almost twice as great for the group with 5 or more conceptions than for the group with less than 5 conceptions. The difference, however, is not statistically significant ($t = 1.12$, d.f. $= 31$, $P = 0.2$–0.3).

It was thought advisable, nevertheless, to test the frequencies of the defect in the offspring of the latter 2 groups of females against each other. The results show (Table 3) that each of the first 4 litters of the "sterile" females is not statistically different from its counterpart from the "nonsterile" females. The possibility is excluded, therefore, that the decreasing frequency of the defect in successive litters was due to the sterilization of the more susceptible females, and the conclusion can be drawn, from Table 1, that primigravid females are significantly more susceptible to the teratogenic effects of cortisone than multigravid females.

It is interesting to note (Table 3), however, that a good deal of the parity effect is due to the "sterile" group, and that when the results for this group are not considered, the difference in incidence of the defect between the 1st and 2nd litters of the "nonsterile" group is not significant ($\chi^2 = 0.29$, $P = 0.59$).

References

1. Fraser, F. C., and Fainstat, T. D. *Pediatrics*, **8**, 527 (1951).
2. Fraser, F. C., Fainstat, T. D., and Kalter, H. *Etudes néo-natales*, **2**, 43 (1953).
3. Carter, T. C., *et al. Cancer Research*, **12**, 602 (1952).
4. Fisher, R. A. *Statistical Methods for Research Workers*. New York: Hafner Publ. Co., 1950.

Manuscript received August 3, 1953.

Effects of Oral Administration of Spanish Moss, *Tillandsia usneoides* L.

Seldon D. Feurt and Lauretta E. Fox

Department of Pharmacognosy and Pharmacology, College of Pharmacy, University of Florida, Gainesville

Spanish moss, *Tillandsia usneoides* L., is described by Small (*1*) as a picturesque and characteristic feature of the southern coastal states. The dried processed inner fiber of the strand of moss has long been utilized in the upholstery industry.

In conjunction with our studies on the estrogenic substance in Spanish moss (*2*), a feeding experiment was devised to show the effects of oral administration of the ground moss to young and adult albino rats.

Twenty fertile adult albino rats of approximately the same age and weight, divided equally as to sex, were placed in two groups each containing 5 males and 5 females. The males and females of each group were separated for 30 days, during which time group I was fed a commercial ration of dog cubes, and group II the same ration powdered and mixed with an equal part by weight of ground Spanish moss.

After feeding this diet 30 days no significant differences in weight were observed.

The rats were then paired with those of opposite sex of their same group and the diets continued. On the 23rd day after the mating, a litter was born to 1 female in each group; 12 young in the litter of group I and 5 in the litter of group II. There was no significant difference in weight at birth. When 18 days old, the young of group I averaged 19.5 g, and those of group II 6.5 g. All 5 young of group II died before they were 20 days old, and only this one litter was born to this group. The animals in group I reproduced normally.

Estrogen administration begun before 4–6 weeks of age inhibits growth and development, but if begun after full growth is attained it does not cause a loss of weight in rats (*3*). The administration of estrogens to lactating mothers inhibits growth of young (*4*). Zondek (*5*) showed a direct relationship between growth inhibition and quantity of hormone administered. The skeletal development as well as organ size is affected. The action is explained by an inhibitory mechanism of the hormone on the anterior pituitary.

Hormonal castration of cockerels by stilbestrol implants is frequently utilized to improve meat quality and stimulate growth. Estrogens apparently have no activity on quantity or quality of meat produced from swine (*6*). A recent publication from Purdue University (*7*) shows that 60 mg-stilbestrol implants in yearling steers will increase daily weight gain by 10%; and 120 mg-implants by 18%. However, 180 mg-implants of testosterone will depress daily weight gain by 2.6%. It is significant that less food is required for a gain of 100 lbs of body weight by animals which received stilbestrol; 4% less food concentrate being required by those receiving 60 mg-implants; and 10% less food by those receiving 120 mg-implants, while the testosterone-treated steers required more food.

In view of the recent trend to improve meat quality by administration of estrogens, it may be possible to utilize the waste material from the processing of fibers of Spanish moss for the upholstery industry, as a fodder supplement for beef cattle. The high fiber content of this waste material would make it unsuitable for feeding swine, but cattle, sheep, and goats could digest the fibers and utilize in addition the vitamin, mineral, and carbohydrate constituents. Webber, *et al.* (*8*) showed the presence of an antibacterial substance in moss. Halligan gives the analysis of green moss (*9*) as:

Protein	3.68%	Iron and aluminum oxide	0.28%
Carbohydrate	15.9%	Phosphate	0.032%
Fiber	8.24%	Calcium oxide	0.058%
Water	69.5%	Sodium oxide	0.58%
Ash	1.57%	Potassium oxide	0.31%

The Florida Agricultural Experiment Station showed that Spanish moss contains more food value than oat straw (*10*) and that moss contains 1.5 mg% of β-carotene, the precursor of vitamin A (*11*). Since the estrogen of Spanish moss is effective by oral administration, it may be possible to utilize the waste from the processing of fibers for the upholstery in-

dustry as a fodder supplement for beef cattle, thereby improving meat quality and increasing quantity in less time with less food.

References

1. SMALL, J. K. *The Manual of Southeastern Flora.* New York : Publ. by author (1933).
2. FEURT, S. D., and FOX, L. E. *J. Am. Pharm. Assoc.*, **41**, 453 (1952).
3. PINCUS, G., and THIMANN, K. V. *The Hormones,* Vol. 2. New York : Academic Press (1950).
4. WEICHERT, C. K., and KORRIGAN, S. J. *Endocrinology,* **5**, 741 (1942).
5. ZONDEK, B. *Lancet,* **10**, 10 (1936).
6. SLEETH, R. B. Agricultural Dept., University of Florida, personal communication.
7. ANDREWS, F. N., BEESON, W. M., and JOHNSON, F. D. *J. Animal Sci.*, **9**, 677 (1950).
8. WEBBER, M. G., LAUTER, W. M., and FOOTE, P. A. *J. Am. Pharm. Assoc.*, **41**, 230 (1952).
9. HALLIGAN, J. E. *J. Ind. Eng. Chem.*, **1**, 206 (1909).
10. PICKETT, J. M. *Florida Expt. Sta. Bull. II* (1890).
11. TRENCH, R. B., and ABBOTT, O. D. *Florida Agr. Expt. Sta. Tech. Bull. No. 444* (1948).

Manuscript received February 11, 1953.

2,4-D Affects Phosphorus Metabolism

A. J. Loustalot, M. P. Morris, J. García, and C. Pagán

Federal Experiment Station in Puerto Rico,[1] Mayaguez

A preliminary experiment in which *Commelina* sp. and *Xanthosoma* sp. were analyzed 24 hr, and 1 wk after being treated with 2,4-D (2,4-dichlorophenoxyacetic acid) showed that the percentage of water-soluble phosphorus in treated plants was consistently higher than in untreated plants. The following experiment was carried out to obtain additional information on the effect of 2,4-D on phosphorus metabolism.

A prepared field was divided into 12 plots each 52×24 ft and planted to a variety of white beans, Blanca Bonita (P.R. 1632). The experimental design consisted of 3 treatments each replicated 4 times in randomized blocks.

When the plants were about 15 in. high and had started to set fruit 1 plot in each of the 4 replications was sprayed with 0.1% aqueous solution of sodium 2,4-D. The plants in another plot of each replication were uprooted at the same time and left lying on the ground to die gradually. The third plot in each replication was left as a control. Two rows of unsprayed or undisturbed plants were left as borders around each plot. The treatments were started at 6 A.M., and samples of 100 plants were taken from each replication of all treatments at 4, 10, 24, and 48 hr and 1 wk after treatment.

The leaves, stems, and roots were separated, fresh and dry weights obtained, and a composite sample of 300 g of dry powdered tissue from each replication was analyzed for inorganic phosphorus. Aliquots of a hot water extract of the dry tissues were clarified with 0.5 g charcoal and used for inorganic phosphorus determination as described by Truog and Meyer (*1*).

Four hours after treatment the sprayed plants showed epinasty and other 2,4-D effects. Ten hours after treatment many of the leaves had curled, and the plants were becoming recumbent. The next morning the plants were somewhat chlorotic and the distortion had increased. The following day many of the leaves had developed necrotic spots. One week after treatment the leaves on most sprayed plants had withered and those that adhered were very chlorotic and sickly in appearance.

The uprooted plants remained fresh for the first day but after that they deteriorated so rapidly that by the end of the week it was not possible to obtain leaf samples.

Figure 1 shows the fluctuations of inorganic phosphorus in the leaves, stems, and roots, respectively, of treated, check, and uprooted plants.

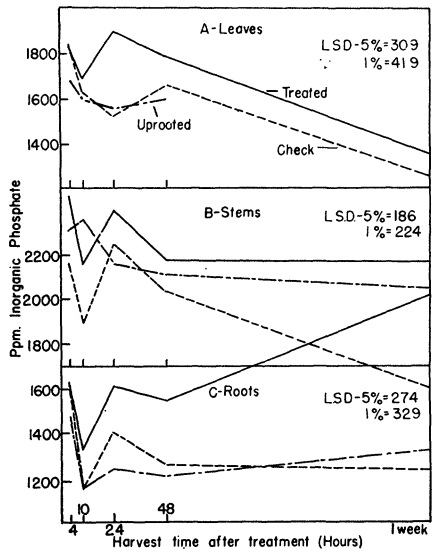

FIG. 1. Levels of inorganic phosphorus (ppm of dry matter) in bean plants analyzed at various intervals after treatment with 0.1% solution of sodium 2,4-D.

The data obtained at each sampling period, expressed as parts of inorganic phosphorus per million parts of dry material, was analyzed statistically by the analysis of variance and the least significant differences between treatments determined.

Four hours after treatment there was no appreciable difference in the amount of inorganic phosphorus in the leaves and roots of treated and check plants, but the stems of treated plants had a significantly higher amount than the checks. The uprooted plants had somewhat less inorganic P than the treated plants in all 3 organs. Ten hours after treatment inorganic P had dropped in all organs of all treatments except in the stems of uprooted plants, where it was somewhat higher; but in roots, stems, and leaves of treated plants it was higher and significantly more so in the roots and stems than in the corresponding organs of check plants. The samples taken 24 hr after treatment showed a sharp rise in the level of inorganic P in roots,

[1] Administered by the Office of Experiment Stations, Agricultural Research Administration, USDA.