# Limit Feeding Light-Weight Cattle High-Nutrient Density Diets Programmed Feeding for Calves (PROGFED2) (Revision 2)

Chris Richards
Associate Professor, Animal Science

David L. Lalman
Extension Beef Cattle Specialist

Oklahoma Cooperative Extension Fact Sheets are also available on our website at:
**http://osufacts.okstate.edu**

***Special Note:*** *This revision adds five new equations to the program to more accurately predict the gain of medium and large frame cattle with greater growth potential. The original version of this program used the 1974 NRC equations which were developed in the 1960's for steers and heifer calves. Through the years, additional growth potential has been bred into cattle. For example, a group of large frame heifer calves, program fed at Pawhuska Research Station with the 74 equation and feeding for 2 pounds per day, actually gained 2.68 pounds per day. Others have reported the feeding schedules developed by the original program underestimated gains of many cattle. With the additional five equations published in the 1984 NRC Nutrient Requirements of Beef Cattle, the user should be able to better match this program to the cattle being fed. The two original equations are retained for reference and for the many cattle to which they still apply.*

For a cattleman, who has light-weight cattle and does not have adequate forage to maintain growth for some limited period of time, but has sound economic reason to retain the cattle for pasture or feeding at a later date, limit feeding may be the answer. Light weight cattle usually are grown on forages or on bulky high roughage growing diets. Another method to grow cattle at moderate rates of gain is to limit feed at a higher concentrate ration. In times of drought or high roughage prices, limit feeding concentrates may be more economical. With limited intake of high energy diets, it may be cheaper for cattlemen to buy complete high-energy feeds from feed manufacturers and achieve lower costs of gain than buying hay or forage, which is expensive and difficult to transport and handle. However, more management is required to handle limit feeding high-concentrate diets than to feed roughages. **Warning!! Complete pelleted diets will not work with programmed feeding.** The usual problem with complete pelleted feed is it not possible to maintain adequate roughage particle size to prevent rumen disorders and bloat.

When limit feeding, one must calculate the amount of feed to achieve competitive but restricted gains on growing cattle. PROGFED2 is a Lotus template designed to calculate the daily amount of feed for a pen of cattle. This amount varies with cattle weight, the energy values of the ration, and the desired rate of gain.

**Feeding Management.** Limit feeding of cattle requires special skills and facilities. Minimum requirements are:

1. Adequate bunk space so most cattle can eat at one time.
2. Pens small enough so cattle come up to the bunk when fed.
3. Scales or other methods of weighing out the daily feed.
4. Roughage feeds to work the cattle up to a high-concentrate diet.
5. Skill on the part of the manager.
6. Sufficient business management skill to assess the economic limitations and opportunities in limit feeding of cattle.
7. A sound plan for the use or sale of the cattle following limit growing.

First, a ration must be formulated or purchased. It is simplest to calculate the ration's net energy values (NEm & NEg) on a dry matter basis. Appendix I gives the energy values on a number of common feeds which may be used. Rations used for limited intake growing programs require special formulation. The levels of protein, vitamins, and minerals must be increased over the levels used in ad libitum fed diets. Consult a trained nutritionist or the *1984 NRC Nutrient Requirements of Beef Cattle* for this information. After energy levels are determined, this program (PROGFED2) can be used to estimate the feed intake required to reach a target gain. The user then should compare the amounts of protein and mineral provided against the NRC tables (amount per day for a given weight and gain) and make any necessary additional adjustments. The recently developed "Spreadsheet Programs for Calculating Complete Diets for Beef Cattle and Checking Nutrient Balance" (Extension publication CR-3027 and AUTONRCA) can help the user in this task.

A sample output from *Programmed Feeding for Calves* is included at the end of the article. Most of the inputs are obvious. In the programs distributed on disk from OSU, all cells are protected, except the ones requiring user input. This is done to prevent accidental erasure of critical formulas used in the calculations.

This program will calculate the amount of feed needed by a single animal or a pen of cattle. The cattle will be fed the same amount of feed each day for a two week period. Then, based on the amount of gain presumably achieved, feed will be slightly increased the next two weeks because

| | Inputs | |
|---|---|---|
| Feed Cost Per CWT as is—>> | $7.73 | |
| Ration Dry Matter % —>> | 90.00 | |
| NEM of Feed, MCAL/CWT—>> | 91.49 | |
| NEG of Feed, MCAL/CWT—>> | 58.00 | |
| Initial Shrunk Weight, LBS—>> | 375.00 | |
| Expected Daily Weight Gain, LBS—>> | 2.25 | |
| Number of Head Per Pen—>> | 100 | |
| Pring Increment, Days—>> | 14 | |
| Pen Number—>> | 1 | *1976* |
| Body Type (1 - 7)—>> | 6 | *NRC* |
| | | *EQUATIONS* |
| Steer Calves | | |

****** Press ALT D to Enter Starting Date ******

one is feeding a heavier animal.

The user inputs are illustrated in the following example:

All of the inputs are required except for pen number. Feed cost per cwt, the ration dry matter percentage, and the net energy values (NEm and NEg) need to be calculated from the ration or obtained from the feed supplier. The initial shrunk weight is either the off truck weight or the gross weight multiplied by 0.96 for full cattle. Programmed feeding will only work with cattle uniform in weight, size, age and background. Sorting cattle into similar groups may be necessary before starting.

The user of this program should use judgement when inserting **expected daily weight gain**. Experience has shown that the net energy system, which is used in this program is quite accurate. Target gains set between 1 pound per day and 2.5 pounds per day should be permissible. If gains are set low, the cattle will not receive much feed. If the gains are to be set to lower levels (less than 1.75 pounds per day) the roughage level may need to be increased with the example ration shown in Appendix I.

**The number of head per pen** determines the amount of dry matter or AS FED feed to be delivered to the pen each day. Recent experience at OSU seems to favor once daily feeding rather than feeding twice daily.

**Body Type.** This program included seven net energy equations. They are based on (1 to 5) the 1984 NRC equations. Equations 6 and 7 were used in the original version of this program are retained for those cattle for which they worked well. The original two equations were used most frequently in receiving programs, where weight gain was often a recovery of purchase weights. The equations for large frame cattle (3 and 5) will result in less feed being fed each day for an expected gain. Select the equation which best describes the cattle to be fed. Equations 6 and 7 might best describe the medium frame cattle of the 1970s, possibly what some might call small frame today.

1) Medium-Frame Steer Calves. 1984 Equation.
2) Large-Frame Steer Calves. 1984 Equation.
3) Large-Frame Bull Calves. 1984 Equation.
4) Medium-Frame Heifer Calves. 1984 Equation.
5) Large-Frame Heifer Calves. 1984 Equation.
6) Steer Calves 1974 NRC Equation.
7) Heifer Calves 1974 NRC Equation.

Type 2 also applies to medium frame yearling steers, type 3 applies to large frame yearlings steers, and type 5 applies to medium frame yearling heifers.

The equation selected is identified in the text on the spreadsheet.

****** Press ALT D to Enter Starting Date ****** The format to enter the date on which programmed feeding is to start is MM/DD/YY. The date that starts every two-week period will be printed in the feeding table. This function requires Lotus Version 2. If only have the older version of lotus is available, request the older version of PROGFEED.

Feed cost of gain is computed for every two-week period. Feed cost is only a part of total cost of gain. The user can use the companion template FLCALC (OSU CR-304) to evaluate total cost of gain. To do this, the average feed intake for the period must be calculated.

Apparent gains of cattle over short periods of time are often distorted by changes in “fill.” Limit-fed animals often have less fill than ad libitum fed animals.

### *Programmed Feeding for Calves*

| | Inputs | |
|---|---|---|
| Feed Cost Per CWT as is—>> | $7.73 | |
| Ration Dry Matter % —>> | 90.00 | |
| NEM of Feed, MCAL/CWT—>> | 91.49 | |
| NEG of Feed, MCAL/CWT—>> | 58.00 | |
| Initial Shrunk Weight, LBS—>> | 375.00 | |
| Expected Daily Weight Gain, LBS—>> | 2.25 | |
| Number of Head Per Pen—>> | 100 | |
| Print Increment, Days—>> | 14 | |
| Pen Number—>> | 1 | *1976* |
| Body Type (1 - 7)—>> | 6 | *NRC EQUATIONS* |
| Steer Calves | | |

| | *Per Animal /Day* | | | *Per Pen / Day* | | |
|---|---|---|---|---|---|---|
| Date | Average Weight | Pounds DM | Pounds AF | Pounds DM | Pounds AF | Feed/Only Cost Gain |
| 03/27/92 | 390.8 | 9.19 | 10.21 | 919.10 | 1021.22 | $0.35 |
| 04/10/92 | 422.3 | 9.74 | 10.82 | 974.13 | 1082.36 | $0.37 |
| 04/24/92 | 453.8 | 10.28 | 11.42 | 1028.14 | 1142.37 | $0.39 |
| 05/08/92 | 485.3 | 10.81 | 12.01 | 1081.22 | 1201.35 | $0.41 |
| 05/22/92 | 516.8 | 11.33 | 12.59 | 1133.44 | 1259.38 | $0.43 |

Developed by Donald Gill & Britt Hicks, 1992.
Animal Science Department, Oklahoma State University.
File Name: PROGFED2

## Appendix I

The following is an example ration for a 450-pound steer to gain about 2.25 pounds per day. This is a very high concentrate ration, which cattle will have to be worked up to with caution. For gains less than 2 pounds per day, additional roughage may need to be added to increase feed intake. Special techniques must be employed to manufacture this ration. To maintain a minimum amount of roughage factor, this ration must be manufactured in two stages. First, all the ingredients, except the alfalfa pellets, coarsely rolled or flaked corn, cottonseed hulls and the molasses, are pelleted into a supplement pellet. Second, the supplement pellets are combined with the other ingredients to form the complete ration that is fed. In no case should the corn or the cottonseed hulls be pelleted.

***Composition***

| Feed | DM % | As Fed % |
|---|---|---|
| Alfalfa Pellets | 8.00 | 7.88 |
| Calcium Carb | 0.94 | 0.87 |
| Bovatec 68 | 0.02 | 0.02 |
| Cane Molasses | 3.50 | 4.18 |
| Rolled Corn | 66.16 | 65.91 |
| Cotton Meal SOL | 13.67 | 13.47 |
| Salt | 0.30 | 0.28 |
| Soybean Meal 48 | 2.38 | 2.38 |
| Vitamin A-30 | 0.02 | 0.02 |
| Cottonseed Hulles | 5.00 | 4.98 |
| Total | 100.00 | |

***Ration Composition***

| Nutrients | DM % | As Fed % |
|---|---|---|
| NEm | 91.19 | 81.77 |
| NEg | 58.00 | 52.01 |
| Crude PROT | 15.67 | 14.05 |
| Ether EXT | 3.61 | 3.23 |
| Crude Fiber | 8.01 | 7.18 |
| K | 0.90 | 0.81 |
| CA | 0.56 | 0.50 |
| PHOS | 0.42 | 0.37 |
| TDN | 79.20 | 71.02 |
| Dry Matter | 100.00 | 89.67 |
| Cost/CWT | 8.62 | 7.73 |

## Questions and Answers about Programmed Feeding of Cattle

**1) Q. What is programmed feeding?**

A. Programmed feeding is the daily feeding of a predetermined amount of feed. The amount is usually determined by the energy levels in the diet, the animals energy requirements as influenced by its weight, sex and the desired level of gain.

**2) Q. How does programmed feeding work?**

A. High concentrate "feedlot type" diets have been known to be very efficient. Programmed feeding is the use of similar diets, limit fed to achieve "target levels" of gain. It is a useful technique as long as the "target gain" is less than the genetic gain potential of the animal.

**3) Q. How is the amount to feed determined?**

A. The everyday amount of feed is determined with the net energy system. The factors used are: the net energy values of the diet, the sex, body type, the weight of the animal and the desired rate of gain. A computer is used to do this, and because the animal on programmed feeding is growing, recalculation of the amount to feed about every two weeks required.

**4) Q. How do I start cattle on a high-concentrate diet?**

A. Very carefully!!! High concentrate diets, which are concentrated enough to be cost-effective will, if consumed freely by unaccustomed animals, frequently result in death, acidosis and founder. Like many high-technology products, the potential benefit and the risk with high energy feeds are both very high. A recommendation is that before starting the cattle on the programmed feed, the owner ensure the cattle are full of the old feed. If, for example, the old feed was grass hay, offer free choice grass hay and then start the cattle on 3 pounds or 4 pounds of the high concentrate at the same time. Keep offering the grass hay and each day increase the concentrate feed up to a pound per head per day. When the level of intake of the concentrate reaches the first programmed level, start gradually reducing the amount of grass hay the animals receive. The hay can usually be completely removed about a week after reaching the programmed level of concentrate.

**5) Q. What is the secret of getting cattle on feed without digestive disorders?**

A. The key is gradual and very consistent change in the diet of the animal. Skilled feeders can do this in a very few days. As a feeder acquires skill they will learn to notice what the animals are eating, rather than what was fed. They will learn to tell on a given day if the animals will eat aggressively or much at all. Skilled feeders do not change diets on days when weather or social problems within the herd have upset normal patterns.

**6) Q. How do I use the tables in OSU PROGFED2?**

A. **Step 1.** Fill out the information on the ration IE. (cost, dry matter, NEm and NEg).
**Step 2.** Enter the initial shrunk weight of the cattle.
**Step 3.** After entering the body type (sex and frame type) of the animals, enter the rate of gain desired. Look at the feed-only cost of gain and add to it the non-feed costs that are appropriate. If the costs are not acceptable, change the rate of gain increase to lower costs) and reevaluate. Remember, cattle grown at rates exceeding 2.25 lbs per day are usually not useful for later grazing medium- or low-quality pastures. Cattle grown at high rates of gain are usually severely discounted as feeders as well.
**Step 4.** Enter the number of cattle in the pen. This will result in the calculation of the pounds of dry matter or "as is" feed required each day for the first two weeks.

**7) Q. Should I feed once a day or twice daily?**

A. If bunk space is adequate so all cattle can eat comfortably at one time, once-daily feeding will cost less to accomplish. Experience at OSU clearly shows an advantage to once-daily feeding if the desired level of gain results in a low amount of feed being fed. In some cases, the cattle will consume the entire day's feed in as little as 10 minutes to 20 minutes. When this happens, the cattle will have to be trained or sorted to get to the bunk and get their share. However, if bunk space is limited, it may be best to feed twice daily. If feeding twice daily, the ration must be bulked up with roughage and the target gain set high enough that there will be feed in the bunk for at least 5 hours to 6 hours out of the day. One feedlot that has used these programs on thousands of cattle and has limited bunk space, feeds first at 8 a.m. and then comes back with the second feeding at 11 a.m. Good results have been reported and have observed this technique allows the "timid cattle" best access to feed. The first feeding satisfies the more aggressive eaters and permits timid cattle the opportunity to come to the bunk. To use PROGFED2 to produce a sheet showing the amount of feed for each of a twice per day feeding schedule, enter half the number of cattle in the pen. If there is an odd number of cattle in the pen, enter number including the fraction (for example, 41.5 for a pen 83 head).

**8) Q. What will happen if a day's feeding is missed due to breakdown or other problems?**

A. Depending on the degree of restriction and how "hot" the ration is, there is a possibility to ruin or kill cattle if the same feed is put out at a later time. If something makes you late with a feeding, the cattle will need to be filled with hay and work them

up on feed again. Doing this will be at a high cost, because gain and feed efficiency of the cattle will be adversely affected during the workup period.

**9) Q. Are there cattlemen who should not even consider programmed feeding?**

A. Yes, producers who have a history of not getting things done on a regular time schedule should not attempt programmed feeding. The same with producers who seem to have more than their share of breakdowns. One experienced feeder relates the story of a pen of cattle that had been, and were used to being, fed at exactly 8 a.m. and one day, they were 30 minutes late in the feeding, the cattle were very upset. The producer stated that if they knew that they were going to be late again, they would at least have offered a reasonable amount of hay at the regular feeding time.

**10) Q. Why not simply feed the animals all they want to eat?**

A. For a feedlot, that is what they will do, unless there is good reason. For example, they want the cattle to gain less than two pounds per day. The real potential for programmed feeding is in the "growing" or holding of animals. For example, a 600 pound steer could be grown at a rate of 2 pounds per day on a self-fed low energy ration. It could eat 24 pounds per day of feed. However, it is possible to formulate a high-energy diet, which would give the same gain with 12 pounds of feed. The best program is likely to be the one that costs the least per day if both give the same gain.

**11) Q. Are high-energy feeds more expensive?**

A. Per pound, usually yes, but in terms of gain potential per dollar, usually not. Cost per unit of gain in the cattle business is what is important along with market timing. These are the reasons for considering programmed feeding.

**12) Q. Does it pay to have cattle gain less than their maximum genetic potential?**

A. From a true biological efficiency standpoint, never. However, market timing and the potential for using forage resources at a later date, or the opportunity for better balancing cattle and forage often spell profit opportunity in holding cattle at less than maximum gain.

**13) Q. Are rations for programmed feeding hard to develop?**

A. No. The important factors in developing rations are to formulate to obtain a high NEg value per dollar of ration cost, then adjust the protein and mineral content of the ration to the animal's requirements, determined by the selected gain, the animal's weight, sex and frame size. Cattlemen could buy complete rations or buy specially formulated supplements for on-the-site mixing with grains and roughages. Warning!! Complete pelleted diets will not work with programmed feeding. The usual problem with complete pelleted feed is that it is not possible to maintain adequate roughage particle size to prevent rumen disorders and bloat. However, rations can be developed with only whole corn and specially formulated supplement pellets. With the whole corn program, the supplement and whole corn will have to be carefully mixed before they are fed.

**14) Q. How do different feeds rank in terms of gain potential?**

A. The following table shows the NEm and NEg values of some common feeds. Note the difference in the NEg values of wheat straw and corn, for example. Corn has 67 and wheat straw has 7, showing that corn has nearly 10 times the potential for adding weight gain to cattle as does the straw. Non-feedlot cattlemen should study this table carefully. Note that a lot of feeds that have good utility as supplements for grass have non competitive NEg values. Unless these feeds are very low priced they may not work from a financial viewpoint. Examples of lower NEg feeds are wheat middlings, cottonseed meal and all the roughage feeds. Examples of high-nutrient density feeds are corn, well processed milo, wheat and soybean meal. Net energy values of selected feeds shown below are expressed as megacalories per 100 pounds of dry matter. These values are for typical high-quality feed ingredients found in feedlot diets.

| ***Feed*** | ***Megacalories/Cwt DM*** | |
|---|---|---|
| | NEm | NEg |
| Alfalfa, dehy. 17% | 66 | 31 |
| Alfalfa hay, excellent | 66 | 34 |
| Alfalfa hay, good | 57 | 27 |
| Barley, 48-52#/bu. | 97 | 64 |
| Barley, 44-46#/bu. | 80 | 53 |
| Barley, 38-42#/bu. | 73 | 46 |
| Cane molasses | 79 | 50 |
| Corn, dent no. 2 | 103 | 67 |
| Corn silage, typical feedlot | 73 | 43 |
| Corn silage, high grain | 73 | 46 |
| Corn stover | 56 | 27 |
| Cottonseed meal | 77 | 50 |
| Cottonseed hulls | 47 | 10 |
| Cottonseeds, whole | 91 | 54 |
| Fat, blend | 208 | 127 |
| Hominy feed | 100 | 65 |
| Milo, minimum process | 80 | 53 |
| Milo, semi process | 90 | 60 |
| Milo, extensive process | 97 | 64 |
| Sorghum silage | 67 | 30 |
| Soybean oil meal | 87 | 59 |
| Wheat | 100 | 65 |
| Wheat middlings | 73 | 45 |
| Wheat Straw | 16 | 7 |

**15) Q. How do I know if a ration is feasible from a financial standpoint?**

A. Use the programmed feeding program (PROGFED2) to calculate the "feed only" cost of gain. After adding the appropriate fixed costs to this figure, determine if the cost is feasible from an economic standpoint. Predicting gain by means of the net energy equations has proven quite accurate in the past, it will be foolish to think costs might be less than the projections. If anything does go wrong, it will likely be that the gains may be lower because of delay in working cattle up on feed.

**16) Q. Should ionophores (Rumensin or Bovatec) be included in diets for programmed feeding?**

A. Yes, either product at the recommended level will improve both the rate and efficiency of gain. There is good reason to believe diets formulated for programmed or limit feeding may not work well without the ionophore. Many of the potentially undesirable effects of feeding very high concentrate diets are moderated or reduced by ionophores.

**17) Q. Should antibiotics be included in high concentrate diets designed for programmed feeding?**

A. Maybe. Antibiotic feeding can improve the efficiency of feed conversion. If using Rumensin including the antibiotic Tylan in the formula may be used. If using Bovatec include Terramycin at a level of 75 mg per head per day may be used. The use of antibiotic should aid in preventing liver abscesses that presumably reduce gains in cattle. The levels of antibiotic included with ionophores will have little or no effect on shipping fever. As the amount of roughage is increased the advantage for the antibiotic decreases.

**18) Q. Should I offer a small amount of grass hay each day along with the programmed ration?**

A. Not after the cattle are worked up on feed. A minimum amount of "roughage factor" must be built into the programmed ration. After this is done, any additional roughage will only reduce the efficiency of the program.

**19) Q. Will programmed feeding work with pasture cattle?**

A. No. The reason is if the ration is palatable and plenty of pasture is available, then a substitution of feed for grass will occur. Because of the variation in the quantity and palatability of forage produced day-to-day, it will be impossible to predict total nutrient intake, and thus gain. The ideal ration for drylot programmed feeding will be a very poor supplement for grass due to the negative associative effects of the diet and forage.

**20) Q. How do I prepare the cattle for Programmed feeding?**

A. The cattle to be fed together need to be as uniform as possible in body type, weight, size, age, disposition and previous background. This means sorting cattle in most cases. The cattle should also be healthy, which means that many groups will have to go through a conventional receiving program before they are ready for feeding.

**21) Q. What kind of cattle are the best prospects for programmed feeding?**

A. Usually calves and very light-weight yearlings. When cattle are weighing more than 600 pounds, because of their size, the efficient gains necessary to make programmed feeding economically feasible are almost impossible to obtain, unless the ration is very inexpensive in relation to the value of gain of stocker cattle.

**22) Q. What do you mean by "value of gain"?**

A. At any time other producers and cattle feeders, in particular, are unwilling to pay more for added weight on cattle, than thought to add it themselves. For example, if 500-pound steers were selling for $1.00 per pound or $500 per head, and if cost of gain in the industry was perceived at $.50 per pound, then a 600-pound animal might be worth $500 + $50 or ($550 divided by 600 pounds or $91.66 per hundred weight). When evaluating any feeding program, the producer should always know the current "value of added weight gain" on stockers and feeders. Just because calves are selling for $100 per cwt does not mean that the gain added is going to be worth that much.

**23) Q. What happens if all the feed is consumed before some of the weaker or timid cattle get to the bunk?**

A. When this happens, a quick reaction to remove these animals from the pen and restart them in an environment in which they can compete. The alternative is dead or severely low-growth cattle. Make provisions to have a place for these cattle before starting to program feed. In many cases, some of these animals may be returned to the larger group after gaining strength and becoming competitive.

# The Oklahoma Cooperative Extension Service
## *Bringing the University to You!*

The Cooperative Extension Service is the largest, most successful informal educational organization in the world. It is a nationwide system funded and guided by a partnership of federal, state, and local governments that delivers information to help people help themselves through the land-grant university system.

Extension carries out programs in the broad categories of agriculture, natural resources and environment; family and consumer sciences; 4-H and other youth; and community resource development. Extension staff members live and work among the people they serve to help stimulate and educate Americans to plan ahead and cope with their problems.

Some characteristics of the Cooperative Extension system are:

- The federal, state, and local governments cooperatively share in its financial support and program direction.
- It is administered by the land-grant university as designated by the state legislature through an Extension director.
- Extension programs are nonpolitical, objective, and research-based information.
- It provides practical, problem-oriented education for people of all ages. It is designated to take the knowledge of the university to those persons who do not or cannot participate in the formal classroom instruction of the university.
- It utilizes research from university, government, and other sources to help people make their own decisions.
- More than a million volunteers help multiply the impact of the Extension professional staff.
- It dispenses no funds to the public.
- It is not a regulatory agency, but it does inform people of regulations and of their options in meeting them.
- Local programs are developed and carried out in full recognition of national problems and goals.
- The Extension staff educates people through personal contacts, meetings, demonstrations, and the mass media.
- Extension has the built-in flexibility to adjust its programs and subject matter to meet new needs. Activities shift from year to year as citizen groups and Extension workers close to the problems advise changes.



Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Director of Oklahoma Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma. This publication is printed and issued by Oklahoma State University as authorized by the Vice President, Dean, and Director of the Division of Agricultural Sciences and Natural Resources and has been prepared and distributed at a cost of 42 cents per copy. Revised 0715 GH

**ANSI-3925-8**