Improved Livestock Distribution with Fertilizer—A Preliminary Economic Evaluation[1]

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Highlight

The use of fertilization to increase forage production is widely known. The value of fertilizer as a tool for improving livestock distribution has often been alluded to, but seldom measured. The findings of this pilot study indicate there are three potential benefits from fertilization and two separate situations under which fertilizer benefits can be analyzed. The study further indicates that the value of fertilization for improving distribution may be of great magnitude. Here-to-fore evaluation of fertilizer applications on range lands has emphasized increased forage production. Correct evaluation of fertilization benefits must recognize both increased forage production and improved livestock distribution. This paper represents an advance in range fertilization evaluation theory.

Mejoramiento de la Distribucion del Ganado con Fertilizacion Evaluacion Economica Preliminar

Resumen[2]

El estudio se llevó a cabo en un pastizal de montaña del norte de Utah. La fertilización aumentó la producción de forraje, pero cuando se analizó únicamente el incremento de producción no resultó económico. Sin embargo la fertilización mejoró la distribución del ganado y el valor del mejoramiento de la distribución del ganado en el pastoreo por si solo pagó la fertilización. Por lo tanto basándose en este estudio la fertilización es recomendada únicamente como parte de un plan de manejo bien desarrollado.

In most range fertilization studies, emphasis has been placed on increased forage production. Increased production is correctly emphasized when livestock use is uniformly distributed over the grazing area before fertilizer is applied, and if distribution is not altered by the fertilizer application. However, fertilizer may also be used as a tool for improving livestock distribution on mountain range lands. Fertilized areas produce forage of increased palatability. Consequently, fertilized areas are utilized to a greater degree than are untreated areas. Utilization of areas surrounding the treatments is also increased since the livestock are drawn to the fertilized forage (Cook, 1963). This study was initiated as a pilot test of the economics of fertilizer as a tool to improve livestock distribution.

Methods

Vegetation.—In this preliminary study, a trial was established in the Cache National Forest in northern Utah on terrain typical of the mountainous aspen and sagebrush-grass range (approximately 25 inches total precipitation) used for summer grazing in the Intermountain area.

Since the main objective was to measure the effectiveness of fertilizer as a tool to improve livestock distribution, only one treatment was made. Nitrogen fertilizer (as 60 lb/acre of elemental N) was applied in the autumn to small areas (10–15 acres) of strategically located native mountain range.

Growth responses were obtained from protected sample areas of both treated and untreated forage the following summer. Utilization measurements were made on the treated areas, on contiguous range surrounding the treatments, and on areas sufficiently removed from the treatments so as to not be influenced by preference for the fertilized forage.

Economics.—The potential benefits of range fertilization are of three types: (a) increased forage production on the treated areas; (b) increased utilization on treated areas; and (c) increased utilization of the range surrounding the areas fertilized. Benefits (b) and (c) are additive with each other. Benefit (a) may be combined with benefit (b) providing that only the increased forage which is actually utilized is included in the calculation. In addition to the three potential benefits, there are two possible situations under which fertilizer benefits can be analyzed: (1) where fertilizer has no effect on livestock distribution; and (2) where fertilizer does affect distribution. Each situation requires a different analysis and particular care should be taken to avoid double counting.

Analyses of fertilizer responses under the assumption of the first situation are essentially measurements of benefit (a). Analyses of fertilization in the second situation involve a combined measurement of benefits (a) and (b) and these must be added to an independent measurement of benefit (c).

Benefits

When Distribution Is Not Affected.—Forage yields on the control area averaged 1,580 lb/acre while yield on the treated area averaged 2,160 lb. This was an increase of about a 580 lb/acre in forage production, or 0.64 AUM/acre (AUM = 900 lb of usable forage). With nitrogen costs of approximately 12 cents/lb, the fertilizer cost on the

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treated area was $7.20/acre. Application costs were approximately $1.50 for a total cost of $8.70/acre.

Assuming an AUM value of $3.50, the value of the increased forage, if completely utilized, was $2.24/acre (0.64 × $3.50). There was a carryover effect into the second year of approximately 100 lb of forage production valued at about $0.40. On the basis of production analysis alone, fertilization does not appear profitable. However, further tests at multiple rates must be made to test first year and carryover effects before a final judgment is made.

This type of analysis is applicable to cases where the entire range area is fertilized or where control over the number and distribution of animals is such that the additional fertilized forage is completely utilized and there is no effect on livestock distribution.

When Distribution Is Affected.—On ranges where the whole area is not fertilized or where fertilization changes the distribution, a different analysis is necessary. In this study, animals did not seek out the fertilized areas, but in the process of herding (Workman and Hooper, 1968), animals were drifted onto the fertilized areas. Of those animals drifted onto treated areas, approximately 45% returned in the next 7 days. On untreated areas, only 30% of the animals returned. This increased frequency of use resulted in 60% forage utilization on the treated areas as compared to only 27% on untreated areas. Approximately 876 lb or 0.97 AUM/acre (2,160 × 60% minus 1,580 × 27% = 876 lb) were gained through improved distribution and increased forage production (combined benefits a and b).

Assuming a value of $3.50 per AUM, the value of the increased yield and utilization is $3.40 per acre (0.97 × $3.50).

Increased utilization in the second year due to the carryover effect was spotty, but averaged about 15%. The value of this increased utilization (if increased forage production is ignored) is about 0.26 AUM (1,580 × .15) or $0.91/acre. An increased utilization carryover effect averaging approximately 10% was noted in the third year following fertilization. The value of this carryover is $0.63/acre.

To compute the value of fertilization, it is necessary to convert benefits to the time base during which the costs were incurred (the revenue stream must be discounted). Using a "present worth of one" table (American Institute of Real Estate Appraisers, 1967), the value of the increased utilization discounted at 10% is $3.40 (the value in the first year) plus $0.83 ($0.91 × .91) plus $0.52 ($0.62 × .83) for a total value of $4.75.

Increased utilization on range adjacent to that fertilized (benefit c) also must be measured. Utilization was increased by as much as 20% in the year of fertilization and carryover effects of lesser magnitude were experienced for two years following fertilization. In this pilot study, insufficient sampling did not allow identification of the unfertilized area influenced by the fertilized area. The magnitude of benefit (c) is the subject of further study. However, based on observations in the study area, for each acre fertilized, approximately 10 acres of unfertilized range received a 10% increase in utilization. The increase of 1,580 lb/acre (1,580 lb × 10 acre × 10%) or 1.75 AUM/acre would be valued at $6.12. Thus, the total value of the three benefits combined was $10.87. Since costs were $8.70, the net return to fertilization was $2.17.

It is of interest to evaluate the benefits obtained by improved livestock distribution alone, separate from the benefits of increased forage production. An estimate of these benefits is $2.03 (33% × 1,580 lb = 521 lb = .58 AUM × $3.50) plus $0.83 for the second year, plus $0.52 for the third year on the treated area, plus $6.12 due to increased utilization on adjacent areas. The total value is $9.50. Based on these figures, the value of improved distribution alone covers the cost of fertilization.

Conclusions

The value of fertilizer for improving forage yields is obvious. The value of fertilization as measured by improved utilization has often been alluded to, but seldom measured. This study indicates that in the mountain range lands of northern Utah where obtaining uniform livestock use is a problem, fertilization may prove useful as a livestock distribution tool. The value of improved livestock distribution alone is difficult to isolate, but it may be of termendous value. Valuing increased forage production alone does not give a true picture of benefits from fertilization.

Each soil and/or range site will exhibit different responses to fertilization; therefore, no general recommendations can be made. In this particular study area, fertilization was profitable; but, only because of coordinated management techniques. Obtaining full economic value of fertilization requires more animals or a longer grazing season to use the increased AUMs due to increased production and better distribution. Care must be taken not to fertilize areas where animals normally congregate and to make the fertilized areas sufficiently large (perhaps about 30 acres) so that excessively heavy use is not experienced. This point cannot be over emphasized! In this study, some areas which were too small or which were incorrectly located received damaging use. Fertilizer placement must be coordinated with herding, salting, and water development.

The primary contribution of this paper is to present the correct fertilizer evaluation procedure and show how it might be used. Evaluation of fertilizer applications must account for three types of benefits. Before a fertilizer program is undertaken, a pilot project should be conducted. The project need not be even as elaborate as the one conducted in this study, but a preliminary trial which gives information on the three potential benefits from fertilization avoids wasting money on a large scale project in the event that fertilization proves unprofitable.

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