 (27% in 1986).

Table 2. Weights and pelvic areas of heifers experiencing different degrees of calving difficulty

Calving difficulty	Prebreeding		Pregnancy check		Late gestation	
	Wt (lbs)	Area (cm^2)	Wt (lbs)	Area (cm^2)	Wt (lbs)	Area (cm^2)
None	671	193	750	219	915	246
Easy assist	678	181	734	210	871	237
Moderate to severe	670	191	743	217	905	249

Further analysis revealed that calf birth weight had a strong association with dystocia (Table 3). Dystocia may also have been associated with individual sires (Table 4), sire breeds (Table 5), and sex of calf (Table 6) probably due to increased birth weights. A positive association of perinatal calf mortality with dystocia was also noted (Table 7).

Table 3. Effect of calf birth weight on dystocia

Dystocia	N	Birth weight
No difficulty	52	65.6
Easy assistance	2	64.3
Moderate to severe	16	78.5

Table 4. Effect of sire on dystocia score

Bull*	N	Dystocia score
A197	5	1.4
A199	7	1.1
A9	15	1.5
G103	6	2.7
G402	10	1.8
G413	4	1.5
L15	11	1.1
L443	10	1.3
L449	3	1.0
Average	71	1.5

*A = Angus, G = Gelbvieh, L = Longhorn

Table 5. Effect of sire breed on dystocia score

Breed of sire	N	Dystocia score*
Angus	27	1.4
Gelbvieh	20	2.0
Longhorn	24	1.2
Average	71	1.5

*Dystocia score: 1 = no assistance; 2 = assistance given, easy pull; 3 = assistance given, moderate to severe.

Table 6. Effect of sex of calf on dystocia score

Sex of calf	N	Dystocia score*
Bull	31	1.8
Heifer	40	1.3
Average	71	1.5

*See Table 5

Table 7. Effect of dystocia on calf livability

Calf livability	N	Dystocia score*
Alive	64	1.4
Dead by 72 hours	3	3.0
Dead at birth	6	2.7

*See Table 5

The data collected during the last two years would indicate thus far that selecting heifers based on pelvic area would serve no purpose in preventing dystocia but that selecting bulls (or breeds) that are known to sire calves with low birth weights would result in a lower incidence of dystocia.

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"TRICH", A VENEREAL ABORTION DISEASE OF CATTLE

Ben B. Norman, DVM, Ph.D

Extension Veterinarian, UCD

Without a calf to sell the rancher can not long stay in business. Of the many things causing poor calf crops there is one disease that recently has caused much concern in California.... trichomoniasis. Just as ranchers have learned to manage for other abortion diseases such as brucellosis, vibriosis and foot hill abortion, knowing the details about "trich" will provide some options for controlling this disease, too.

During the past 4 years Dr. Robert BonDurant and co-workers at the University of California, Davis, School of Veterinary Medicine have been heavily involved with research work in bovine trichomoniasis. The work has concentrated mainly in beef cattle, although some studies involving dairy cattle have been done as well. As of this writing, trichomoniasis has been diagnosed in at least 22 counties in California, with many counties still untested.

Trichomoniasis is a veneral disease, caused by the protozoan, Tritrichomonas foetus, and is spread at the time of breeding from the bull to the cow. Neither the bull nor the cow shows any significant signs of illness, and so the disease is usually undetected until it has wreaked havoc with the reproduction program in a herd. In most cases, the organism does not prevent conception following breeding, but rather kills the embryo at some early stage in its development. The net effect is that the cow that one thinks is pregnant returns to estrus at some time either late in the breeding season or after the breeding season is over. The economic effects of trichomoniasis are not precisely quantified but are devastating none the less. A California study in 1986 determined that when trichomoniasis infects a dairy herd, it costs as much as $600 or more per infected cow.

Resolutions from Northern California county Cattlemen's Associations have caused CCA and NCA to lobby for research funds for trichomoniasis. This has been successful both at the state and national level.

The efforts at UC Davis have been generally directed toward developing better diagnostic tests for this disease. Currently, the "gold standard" for diagnosis of trichomoniasis is the culture of either smegma from the sheath of the bull or mucus from the vagina of the cow. Work at UC Davis has shown that, even under the best of conditions, this culture technique is only about 80-90% sensitive in the bull. That is, even when we know the bull is infected, we are only able to detect that infection in about 80-90% of cases sampled. In the cow, the culture technique is even less sensitive; i.e., we are more likely in the cow to miss an infected animal by using the culture technique.

We have been trying to develop a technique that can diagnose the presence of antigens of Tritrichomonas foetus, rather than relying on culturing the whole organism. Specifically, we have

been trying to develop an ELISA, a technique that uses antibodies to detect trichomonad antigens. Early efforts were relatively successful, in that we could identify tiny amounts (10 parts per billion) of trichomonad antigens in laboratory samples. But when we took these tests to the animal, we found that there were many confounding factors that made the test non-specific; that is, the test became positive in animals that we knew were not infected. This lack of specificity is now being addressed in further experiments, in which we are using monoclonal antibodies to the trichomonad. These antibodies, developed in our laboratory, have been shown to be exquisitely specific to certain molecules in or on the protozoan parasite. We are now attempting to use these antibodies in a new ELISA for the disease.

We are also conducting studies which are examining the cow's immune response to infection with a heavy dose of trichomonads, it takes at least 14 to 18 weeks before a cow can "clear" herself of the infection. Some cows take even longer than this. We also know the cow recognizes specific molecules the trichomonad, and we are hoping to capitalize on this recognition in a way that may some day lead to an effective vaccine. Much like the cow's response to the related disease vibriosis (Campylobacteriosis) the cow makes antibodies in the mucus of her vagina. We are studying these antibodies to determine exactly to what antigens the cow is recognizing and responding. From early experiments it appears that she responds to very few antigens before the 10th or 11th week following infection. The reasons for this "slow" response are still uncertain.

This cross-reactivity could not be removed even after careful laboratory purification of the antibodies. This suggests that there are antigens on the trichomonad which are either identical to or very similar to antigens in the bovine cervical mucus itself. This further suggests that the trichomonad organism has been able through evolution to adapt to the environment in which it lives (the vagina) by "hiding" itself in antigens of the host. This is a clever and effective way to avoid immune response. We are hoping that the use of hyper-specific monoclonal antibodies will overcome this cross-reaction and detect only the trichomonads. These same monoclonal antibodies are allowing us to begin studies which will look at the possible variation between "strains" of trichomonads. We already know that monoclonal antibdies can detect differences between organisms from the same culture. This is, when trichomonads, isolated from the sheath of a bull, are cultured, there are genetic differences between individuals in the culture that can be detected by monoclonal antibodies. Any development of future vaccines for this disease will have to take into account such strain differences, such that a single vaccine can protect against multiple strains of the organism.

Two other universities, UN Reno and Texas A&M, are working on vaccines and are field-testing some products. We are watching their progress and field test any products which they may develop. Future UCD projects include a proposed USDA study in which we plan to develop a DNA probe for the organism. The advantage of such a probe is that it can be extremely specific for trichomonias, and will not be "confused" by any hiding that

the organism does in host antigens. Preliminary studies are showing that such a DNA probe is capable of finding as few as 10 trichomonad organisms. Since previous studies by others has shown that it probably requires something in the order of hundreds of organisms to establish an infection in a cow, the ability to detect as few as 10 organisms may create the ultra-sensitive diagnostic tests we have been looking for. (Parts of this report have appeared in other publications in 1988.)

YOUR $1 CHECKOFF AT WORK

Greg Findley/Mary Ryan
California Beef Council

California beef producers understand the value of the state $1 checkoff. Our state set the example for a national $1 checkoff by starting a state $1 checkoff in 1982. In six years we've seen positive shifts in California consumers' attitudes toward beef. The National Beef Checkoff, in effect since October, 1986, has, in over just one year, created a healthy impact on beef's popularity and demand. A continued nationally-funded program is important to maintain our marketing strength and build a future for the beef industry in a competitive marketing environment.

Is $1 worth it? Is your $1 being well spent? The answer to both questions is YES! Your dollar is reaching your potential consumer. Fifty percent of your dollar is sent to the Beef Board for national programs. Half of that amount (25 cents) is used for advertising. For every $1 sent to national, $3 is returned to California in consumer advertising alone -- a return on investment which could never be matched if purchased on a statewide basis. The remaining 25 cents is used for major research studies and consumer information programs.

<u>California Beef Council 1988 Budget - $3,345,579</u>

1. Promotion & Beef Board Contribution 63.9%

   Television
   Consumer Magazines
   Radio
   Retail Merchandising
   Foodservice
   USMEF
   CBC/BIC Joint Programs

2. Public Information 11.5%

   Beef Cook-Off
   Food Editors
   Special Event s
   Publicity
   Media Relations
   Fair Materials
   Newsletters

3. Reserve 7.8%

4. Education 5.2%

   Nutrition
   Usage and Care of Beef
   Healthcare, Educator, and Consumer Programs

5. Research 3.7%

   Diet/Health
   Consumer Attitudes and Market Behavior
   New Product Development

6. State Administration 4.3%

7. Administration (Council) 3.7%

Our Mission

Our mission is to increase the opportunity for all segments of the beef industry to earn an adequate return on investment through market development programs (Promotion, Research, Education and Public Information) which will build demand for beef and veal products that satisfy consumers' needs and wants.

Producer Funded, Producer Controlled

Your California Beef Council consists of 21 appointed representatives from the beef production and distribution chain. The national Beef Board has five members from California, ensuring a strong voice for our state. Together, your representatives determine how best to use industry funding both nationally and in California, to build demand for beef using the four strategies of Promotion, Research, Education and Public Information.

The 1988 California Beef Council budget is $3.3 million. Combined state and national investments for 1988 are over $73 million.

Results Check Progress

Producers in California and nationally provide the checkoff funds to make a beef program possible. In just one year at a $1 national level, your investment has yielded opportunities and progress which were never possible before. National ongoing research has shown that your checkoff $1 has made a significant difference in improving the market for beef.

Reaching Real People

In 1988 when consumers watch, listen to, and read their favorite television and radio shows and magazines, they'll get the beef message loud and clear. TV viewers see the ads on all types of programs: prime-time shows, evening news, weekend sports, and the 1988 Calgary Winter Olympic. Driving to and from work, or listening at work or at home, radio audiences will hear "beef" during news, cooking shows, and on the popular Paul Harvey show. Reach for a magazine, whether Newsweek or National Geographic, and learn about beef's nutritional benefits. All totaled, 96% of our target audience will be reached through beef advertising.

Consumer tests of the celebrity television advertising campaign just six months after the introduction, showed the highest advertising awareness for a commodity product in such a short time period. Further, in recall tests of the ads, consumers who had seen the ads had very favorable attitudes about beef - in fact, those who saw the ads had far more positive attitudes than non-viewers. Viewers agreed that beef is good tasting, a good source of nutrients and can be prepared quickly. In-home consumption studies conducted by National Eating Trends show that nearly everyone in the United States and California eat beef. In California, 87% of the population eats beef at least 4 1/2 times every two weeks.

In California, your $1 will help supplement the national media by zeroing in on California's unique and growing consumer segments. Sports enthusiasts, busy urban professionals, Hispanics and senior citizens will be targeted through additional California media and public relations to respond to California's developing trends. Nutrition, convenience, health and beef as "trendy" will be the focuses.

Retailers appreciate the information, meat science research, and promotional support they are provided by the beef industry to help them offer a quality product and better service to their customers. Meat Features video tapes are available for most beef cuts as well as veal. In California, Meat Features will also be available in Spanish as an extra service to supermarkets in large Hispanic neighborhoods. The 1/4" fat trim program has become an industry standard with a further movement to no trim. An "all red" product in the meat case improves beef's image as a nutritious, lean source of protein. Shoppers in California who want the beef cuts that are lowest in fat and calories can select the "Skinniest Six" cuts with the help of special point-of-sale identification of the leanest beef cuts.

Beef is Back! Pick up a newspaper or popular consumer magazine and when you see an article about beef it is generally favorable. Headlines like "Beef Makes a Comeback"" or "The New Lean Beef" are all results of communicating the latest nutrition information (from USDA Handbook 8-13), changes in production and

feeding and changes in fat trim at the supermarket, to editors and writers. The beef industry is respected as a reliable news source.

Public relations, advertising to doctors, consumers and restaurant operators, food editorial placements, media relations, and events targeted to active and trendy lifestyle groups, are all helping to increase beef's image as a food that fits a healthy lifestyle and as a food that consumers enjoy.

The California and National Beef Cook-Off events are larger in scope and publicity than ever, including a $15,000 national prize in 1988, and a food editor seminar at the event drawing press coverage year-round.

The National Beef checkoff also includes a veal program. The veal marketing plan is structured similarly to the beef plan, including the four program areas: Promotion, Research, Education and Public Information. $2.6 million will be spent to carry out these activities for the 1988 veal program.

- Promotion:

  Foodservice magazine advertisements.
  Recipe cards for chefs.
  Veal Meat Features videos and point of sale in supermarkets

Research:

Market research focusing on veal consumption and consumer usage and attitudes about veal.

Education and Public Information:

Veal recipes/photographs sent regularly to newspaper food editors.

On May 10 it is up to producers to decide the fate of the dollar checkoff. The election will be held at your County Extension Office. You can vote prior to May 10 with an Absentee Ballot, as long as it is in the hands of your County Extension Office by the close of business May 3.

As the first state to go to the $1 checkoff in 1982, we have a longer record to show that producer investment in marketing efforts can make a difference. Hopefully, the California producers' five-year investment in promotion, research and education will be upheld as the "real way" to keep a viable beef industry in America.

THE EFFECT OF BLUE OAK REMOVAL ON HERBACEOUS PRODUCTION

Bob L. Willoughby[1]

Introduction

Blue oak, Quercus douglasii, is restricted to the foothill woodland community and forms extensive savannas. There have been many studies up and down the state with vastly different results. Kay and Leonard (1980) reported on the effect of blue oak removal on herbaceous forage production in the northern Sierra Nevada foothills. Over a 13-year period they found that forage yield averaged 67 percent more on cleared areas than on tree-covered areas, and 17 percent less on tree-covered areas than on adjacent open grassland areas.

In contrast to these findings and recommendations, Holland (1973; 1976; and 1980) reported that forage production was 40 to 100 percent greater under blue oaks than in open grassland and recommended that blue oak clearing be stopped. Holland's findings were based on studies in the south-central Sierra Nevada foothills and Southern Coast ranges. Others (Duncan, Clawson) concluded that a possible explanation for these contradictory findings may include: (1) regional climatic difference; (2) different levels of blue oak canopy; and (3) edaphic differences.

This study was started in the fall of 1979 by Henricus C. Jansen[2]. After data was collected for six years it was decided the study should be continued for at least four more years. This study is to determine the relationship between the level of blue oak canopy and herbaceous production throughout the season of rapid plant growth (approximately March 1 to May 31) for two contrasting situations: (1) tree canopy left intact; and (2) tree canopy removed. A second purpose of the study was to determine the long-term trend in herbaceous production following tree removal.

The site is located at an elevation of 425 m (1394 ft.) with gentle slope and annual rainfall at 732 mm (28.8 inches). The soils at the site are shallow to moderately deep clay loams in the Auburn-Las Posas-Sobrante complex.

Methods

Eight 0.1 ha (1/4 acre) plots were established on a 20 ha site. The site was selected from aerial photos and chosen because it provided a full range of oak canopy levels. One pair of plots was located in open grassland and three pairs were located in blue oak woodland such that these three pairs of plots had approximately 25, 50, and 75 percent tree canopy. In February 1980, tree canopies were completely removed from one randomly-selected plot of each of the three pairs. Great care was taken to minimize soil surface disturbance during tree removal.

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Each year in January, twelve small (9 sq. ft.) wire mesh cages are placed in each plot. A random procedure with proportional allocation was used for cage placement, with existing or former tree canopy and non-canopy areas serving as the two strata. Clipping occurred inside the cages on 1 sq. ft. microplots. Clipped plots did not overlap to avoid measurement of regrowth and clipping effect and were clipped to ground level. Clippings were taken three times: early (Feb. 1), mid-season (March 20), and end of season.

Results and Discussion

Blue oak removal caused a significant increase in total production, greater than 60 percent (Table 1). The effect of tree canopy (0 to 75%) on standing crop was significant for both non-cleared and cleared plots. However, this effect varied by season and was not significant at the beginning of the growing season. Tree canopy effect on standing crop was greater for cleared than non-cleared conditions. Even though there was a significant difference between cleared and non-cleared conditions, there is no significant difference between the three canopy levels on the cleared plots or the non-cleared plots.

Table 1 Herbaceous Standing Crop at End of Growing Season Representative Years and Mean

Experimental Treatment	1981	1983	1986	1987	Mean[1]
No Tree Removal			Kg/ha		
0 pct canopy (control)	3315	4484	2807	1087	2981
25 pct canopy	1982	4204	2574	1136	2453
50 pct canopy	1990	4803	3012	1150	2754
75 pct canopy	2235	5013	2443	1261	2410
Complete Tree Removal					
0 pct canopy (control)	2326	4518	2480	1255	2798
25 pct canopy	3504	6218	3405	1812	3672
50 pct canopy	3856	6101	4531	2211	4048
75 pct canopy	3224	6795	3661	1977	3817

[1]All years except 1980

The 1980 results were not used because tree removal did not cause significant changes in production. This was probably due to the fact that removal took place during the first half of February while germination and establishment of most annual plants took place the preceding fall. Kay and Leonard (1980) also reported a lack of effect for the first growing season following tree removal.

The presence of blue oaks slightly depressed herbaceous production, while their removal greatly enhanced it.

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EFFECT OF GRAZING HISTORY AND CANOPY COVER ON BLUE OAK (QUERCUS DOUGLASII) SEEDLING WATER STRESS AND SURVIVAL

John W. Menke

Introduction

This report discusses the effect of grazing history and mature oak canopy on regeneration success indicators in blue oak (Quercus douglasii) natural occurring seedlings, planted seedlings, and transplanted saplings (3-4 yr-old). Preliminary ecological and managerial interpretations of the results are given.

Transplant Experiment

One-year-old blue oak seedlings obtained from Blue Oak Nursery were planted and covered with window screen cages (Frank Chan type without collar) on 20 April 1986 in blocks of 25 seedlings under and outside mature blue oak canopy in both grazed and ungrazed (15-yr livestock free) sections of the deer-proof exclosure of the Koch Pasture. Seedlings were drip irrigated the first summer with about 1 gal/wk from May through September to aid in establishment; from then on they only received natural rainfall. Gravimetric soil water content (15 and 50 cm depths) taken near each plot and leaf conductance, tissue water relations, leaf area, specific leaf weight, and shoot weights were measured on three seedlings from each treatment combination on 4 May, 8 June and 4 July 1987.

Soil water contents at both depths were lowest in the grazed open and highest in the ungrazed canopy environments. Tissue water relations indicated that water stress was greatest in the grazed, under-canopy environment during this relatively dry year. Reduction rates of water potential components per day were also greatest in the grazed canopy areas. Air relative humidities were higher and temperatures were lower during the May through July sampling period under mature oak canopies compared to open grassland sites. Daily maximum leaf conductances were higher in the open grasslands than under canopy. Leaf area per seedling was greater in the grazed environments in May. By June and July seedlings in the grazed environments had higher leaf-to-stem ratios. Specific leaf weights consistently indicated that leaves were thickest in the grazed open and thinnest in the grazed canopy sites.

High density of annuals and lack of a litter mat covering the soil and reducing soil evaporation, like that in the ungrazed environments, likely contributed to the more stressful condition for oak seedlings in the grazed canopy environments. In this dry year, annual plant productivity was much greater under canopy than in the open in the grazed environments which likely increased the transpiration of annual grasses, causing competition for moisture with the oak seedlings. These results corroborate the results of Welker and Menke (1987, see citation below) where they found water stress to be less for natural blue oak seedlings in ungrazed verses grazed under-canopy environments. In summary, oak regeneration for two years at Sierra Foothill Range Field Station appears to be least likely in grazed canopy environments, unfortunately the most likely location of acorn propagules.

All transplanted seedlings senesced and appeared to die soon after the last sampling date, however, some have regrown as evidenced by bud activation in

February 1988. Remaining individuals will be inventoried for survival in spring 1988.

Water Relations of Natural Seedlings

Naturally occurring (3-4 yr-old) blue oak seedlings in three patches under different mature blue oaks in each of the grazed and ungrazed environments as described above were sampled (3 seedlings were destructively sampled for each treatment combination on each date) for leaf conductance and tissue water relations on 12 June, 4 July and 30 September 1987.

Seedlings from the site ungrazed for 15 years maintained higher predawn and osmotic component water potentials compared to the grazed environment in June and September during summer drought. In June and July seedlings in the grazed environment maintained higher leaf conductances in the morning further increasing their stress levels. Rapid and severe drought resulting from dense annual plants in the grazed environment appeared to inhibit or reduce seedling osmotic adjustment. Naturally occurring seedlings must have deeper and more developed root systems because of their lower relative stress levels compared to transplanted blue oak seedlings.

Herbaceous Plant Production

A herbaceous plant defoliation study was initiated in fall 1987 to determine possible beneficial effects of livestock grazing on oak seedling regeneration under the general hypothesis that transpiration from annuals could be reduced by grazing and therefore more soil water would be left in summer promoting oak seedling survival. Four replications of blocks of 72 double-planted, pre-germinated blue oak seedlings were established under four mature oak canopies each, on 15-yr. livestock free and livestock grazed sites, respectively, at Sierra Foothill Range Field Station (Koch Pasture exclosure). Water relations will be compared this spring and summer for seedlings growing in herbaceous plant undefoliated plots and defoliated plots. In this study herbaceous annual grasses and forbs surrounding each block of seedlings are being clipped periodically in late winter and spring to a 5.0-cm stubble height to simulate the effect of grazing of the herbaceous forage on seedling water relations. Fifteen 0.1 m^2 quadrats are clipped in each of the eight plots. We hypothesize that the lower leaf area present on grasses and forbs will reduce water transpired and leave greater quantities of soil water in summer to sustain oak seedlings and increase their first-year survival.

Clipped plot data collected on 24 February 1988 shows the significantly higher ($p > 0.01$) productivity and leaf area on the historically grazed verses the 15-yr ungrazed site (Table 1.).

Table 1. Herbaceous plant (composite of all grasses and forbs) leaf area and biomass comparison under mature blue oak canopy in grazed verses 15-yr livestock free conditions on 24 February 1988. Sample size is 60 0.1-m^2 plots per treatment.

Treatment	Leaf Area $cm^2/0.1\text{-}m^2$	Biomass $g/0.1\text{-}m^2$
Grazed	124	1.05 (935 lbs/ac)
15-yr non-grazed	78	0.56 (498lbs/ac)

Additional clippings will be made this spring to maintain the leaf area in a grazed state. The nearly 60% higher leaf area on the grazed site in February in combination with the lack of a litter cover certainly can help explain the divergent water resource competition levels observed between oak seedlings and annual plants in grazed verses non-grazed sites.

Regional Blue Oak Seedling Water Relations

Pre-dawn plant water potential measurements were made on natural seedlings at Sierra, Hopland, and Hastings study sites in late spring and summer 1987 (no natural occurring seedlings were present at the San Joaquin Range study area). Previous work in the literature has shown that plant and soil water potentials equilibrate during the night so that pre-dawn measurements of plant water potential are good estimates of soil water availability. Results from the pre-dawn measurements are summarized in Table 2. Two major trends are apparent from the data. On a regional scale, plant water potentials are most negative and thus water stress was highest at SFRFS (note San Joaquin was not included because no natural seedlings are present, indicating in fact it might be the driest site). Hopland is intermediate in terms of water stress and natural seedlings at Hastings experienced the least amount of water stress. Overall, there appears to be lower water availability in the grazed areas. However, this difference is detectable only very early in the growing season, so the potential significance of this difference is unclear at this time.

Table 2. Changes in soil water availability as measured by pre-dawn plant xylem potentials in natural seedlings under canopy at three regional study sites in 1987. Values are in MPa and are means ± 1 S.D. A larger negative value indicates greater stress.

	MAY	JUNE	JULY	AUGUST
SIERRA (SFRFS)				
Grazed	-2.2 ± 0.1	-4.3 ± 0.2	-4.5 ± 0.1	-5.7 ± 0.6
Ungrazed	-1.8 ± 0.1	-3.5 ± 0.2	-4.8 ± 0.3	-5.3 ± 0.6
HOPLAND				
Grazed	-1.0 ± 0.1	-1.9 ± 0.3	-3.7 ± 0.8	-6.3 ± 0.4
Ungrazed	-0.6 ± 0.2	-1.9 ± 0.3	-3.5 ± 0.5	-4.6 ± 0.4
HASTINGS				
Ungrazed	---	-1.2 ± 0.2	---	-2.5 ± 0.1

Blue Oak Seedling Emergence and Mortality

Data on emergence and mortality at San Joaquin and Hopland, respectively, in spring 1988 further indicate that livestock removal of litter and the resulting enhanced annual plant productivity reduces emergence and survivorship, two critical steps in the oak regeneration process (Table 3). Following a relatively normal fall rainfall period, an abnormally dry winter in 1988 has certainly contributed to depressed emergence of pre-germinated oak seedlings at the San Joaquin Range. However, more than four times the number of seedlings emerged in the long-term (since 1936) livestock-free exclosure compared to the historically cattle grazed site.

Not only does grazing history appear to strongly influence emergence this Spring, lack of any emergence under the same planting regime at Hastings, indicates that under low winter rainfall conditions, the lighter textured soil at SJER is more conducive to seedling emergence than the heavy clay textured soil at Hastings. It is commonly known that matric forces in more well developed, heavy textured soil may release less water for plant growth than lighter textured soils under similar drought conditions. However, the water holding capacity of a clay soil usually is considerably higher and therefore the expected survival of the emerged seedlings at SJER is still expected to be low this year because of drought conditions after emergence.

Similarly at Hopland, the site sheep-free since 1951 had a natural seedling mortality less than one-quarter as high over a one year period compared to an adjacent area grazed by sheep (Table 3). Again, plant litter impacts on reducing the annual plant density, leaf area, and resulting evapotranspiration is the hypothesized operational mechanism proposed to explain the difference.

Table 3. Blue oak seedling emergence in spring (18 March 1988) following double planting of pre-germinated acorns in winter 1988 at San Joaquin Experimental Range and natural seedling mortality from spring 1987 to 1988 at Hopland.

San Joaquin Emergence Results (planted)	
Grazed	15 emerged out of 200 planted
Ungrazed	66 emerged out of 200 planted
Hopland Mortality Results (natural occurring seedlings)	
Grazed	25%
Ungrazed	6%

Preliminary Ecological and Managerial Interpretations

The dominant resident annual plants that make up the typical moderate livestock grazed California annual-type grasslands today appear to be such strong competitors for seasonal rainfed soil water resources that blue oak seedlings will continue to have a difficult time in establishing. Whether the former native annual and native perennial grassland provided a more conducive environment for oak regeneration is unknown, but indications are that at least light-grazed grassland with substantial litter build-up does provide a wetter soil environment during our normal 6-8 month dry season.

Unfortunately for oak seedling regeneration, the greater availability of nutrients under the oak canopy, due both to oak mast as well as animal transported inputs, promotes enhanced growth in dry years under partial shade of the canopy to make regeneration there even more unlikely than in open sites. Canopy shade in dry years can enhance annual plant production, leaf area and evapotranspiration, above that of open grassland even at northern California locations where canopies normally reduce understory production. This may not be important to recruitment anyway because regeneration windows in time may be limited to wet spring years.

On a more positive note, it appears from our oak defoliation studies (not part of this report) that direct defoliation of oak seedlings in spring or

early summer may reduce the effect of drought stress and increase seedling survival. Additionally, defoliation of annual vegetation surrounding growing oak seedlings probably could be beneficial in reducing evapotranspiration of competing vegetation thereby reducing oak seedling water stress. If it were possible to protect seedlings from direct livestock grazing and trampling in an agroforestry situation, grazing may have an important role in seedling establishment.

Given the severe water stress that typically occurs in California each late spring, summer and fall, it is likely that regeneration success will be episodic in years with wet springs following good acorn crops. Agroforestry activities will optimally be timed to coincide with these conditions, that is, cages would only be erected on natural seedlings in these favorable years. Our experience with transplanting of older age classes indicates that sapling transplants are even less likely to be successful.

Acknowledgments

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WARM SEASON GRASS TRIAL

A Progress Report

Melvin R. George, Charles B. Wilson
Peter Sands, Roger Ingram, Michael Connor

Introduction

The cool season species commonly used in foothill and valley irrigated pastures are not very productive during the hot summer months. Only dallisgrass, a warm season grass, remains productive during July and August. Warm season grasses, being of tropical origin, have a high optimum temperature for growth and therefore do quite well under hot summer temperatures. Additionally, several warm season grasses are drought tolerant, producing green forage with as little as three inches of precipitation per month.

The objective of this study is to test several warm season grasses for their adaptability to foothill irrigated pastures during the summer and to determine yield response to adequate and reduced irrigation. The irrigation treatments are not reported in this progress report.

This project was initiated with a grant from the California Cattlemen's Association and seed from the USDA Soil Conservation Service Plant Material Centers.

Procedure

The trial is being conducted at the U.C. Sierra Foothill Range Field Station in Yuba County at an elevation of 1000 feet. Land preparation was conducted from summer, 1984, through spring, 1985. On June 10, 1985, treble superphosphate (0-40-0) was applied at the rate of 400 lbs/a. Six replications of 20 plots each were laid out. Irrigation water delivery was delayed until late July 1985.

On July 25, 1985, 16 of the 20 entries were seeded. On August 13, 1985, the buffelgrass entry was seeded and the stoloniferous entries were transplanted.

Sudangrass was the first entry to emerge and required clipping on August 15, 1985. All entries were mowed and fertilized with ammonium nitrate at the rate of 50 lbs/a of nitrogen on September 20, 1985. All warm season grasses were dormant by early December.

The buffelgrass entry did not survive the winter of 1985-86. On May 20, 1986, the buffelgrass and sudangrass entries were replaced with Verde kleingrass and laurisagrass. All replications were irrigated weekly. The trial was fertilized twice each year in the spring and summer with approximately 50 lbs of N as ammonium nitrate.

On May 20, 1986, the plots were mowed for weed control purposes. Yield was measured in 1986 on June 10, July 9, August 15, and September 25 and in 1987 on May 15, June 16, July 15, August 18, September 15, and October 15.

Results and Discussion

Table 1 reports the dry matter yields for 18 entries that were harvested on all four harvest dates in 1986. Table 2 reports the total yield for the last two harvests and includes the yield of Verde kleingrass and laurisagrass that were added to the trial in June, 1986. Tables 3-6 report protein, ADF, NDR, and ash on four harvest dates in 1986. Table 7 reports the yields for 1987 except for perennial ryegrass which died early in the summer. Nuetral detergent residue (Table 5) is an indicator of digestibility. As NDR increases digestibility decreases.

In 1986 switchgrass was the most productive over four harvests followed by indiangrass, sand lovegrass, and side-oats grama. Sand lovegrass is an exotic used in the southwestern states where summer rainfall occurs natur-

ally on these rangelands. The other three are natives of the North American Prairie. In 1987 indiangrass, big bluestem, Lehmann's lovegrass, little bluestem, and Boer lovegrass were most productive.

The cool season grasses, tall fescue, perennial ryegrass and orchardgrass, were least productive over four harvests in 1986 and six harvests in 1987. The stoloniferous entries, bermudagrass and limpograss, were among the least productive of the warm season grasses in both years. Perennial ryegrass died during the summer of 1987.

Table 1. Total forage dry matter yield for the warm season grass trial at U.C. Sierra Foothill Range Field Station harvested monthly from June - September, 1986.

Common Name	Variety	Yield (lbs/a)	
Switchgrass	Kanlow	9620	A
Indiangrass	Osage	9216	AB
Sand Lovegrass	Bend	8684	ABC
Sideoats Grama	El Reno	8512	ABC
Lehmann's Lovegrass		7768	BCD
Little Bluestem	Aldous	7760	BCD
Kleingrass	Selection 75	7720	BCD
Dallisgrass	Common	7572	BCD
Big Bluestem	Kaw	7200	CDE
Boer Lovegrass	Catalina	7144	CDE
Bermudagrass	Coastcross 1	6700	DEF
Bermudagrass	Tifton 68	6572	DEF
Bahiagrass	Pensecola	6108	DEF
Bermudagrass	NK Pasto Rico	5520	EF
Limpograss	Bigalta	5432	F
Tall Fescue	Fawn	3760	G
Orchardgrass	Akaroa	3476	G
Perennial Ryegrass	Ariki	2444	G

Yields followed by the same letter are not significantly different (p=0.05).

Table 2. Total forage dry matter yield for the last two harvests of the warm season grass trial at U.C. Sierra Foothill Range Field Station in August and September, 1986.

Common Name	Variety	Yield (lbs/a)	
Kleingrass	Verde	4450	A
Lehmann's Lovegrass		4218	AB
Sand Lovegrass	Bend	3976	ABC
Switchgrass	Kanlow	3958	ABC
Sideoats Grama	El Reno	3718	ABCD
Kleingrass	Selection 75	3642	ABCD
Bermudagrass	Coastcross 1	3636	ABCD
Indiangrass	Osage	3564	ABCD
Laurisagrass		3454	ABCD
Limpograss	Bigalta	3186	ABCD
Little Bluestem	Aldous	3140	ABCD
Bermudagrass	Tifton 68	2990	BCDE
Big Bluestem	Kaw	2950	BCDE
Dallisgrass	Common	2908	BCDE
Boer Lovegrass	Catalina	2656	CDE
Bahiagrass	Pensecola	2536	DEF
Bermudagrass	NK Pasto Rico	2468	DEF
Tall Fescue	Fawn	1770	EFG
Orchardgrass	Akaroa	1304	FG
Perennial Ryegrass	Ariki	804	G

Yields followed by the same letter are not significantly (p=0.05).

Table 3. Protein (%) on four harvest dates in 1986.

Common Name	Entry	June	Jul	Aug	Sept
Bermudagrass	Coastcross 1	5.01	7.27	8.52	8.80
Bermudagrass	Tifton 68	10.24	8.56	9.72	9.07
Bermudagrass	NK Pasto Rico	6.29	7.23	7.92	6.66
Limpograss	Bigalta	7.20	8.11	8.33	7.05
Big Bluestem	Kaw	6.79	7.06	7.78	7.86
Sideoats Grama	El Reno	-	5.80	8.08	6.76
Boer Lovegrass	Catalina	10.85	5.01	7.32	6.60
Lehmann's Lovegrass		4.32	6.55	7.50	7.08
Sand Lovegrass	Bend	3.84	5.80	8.61	7.90
Kleingrass	Selection 75	5.58	7.01	7.90	8.58
Switchgrass	Kanlow	10.12	6.57	9.72	8.75
Dallisgrass	Common	6.64	7.21	7.99	7.58
Bahiagrass	Pensecola	7.71	7.25	12.49	8.31
Indiangrass	Osage	4.29	6.88	9.49	7.51
Little Bluestem	Aldous	8.46	7.34	9.09	8.98
Laurisagrass				8.63	8.02
Kleingrass	Verde			10.33	8.95
Orchardgrass	Akaroa	5.07	10.74	15.23	14.20
Tall Fescue	Fawn	6.91	11.05	15.68	13.27
Perennial Ryegrass	Ariki	7.45	9.29	11.51	16.84

Table 4. ADF (%) on four harvest dates in 1986.

Common Name	Entry	June	Jul	Aug	Sept
Bermudagrass	Coastcross 1	37.65	39.18	38.42	38.03
Bermudagrass	Tifton 68	37.00	41.00	37.62	38.86
Bermudagrass	NK Pasto Rico	36.36	37.23	36.00	36.94
Limpograss	Bigalta	34.83	38.68	35.67	38.64
Big Bluestem	Kaw	38.92	41.63	37.59	39.48
Sideoats Grama	El Reno	38.30	42.96	39.28	42.45
Boer Lovegrass	Catalina	39.51	43.19	40.57	43.11
Lehmann's Lovegrass		41.82	45.85	44.31	45.15
Sand Lovegrass	Bend	34.74	36.00	36.55	40.37
Kleingrass	Selection 75	33.62	34.67	36.52	35.33
Switchgrass	Kanlow	36.32	36.47	35.13	36.06
Dallisgrass	Common	42.45	44.80	43.21	43.66
Bahiagrass	Pensecola	37.07	40.75	39.79	40.20
Indiangrass	Osage	41.41	44.51	42.32	44.17
Little Bluestem	Aldous	40.54	43.51	40.63	41.70
Laurisagrass		.00	.00	37.33	39.28
Kleingrass	Verde	.00	.00	37.33	35.48
Orchardgrass	Akaroa	37.65	38.48	34.76	35.03
Tall Fescue	Fawn	35.35	35.67	35.08	33.71
Perennial Ryegrass	Ariki	38.63	42.96	33.05	32.47

Table 5. NDR (%) on four harvest dates in 1986.

Common Name	Entry	June	Jul	Aug	Sept
Bermudagrass	Coastcross 1	23.51	23.57	22.35	24.62
Bermudagrass	Tifton 68	20.94	24.30	22.90	24.31
Bermudagrass	NK Pasto Rico	25.13	27.17	27.25	29.18
Limpograss	Bigalta	16.71	16.10	19.98	19.18
Big Bluestem	Kaw	18.59	20.77	26.22	20.32
Sideoats Grama	El Reno	22.15	25.68	41.56	32.21
Boer Lovegrass	Catalina	33.05	47.08	38.06	42.13
Lehmann's Lovegrass		27.69	36.38	28.98	29.51
Sand Lovegrass	Bend	22.97	35.30	26.05	32.75
Kleingrass	Selection 75	23.20	24.27	27.93	26.78
Switchgrass	Kanlow	31.00	29.76	26.91	34.74
Dallisgrass	Common	22.36	22.85	23.66	26.58
Bahiagrass	Pensecola	24.49	28.50	40.00	31.44
Indiangrass	Osage	20.12	19.77	24.82	25.69
Little Bluestem	Aldous	24.22	23.28	40.53	27.25
Laurisagrass		.00	.00	42.83	28.65
Kleingrass	Verde	.00	.00	27.33	24.21
Orchardgrass	Akaroa	22.70	19.74	16.67	16.20
Tall Fescue	Fawn	21.08	24.02	17.97	18.18
Perennial Ryegrass	Ariki	26.59	29.24	26.03	15.96

Table 6. Ash (%) on four harvest dates in 1986.

Common Name	Entry	June	Jul	Aug	Sept
Bermudagrass	Coastcross 1	11.71	12.06	10.92	12.17
Bermudagrass	Tifton 68	14.42	16.48	12.30	13.80
Bermudagrass	NK Pasto Rico	10.43	13.00	10.98	11.73
Limpograss	Bigalta	14.12	12.81	10.32	12.88
Big Bluestem	Kaw	9.23	10.18	8.96	10.28
Sideoats Grama	El Reno	10.36	11.35	10.77	12.70
Boer Lovegrass	Catalina	8.78	10.32	8.47	9.51
Lehmann's Lovegrass		8.23	8.97	7.91	8.71
Sand Lovegrass	Bend	7.33	8.67	8.21	8.08
Kleingrass	Selection 75	9.77	9.84	8.80	10.77
Switchgrass	Kanlow	8.31	10.12	8.03	8.76
Dallisgrass	Common	11.92	11.69	10.89	10.97
Bahiagrass	Pensecola	11.45	10.64	10.26	10.21
Indiangrass	Osage	10.02	11.27	9.97	15.13
Little Bluestem	Aldous	9.25	10.49	8.71	10.64
Laurisagrass		.00	.00	14.70	16.38
Kleingrass	Verde	.00	.00	10.66	11.76
Orchardgrass	Akaroa	12.97	15.80	12.95	12.47
Tall Fescue	Fawn	14.75	17.16	13.57	14.56
Perennial Ryegrass	Ariki	11.24	13.12	11.85	13.87

Table 7. Total forage yield for the six harvests of the warm season grass trial at U.C. Sierra Foothill Range Field Station in 1987.

Common Name	Cultivar	Yield (lbs/a)
Indiangrass	Osage	7849 A
Big Bluestem	Kaw	7632 AB
Lovegrass	Lehmann's	7456 ABC
Little Bluestem	Aldous	7025 ABCD
Boer Lovegrass	Catalina	6873 ABCDE
Kleingrass	Selection 75	6520 BCDEF
Switchgrass	Kanlow	6450 BCDEF
Sand Lovegrass	Bend	6341 CDEF
Sideoats Grama	El Reno	6171 CDEF
Bahiagrass	Pensecola	6023 DEFG
Kleingrass	Verde	5882 DEFGH
Bermudagrass	Coastcross 1	5586 EFGH
Laurisagrass		5459 FGHI
Dallisgrass	Common	4890 GHI
Bermudagrass	NK Pasto Rico	4724 HI
Limpograss	Bigalta	4708 HI
Bermudagrass	Tifton 68	4596 HI
Tall Fescue	Fawn	4289 IJ
Orchardgrass	Akaroa	3363 J
Perennial Ryegrass	Ariki	- -

Yields followed by the same letter are not significantly different (p=0.05).

EVALUATION OF HARDWOOD SPECIES FOR FUELWOOD

Janine Hasey, Richard Standiford, Roy Sachs, Mike Connor

Objectives

In March 1984, a six year test planting of selected Eucalyptus and poplar species and clones was established at the Sierra Foothill Range Field Station. The main objectives were to evaluate survival and growth characteristics and to determine optimum harvest time of intensively managed hardwood trees as energy crops grown under foothill conditions.

Seed source of the Eucalyptus species is very important in determining ultimate survival and growth. The species, clones and seed source in this study were chosen for their cold tolerance and/or fast growth.

Results and Discussion

The data in Table 1 was taken in October 1987 when trees were 3½ years old. Included in the table are average diameter at breast height (DBH), height, volume, and mean annual increment (MAI) which is the average annual growth in cubic feet per acre per year.

The largest yields per acre were the same for E. globulus and C-2 clone. As a general relationship in wood product measurement, one cord equals 85 cubic feet of solid wood. Thus, both E. globulus and C-2 clone have yielded 23.2 cords per acre over the 3½ year period.

The seedling population of E. globulus are fairly uniform with most trees having single, straight stems, a desirable characteristic for fuelwood trees. The C-2 clone is even more uniform as would be expected from a clonal population. It too has a very upright, single stem.

As an example of the lower variability in clonal populations, the coefficient of variation (CV) for 1987 DBH of the C-2 clone was 15.5 percent and the CV of the hybrid poplar clone was 16 percent. In contrast, the CV of seedling populations of E. globulus was 51 percent and 76 percent for E. viminalis.

The large growth differences between the C-1 and C-2 clones point out the seedling variability inherent within a species. These clones were selections from Eucalyptus camaldulensis seedlings. The C-1 which has consistently performed poorly was cloned from a random selection, whereas the superior performing C-2 was cloned from improved Spanish seed.

Early rates of growth during these 3½ years do show that there is considerable promise for the production of large volumes of woody biomass from intensively managed plantations of exotic hardwood species on foothill rangeland sites.

Table 1. Trees at 3½ Years Old

Species/Clone	Survival %	DBH (inches)	Height (feet)	Volume (cu.ft./ac.)	MAI (cu.ft./ac./yr.)
Eucalyptus globulus	86	3.93 a	46.5 a	1970.55	550.43
E. c. C-2 clone	100	3.90 ab	43.4 a	1969.88	550.25
E. dalrympleana	94	3.56 abc	34.2 bc	1588.74	443.78
E. viminalis	83	3.34 c	34.1 bc	1449.27	404.82
E. camaldulensis	100	3.48 c	31.9 c	1435.15	400.88
Poplar clone	100	3.50 bc	38.2 b	1286.25	359.29
E. c. C-1 clone	100	3.32 c	31.9 c	1086.27	303.43

LSD (.05)

Treatments followed by the same letter are not significantly different.

ARTIFICIALLY REGENERATING NATIVE OAKS IN CALIFORNIA

Doug McCreary

Introduction

Recent inventories of oaks in California have indicated that for several native species, including blue and valley oak, there is insufficient natural regeneration to maintain current stand densities. However, the presence or absence of seedlings is very site-specific. In some areas there are abundant young seedlings growing, while in other places, current stands are comprised almost entirely of older trees.

In the last decade, a number of studies have investigated the causes of poor regeneration. While no single cause has been identified as universally responsible, a whole host of factors have been shown to contribute to poor seedling establishment. These include limited soil moisture, acorn predation from deer, birds and rodents, defoliation by insects, and browsing by wild and domestic range animals.

In order to ensure that oaks remain a component of the natural landscape in those areas where natural regeneration is poor, it will likely be necessary to re-stock these areas using techniques of artificial regeneration. Unfortunately, our current knowledge in this area is limited. During the past year, several studies were initiated at the Sierra Field Station to test alternative practices and develop techniques for successfully establishing and growing seedlings. These studies are described below.

The Collection and Treatment of Acorns

Two studies investigated the effects of different collection dates and pre-storage treatments on the timing and extent of germination for blue oak acorns. In the first study, 300 acorns were collected from two sites every other week from late August until late October. After collection, acorns were either soaked for a day and then refrigerated; air dried for a week and then refrigerated; or refrigerated immediately after collection. In the second study, 400 acorns were collected from a single tree in late September and divided into six treatment groups. These groups were allowed to dry out to varying degrees, ranging from 0% (refrigerated immediately) to 30% (30% moisture loss resulting from two months of air drying). In early December, all acorns from both studies were placed in a growth chamber for a standard germination test, with twice-weekly evaluations to determine the date of germination for each acorn.

The speed germination varied greatly by treatment and was closely related to collection date, with acorns collected earliest germinating most rapidly. However, there was a wide interval over which acorns could be collected and still have high germination. By the end of the 10-week germination period, acorns from all collection dates had over 90% germination, as long as they were not allowed to dry out first. Even a relatively short, one-week exposure interval, however, resulted in substantially delayed and reduced germination. Longer drying intervals were even more damaging. All acorns left out (in a tray on a laboratory bench) for over a month failed to germinate.

is used, acorns should be collected during September or early October, while they are still on the trees. After collection, they should be refrigerated (in zip-lock storage bags) until they are planted. Acorns should be planted early in the fall, after the first rains have soaked the soil.

Seedings can also be successfully established by directly planting small container plants. Chances for survival and vigorous growth can be improved by planting seedlings in deep, augured holes, irrigating them during the first summer after planting, and keeping the area around the seedlings free of weeds.

Future Research

During the next year, several additional research projects on the artificial regeneration of oaks will be initiated at the Sierra Field Station. These will address a number of important aspects of regeneration including:

- A comparison of seedlings grown in different sized containers;
- The effects of different types of time-release fertilizers on seedling survival and growth;
- The field performance and growth rate of different sized acorns;
- A comparison of direct-seeded acorns and 2-3 month-old container stock;
- An evaluation of different irrigation regimes on establishing valley oak seedlings.

The ultimate goal of these studies is to provide information that can be used to develop practical low-cost regeneration procedures. The adoption of these techniques will help ensure that oak trees remain a vital component of the landscape of California.