tions regarding costs and revenues, campgrounds failed to yield benefit-cost ratios of one or greater.

Does recreation pay? The answer is a conditional yes, within the context and assumptions of this case study. But the results do not give an unconditional, conclusive answer equally applicable to all forests. Some important elements in the decison to change land-use from timber to recreation have been identified, but the weight properly attached to these factors obviously will vary from one forest to another. Moreover, the analysis considers only those benefits which are calculated in money returns. To some owners other benefits may also be important. For example, a large industrial owner whose lands are open to public recreation may wish to operate campgrounds as a means of controlling the place and manner of the camping that would probably occur even in the absence of such facilities. Finally, given uncertainties surrounding factors which influence costs and returns, the element of risk may loom large in the minds of some landowners. For this reason alone, study results should be interpreted with caution. In the last analysis, the question, "Does recreation pay?" can be answered in any specific circumstance only through informed, carefully conducted advance planning.

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Fertilization method and nitrogen content of annual flowering plants

TOK FURUTA · JOHN RIBLE

LYLE PYEATT

UNIFORM NITROGEN CONTENT in the foliage is desirable for optimum growth of annual flowering plants (bedding plants). Two of many fertilization procedures suggested to maintain this uniform level, include the use of controlled release nitrogen fertilizers, and constant fertilization at each irrigation with a dilute fertilizer solution. Tests reported here, were to determine the ability of these procedures to maintain nitrogen uniformity during early growth under commercial conditions.

Seedlings of petunia Pink Satin and zinnia Giant Dahlia were grown in a lightweight mix of two parts sand, two parts perlite, three parts redwood sawdust and two parts peat. Single superphosphate, oyster shells, dolomite limestone, and iron sulfate were incorporated into the mix. Differential fertilizer treatments began 12 days after the transplanting of the petunia plants, and 17 days after the transplanting of the zinnia plants. These treatments were: (1) controlled release nitrogen only; (2) constant fertilization only; and (3) a combination of controlled release and constant fertilization. The controlled release nitrogen treatment was sulfur-coated urea applied as a top dressing. The product was 32 per cent N, 25.6 per cent sulfur coating, and it had a dissolution rate of 5 per cent. The constant fertilization treatment consisted of applying nitrogen, phosphorus, and potassium at each irrigation.

Medial leaves

Medial leaves were collected at the time of treatment and from all treatments five times during the experiment, beginning 10 days after treatment and ending 37 days after treatment. The leaf samples were analyzed for total nitrogen content, and soil samples were collected at that time.

At the time of the treatments, the zinnia and petunia plants had leaf nitrogen contents of 4.20 per cent. There was less variation in nitrogen content of the foliage of both species when the combination fertilization was used than when either method was used alone (see

TOTAL NITROGEN CONTENT OF FOLIAGE AND SOIL pH OVER A SIX-WEEK PERIOD, AS INFLUENCED BY FERTILIZATION PRACTICE

Plant	Fertilization program	Leaf nitrogen		Soil pH	
		Average	Standard deviation	Average	Standard deviation
		%	%		
Petunia	Constant fert, alone	4.9	0.54	7.1	0.21
	Controlled release, alone	5.3	0.35	7.1	0.21
	Constant fert, plus controlled release	5.7	0.30	7.0	0.20
Zinnia	Constant fert, alone	4.3	0.30	6.8	0.26
	Controlled release, alone	3.5	0.38	6.8	0.17
	Constant fert, plus controlled release	4.6	0.15	6.9	0.23

table). The combination treatment also resulted in highest leaf N content. Only one-half the amount of controlled release N was used on plants in the combination treatment as was used on plants where controlled release N was the only fertilization.

Soil tests did not show significant variation between treatments with regard to pH, salinity, P, K, Ca and Mg content. The pH ranged from 6.5 to 7.4 and the salinity was not high enough to adversely influence plant growth.

Temperature and microbial activity have been reported to influence the release of nitrogen from granules of sulfur-coated urea. The plants in this experiment were subjected to normal outdoor fluctuation in temperature which may account for some of the variation noted.

The length of the experiment probably was too short for a change in pH to be reflected as the sulfur was converted to sulfates. Even had this happened, the change would have been slight because a very small amount of sulfur was applied—6 to 12 grams per cubic ft of soil mix.

The reason for dilute applications of fertilizer at each irrigation (constant fertilization treatment) was to supply nitrogen as required. The procedure is based on the assumption that water use (evapotranspiration) and plant growth are closely correlated. While it is evident that the correlation is close enough for practical use, it is also evident that difficulties can arise from complete reliance on the procedure. The fluctuation in leaf N suggests that it may be below optimum levels at times. Also, changes in rate of evapotranspiration may not always be correlated with plant growth. Such environmental conditions as dry wind may increase evapotranspiration, without a corresponding increase in growth. Repeated applications of dilute fertilizer solution (under such conditions) may result in an injurious buildup of salt levels.

A combination of controlled release and constant fertilization overcame the difficulties of each treatment used separately, and resulted in greatest uniformity of N content. This was reflected in the uniform growth of the test plants.

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Effects of

SHALLOW VS. DEEP IN

AND SEMEN

ON TURKEY FERTILITY

F. X. OGASAWARA · J. P. SCHROEDER · R. A. ERNST

PREVIOUS RESEARCH has attributed a decline in turkey fertility to shallow insemination into the oviduct of the turkey hen. The study reported here was conducted to obtain more information on the effects of variations in depth of insemination, and/or dosage of semen during the artificial insemination (A.I.) process.

Small Bronze turkey hens were reared on the range of the poultry experimental farm at Davis until they were 24 weeks of age, and were then transferred to turkey cages. At 30 weeks of age, the hens were randomly divided into five groups (14 to 15 hens per group), and given 15 hours of light. Insemination was performed according to the experimental design (table 1) at biweekly intervals. Semen doses were measured as accurately as possible by aspiration into 4-inch sections of glass pipettes calibrated to read in .001 ml. The semen was expelled from plastic tubes by the exhalation technique at the predetermined depth. Eggs were gathered through the day, stored under standard conditions, and set weekly in the departmental hatchery. Fertility was determined by candling after seven days of incubation, and is reported in table 3 as the percentage of live embryos. Additional data from the five experimental groups of hens were obtained on rate of lay, number of days of fertility, and percentage of hatchability.

Two groups of 12 males were each grown under the same conditions as the hens until they were 24 weeks of age, after which they were confined in two floor pens. Semen quality was assessed by laboratory tests on alternate weeks, when semen was not being collected for A.I. Volume, concentration, motility, live-dead ratio, and methylene-blue reduction time were determined. The results of these tests indicated that the males were in normal reproductive condition throughout the 12-week trial. Although the confinement of turkey hens in cages usually results in decreased egg production, during the 12 weeks of this experiment, the hens were laying at a normal rate (table 2).

TABLE 1. DESIGN OF EXPERIMENT

Groups	No. Hens	Procedure
A	16	.03 ml semen; Deep* A.I.
B	14	.005 ml semen; Deep A.I.
C	14	.03 ml semen; Shallow† A.I.
D	14	.01 ml semen; Shallow A.I.
E	16	.005 ml semen; Shallow A.I.

* A.I. at least 2 inches into oviduct.
† A.I. into orifice oviduct.

TABLE 2. PERCENTAGE OF TURKEY EGG PRODUCTION

	Week of lay					
Group*	1–2	3–4	5–6	7–8	9–10	11–1
			Deep insemination			
A (control)	70.9	64.3	68.2	66.5	62.0	58.1
B	64.3	58.1	65.1	60.7	54.1	52.[illegible]
			Shallow insemination			
C	67.7	71.4	61.2	58.7	56.6	53.8
D	67.3	67.3	68.4	63.3	57.1	58.2
E	62.8	57.6	58.9	56.7	54.2	49.5

* No. of hens per group: 14 or 16.