SELENIUM SUPPLEMENTATION OF MULE DEER IN CALIFORNIA

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Abstract: Selenium (Se) deficiency is documented in several species of wild ruminant animals in California. Because it has been shown that Se intrarumenal pellet supplementation of mule deer (*Odocoileus hemionus*) does can triple fawn survivability, we collected limited pilot data on the consumption of several formulations of livestock range blocks and loose mineral by deer. Our experience indicated little opportunity for Se supplementation of deer by this route. We were unable to identify ingredients that fostered measurable consumption. The safety and efficacy of using a commercially produced Se fertilizer (1% Se as selenate) on deer browse was also evaluated as a means of elevating Se in the diet. On our limited plots, Se fertilizer was effective at elevating Se content of deficient forage to efficacious levels when applied at 1 kg/ha. When applied at 4 kg/ha, Se uptake from fertilization remained below the minimal toxicity level. Larger scale fertilizer work with browse is in progress. Opportunities exist for further research into improving fawn survivability by Se supplementation.

SELENIUM DEFICIENCY

Selenium deficiency has been documented in mule deer in California (Oliver 1990). The first quartile means of pronghorn antelope (*Antilocapra americana*), elk (*Cervus elaphus*), and bighorn sheep (*Ovis canadensis*) sampled in California have had blood selenium levels suggestive of selenium deficiency (Masupu 1990). Over 60% of ranch cattle in California have been reported to be selenium deficient (Williams 1980, Dunbar et al. 1988). The effect of supplemental Se on enhancing fawn survival was demonstrated by administering Se rumen pellets to pregnant, Se deficient does. Fawns born of selenium supplemented does had survivability rates that averaged 2.6 times higher than unsupplemented controls (Flueck 1989).

SUPPLEMENTS

In 1983 and 1984 we evaluated four commercially produced livestock range block supplements for consumption by deer. These blocks contained 10 to 20% salt and ranged from 18 to 21% protein. Principal ingredients included cottonseed meal, ground grain, rice bran, alfalfa meal, cane molasses, and whey solubles as well as an added minerals list including calcium, phosphorous, magnesium, manganese, zinc, iron, copper, iodine, cobalt, sulphur, and potassium. All of these formulations are routinely consumed by cattle at a rate of 1 to 4 oz per head per day. Suppliers of these products reported customer observations of occasional consumption by deer.

We presented the four supplements to a group of deer that were being held at a California Department of Fish and Game facility. Four penned adult deer being fed a standard maintenance ration without supplemental salt were observed to determine if they consumed any of the block supplements. No visible consumption was noted for any of the four formulations after six months. Two of these formulations were presented to a migratory deer herd in Tehama County for three months during the winter, and to a resident herd in Santa Clara County for 6 months during the summer and fall. Again, no measurable consumption was noted in either of these situations.

The resident herd in Santa Clara County was also provided access to a livestock loose mineral supplement that is typically consumed by cattle at a rate of 1 to 4 oz per head per day. Because of field reports that deer could be trapped with apple pomace, 2 pounds per ton of an apple essence attractant was also added to the mineral. No measurable consumption was detected from sixteen covered feed troughs during a 1-year period. In addition to not identifying a palatable feed supplement, we were also concerned that even with a palatable supplement, there would likely be high variability of individual animal preference that could result in inadequate consumption by some deer and overconsumption by others. We turned our attention to fertilizing browse with Se fertilizer as a means of elevating Se in the diet.

FERTILIZER

If various species of deer browse could be fertilized with an application rate of Se fertilizer that would assure a more preferred level of Se in the deer diet without risking Se toxicity, the problem of variability in individual animal consumption would

be avoided. A commercially produced Se fertilizer (Selcote, Agtech Developments Ltd., New Zealand) contains 1% Se as selenate in a superphosphate-encapsulated pril. The manufacturer's recommended annual application rate of 1 kg/ha (approximately 1 lb/acre) has been used for many years on thousands of acres of pasture in New Zealand and Australia, and has successfully eliminated Se deficiency in sheep grazing these pastures (Watkinson 1983, Halpin et al. 1985). However, no safety or efficacy data exists for uptake of Se by brush species as a result of Se fertilization.

Since 1986, we have been evaluating Selcote on small field plots containing various brush species: sagebrush (*Artemesia tridentata*); bitterbrush (*Purshia tridentata*); mountain mahogany (*Cercocarpus betuloides*); buckbrush (*Ceanothus cuneatus*); desert peach (*Prunus andersonii*); and blue oak (*Quercus douglasii*). Field plots also included pasture which consisted of various grasses and forbes. Field plots measured approximately 6.5 m per side and were fertilized at rates equivalent to 1 and 4 kg/ha. Periodic samples of brush and pasture were clipped in a manner meant to duplicate the feeding behavior of deer. A composite sample of each browse specie was collected from each plot for each sample date. Samples were analyzed for total Se content (dry matter basis) using digestion and fluorometric analysis (Whetter and Ullrey 1978).

COMMENTARY

Neither the scope of our feeding trials nor the size of our field plot studies lend themselves to adequate statistical evaluation because of inadequate repetition and limited sample size. These trials were not funded and the observations were collected as "add ons" to other projects. However, as biologists, nutritionists, pathologists and veterinarians the observed trends appear to be consistent and the need for a method of improving fawn survivability is real and urgent.

Our experience with all livestock supplements offered to captive deer was similar: the deer didn't eat them. To date, our observations have demonstrated uptakes of Se by all fertilized browse species to levels that are consistently greater than control plots. Data for sagebrush (Fig. 1) demonstrates a much higher level of accumulation than that of bitterbrush (Fig. 2). Selenium uptake levels in bitterbrush are comparable to those

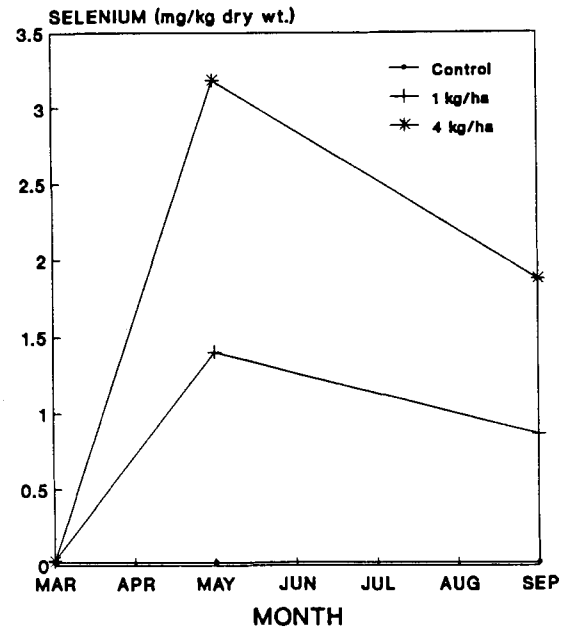

Fig. 1. Selenium levels in sagebrush (mg/kg dry weight) following spring application of Se fertilizer at 1 kg/ha and 4kg/ha. One sample per data point.

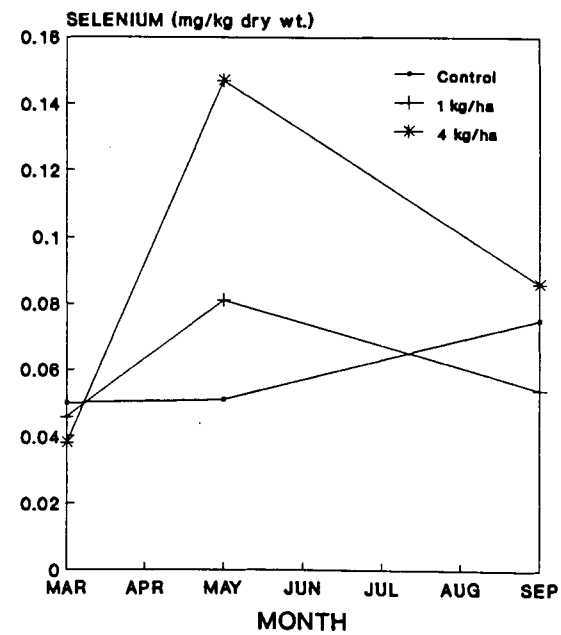

Fig. 2. Selenium levels in bitterbrush (mg/kg dry weight) following spring application of Se fertilizer at 1 kg/ha and 4kg/ha. One sample per data point.

observed in the other species of brush that we monitored. Pasture uptake of Se (Fig. 3) is comparable to that of sagebrush, and has been quite consistent from all test sites. Data in Figures 1, 2

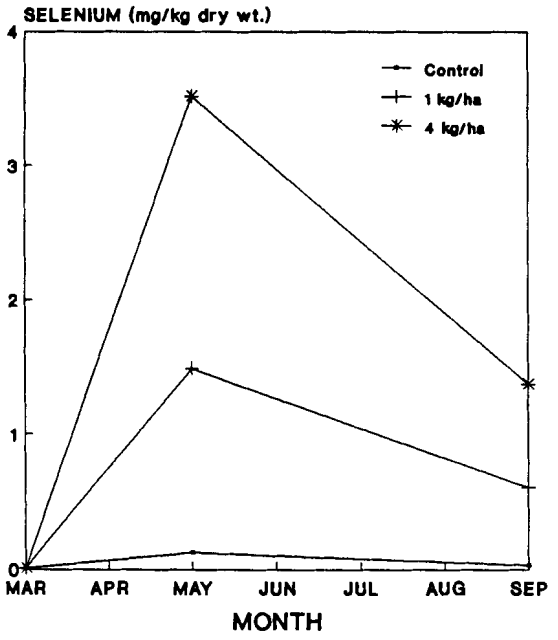

Fig. 3. Selenium levels in pasture (mg/kg dry weight) following spring application of Se fertilizer at 1kg/ha and 4kg/ha. One sample per data point.

and 3 are from one test site, but are typical of other sites.

The level of Se in forage (dry matter basis) that is considered to be the minimum toxic level for most species of livestock is 5.0 mg/kg. Recommended minimum levels for prevention of selenium-deficiency disease in livestock range from 0.1 mg/kg to 0.2 mg/kg (Puls 1981, Blood and Radostits 1989). Livestock grazing on pasture that contains less than 0.02 mg/kg can be expected to exhibit clinical signs of Se deficiency (Andrews et al. 1976).

These limited test plot data suggest that efficacious levels of Se can be achieved in brush and pasture when fertilized at the rate of 1 kg/ha, and that concentrations were still less than the minimum toxic level when fertilizer was applied at 4 kg/ha. This work must be repeated and validated. Range managers and wildlife nutritionists are encouraged to consider these observations in their work on improving fawn survivability.

CURRENT FIELD WORK

We are presently evaluating two large test sites (approximately 1 and 4 sections, respectively) wherein Se fertilizer has been applied at the rate of 1 kg/ha. Both sites were used by deer that are considered to be Se deficient on the basis of blood levels. In addition to monitoring uptake of Se by plants, we will measure blood Se levels in deer following their use of these sites. The fawn recruitment rate from each herd will be compared with historical data and with current recruitment rates from neighboring deer herds that have not used Se fertilized ranges.

If our studies show that fawn recruitment is improved without detecting adversity to other biological systems, seleniferous fertilizers might be recommended, on a limited scale-up basis, for application on some winter ranges of migratory deer herds. This management strategy would require fertilizing only the most heavily used acreages as a means of supplementing does during late pregnancy. Fawns receiving adequate amounts of Se in utero may be less likely to succumb to neonatal Se deficiency disease, predation, or infectious diseases. If the application of Se fertilizers threatens other components of the environment, it may be possible to adjust application rates, application times, specific application sites, or the forms of Se used in the products to ameliorate the threat and still supply this required nutrient to deer.

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