Balancing Ration for Beef Using Pearson Square Method

By

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It is important to supply the required nutrients in rations of beef cattle in order for an operation to remain profitable. Nutrient deficiencies lead to reduced growth, low reproductive performance and poor animal health that can be costly. Rations can be balanced by using the Pearson Square method, substitution formulation and computer programs for feed formulations. The use of Pearson square is most effective when only two feeds are being used. In addition, the animal requirement (i.e. the number in the center of the square must fall between the nutrient concentrations in both feeds). For example, if the animal requirement is 10% crude protein, then one feed must be greater than 10% and the other must be less than 10%.

A ration can be balanced for Total Digestible Nutrient (TDN) and crude protein (CP), fat (EE) etc. When balancing beef rations for these nutrients, the method requires their nutritive values which can be found in the farm's forage/feed analysis reports or from University of Florida publications. Table 1. lists the ingredients that will be used to balance a beef ration using Bahia grass hay referred to in this article as Bahia hay, whole shelled corn and cottonseed meal.

Table 1 Nutritive Value of Feed Ingredients Used in Balancing Beef Ration

Feedstuff	**% Dry Matter**	**% TDN**	**% CP**
Bahia hay	93	51	8
Whole shelled corn	88	88	9
Cotton seed meal	92	75	49

The nutrient requirements of the animal must be known as well. Nutrient requirements vary with the weight, sex, average daily gain etc. These are taken from the Nutrient Requirements of Beef Cattle (Updated 2000). A ration will be balanced for a 500 lb. heifer with an average daily gain of 1.5 lbs., and requiring 68.5 TDN and 10.3 % crude protein.

Table 2. Daily Gain, Dry matter Intake, Total Digestible Nutrient (TDN) and Crude Protein (CP) for Heifers

Stage of Production	Daily gain	Dry Matter Intake	Total Digestible Nutrients		Crude Protein	
Heifers	Lb.	Lb.	Lb.	%	Lb.	%
500	0	9.8	4.9	50.0	0.75	7.6
500	0.5	11.0	6.2	56.0	0.94	8.5
500	1.0	11.8	7.3	62.0	1.11	9.4
500	1.5	12.1	8.3	68.5	1.25	10.3

Nutrient Requirements of Heifers and Cows, NRC 2000

Steps in Balancing the Ration

Step 1. To balance the TDN in a ration draw a square and put 68.5 (the desired TDN) in the center of the square.

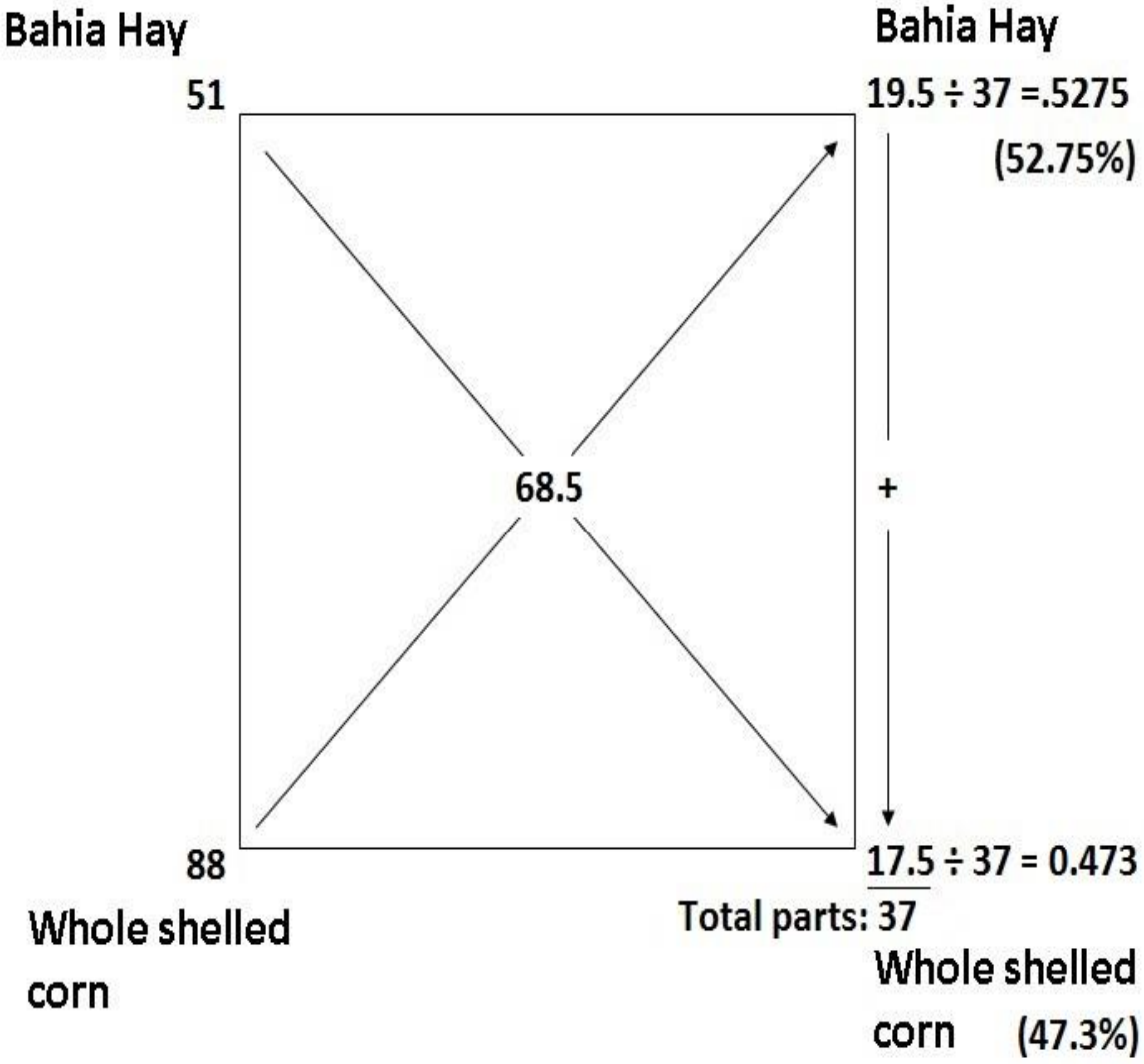
Step 2. Write the TDN value for Bahia hay (51) on the upper left corner of the square, and whole shelled corn (88) on the lower left corner.

Step 3. Write Bahia hay and whole shelled corn on the right side of the square.

Step 4. Subtract diagonally the smaller number from the larger number (68.5 - 51 = 17.5; 88 - 68.5=19.5) Write the results on right side of square.

Step 5. Divide the Bahia hay and the whole shelled corn by the total parts to get their preliminary percentages. For Bahia hay it is (19.5 ÷ 37 = .527 = 52.7%) and for whole shelled corn it is (17.5 ÷ 37 = .473 = 47.3%)

The image of the Pearson Square should look like the one on the next page.



Step 6. Next calculate the protein concentration in the Bahia hay and the whole shelled corn by multiplying each feed ingredient percentage by its crude protein.

Bahia hay =	.527 X 8 =	4.216
Whole shelled corn	.473 X 9 =	4.256
		8.472

Step 7. Find out if the crude protein is adequate in the ration. The concentration in the Bahia hay and whole shelled corn is 8.47%. The heifer requirement is 10.3 %. Therefore 1.83 % CP (10.3-8.47) is lacking in the ration. It can be increased by adding a protein

supplement such as cotton seed meal.

Step 8. Once again use Pearson Square method to balance for crude protein.

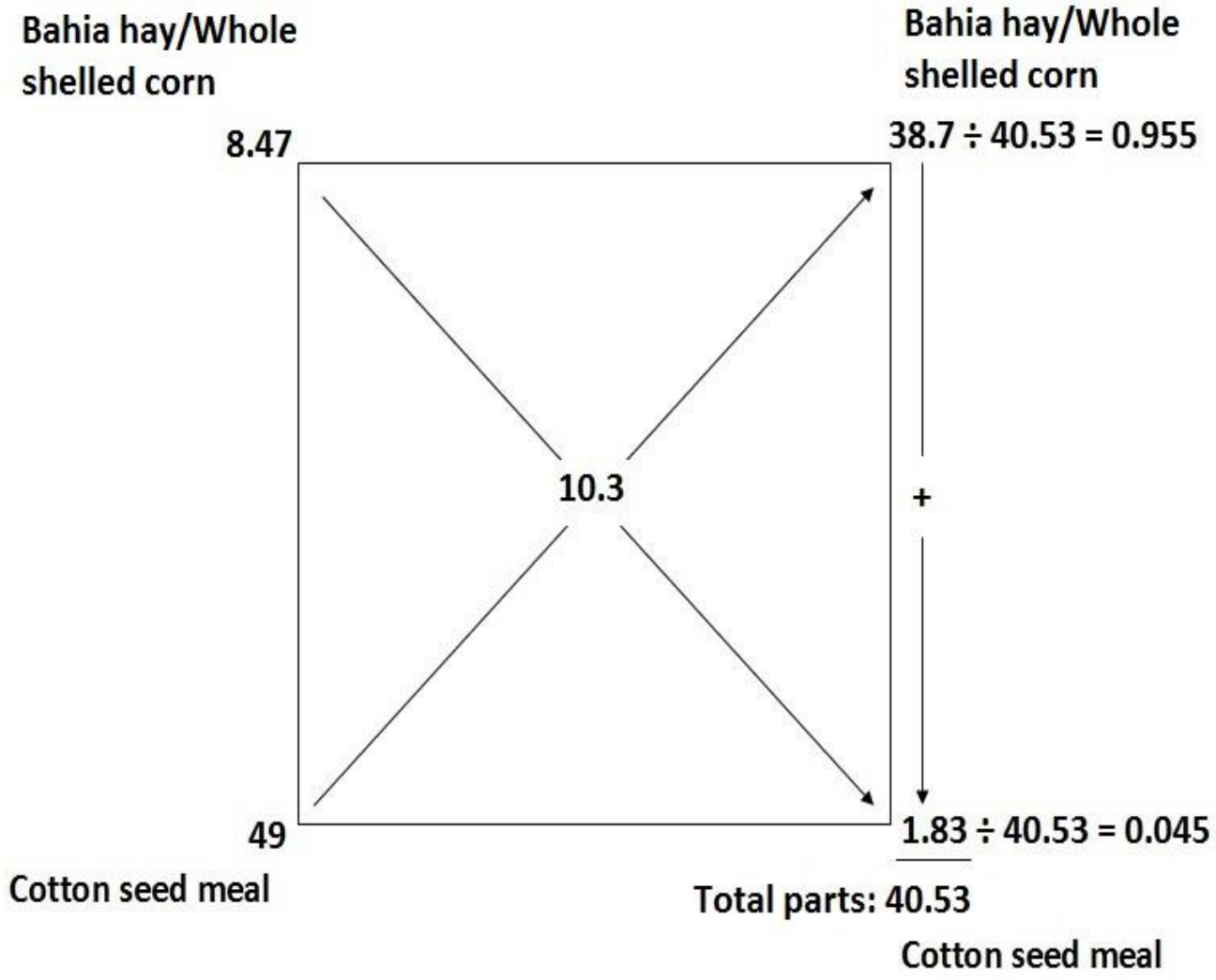
Step 9. We now have to use Bahia hay/whole shelled corn mix as a feedstuff (8.47%) which goes on the upper left corner, and cotton seed meal (49%) which goes on the lower left corner.

Step 10. Subtract diagonally the small number from the large number (10.3 – 8.47) = 1.83; (49-10.3) = 38.7. Then write the numbers on the right side of the square.

Step 11. Add the (CP values) on the right side of the square (38.7 + 1.83 = 40.53). 12. Divide the Bahia hay/whole shelled corn and cotton seed meal to obtain the preliminary percentages (38.7 ÷ 40.53 = .955) and (1.83 ÷ 40.53 = .045).

Step 12. The result shows that 95.5% of Bahia hay/whole corn and 4.5% of cotton seed meal make up a ration consisting of 10.3% CP.

The image of the Pearson Square should look like the one on the next page.



Step 13. Calculate the pounds of dry matter that each feedstuff contributes to the total ration. Multiply pounds of dry matter required on a daily basis (12.1) by the percentages of the cotton seed meal. The dry matter component made up by cotton seed meal is (12.1 X .045) = 0.5445 lbs. Therefore the amount of dry matter that should come for Bahia hay/whole shelled corm is (12.1 - .5445) = 11.55 lbs.

Step 14. In order to calculate the amount of dry matter from Bahia hay and whole shelled corn, multiply 11.55 by the percentage of Bahia hay and whole shelled corn that was obtained in **Step 5.**

These can be seen in the table below on table 3.

Table 3. Composition of the ration on a DM basis.

Bahia hay (Lbs.)	11.55 X 0.527	6.09
Whole shelled corn (Lbs.)	11.55 X 0.473	5.46
Cottonseed meal (Lbs.)		0.55
Total (Lbs.)		12.1

Step 15. Since the ration was calculated using the values on a dry matter basis, they must be converted to an "as fed basis" by dividing each feed ingredient by its dry matter percentage.

Bahia hay = 6.09 ÷ .93 = 6.55

Whole shelled corn = 5.45 ÷ .88 = 6.20

Cotton seed meal= 0.544 ÷ 92 = 0 .59

Making 1000 Lbs. of the Feed

Bahia grass hay	(6.55/13.34) X 1000	491 lbs.
Whole shelled corn	(6.20/13.34) X 1000	465 lbs.
Cotton seed meal	(.59/13.34) X 1000	44 lbs.
Total		1000 lbs.