three years or older — eight per cent. The harvested number of rabbits known to have been using the area the fourth year was comparable to previous fall populations indicating that before intensive hunting took place rabbits were removed by other decimating factors. The broomsedge grass type was used sparingly in relation to weeds, various grasses, bottom areas of briars, and hardwood brush. A study is now underway to determine the usage by rabbits and the feasibility of construction of earthen mounds for long-lasting desirable habitat.

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UTILIZATION OF DOMESTIC FORAGE CROPS BY DEER AND WILD TURKEYS WITH NOTES ON INSECTS INHABITING THE CROPS

BY

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INTRODUCTION

This study was initiated in 1959 to determine the availability and utilization of various domestic forage crops when planted in food plots for deer and wild turkeys. Included in the tests were plots of Ladino Clover, giant white Dutch Clover, Dixie reseeding Crimson Clover, Kentucky 31 fescue grass, Chapel Hill rescue grass, perennial rye grass, oats and wheat.

An additional study was initiated on the same plots upon realization that some older food plots were being utilized by wild turkeys during the summer months without any apparent sign of the crops being grazed. The objectives of this phase of study were to determine the numbers and kinds of insects available on each of the forage crops during the summer months when insects are so prevalent in the diet of young turkeys.

The study areas were located on lands belonging to Clemson College which, along with the South Carolina Wildlife Resources Department, is a joint sponsor of the Clemson Wildlife Management Research Project.

Techniques

During the Fall of 1959, two 2-acre plots were disked, limed, fertilized and planted. One-quarter acre plots of each of the eight crops were established in each of the 2-acre study areas. As far as possible, the three clovers were established alternately among the three perennial grasses with the oats and wheat plots being situated on each end of the 2-acre plots so as to facilitate annual replanting. Liming, fertilizing and planting dates conformed with those recommended by Clemson Agricultural College.

Restraining pens (4′ x 4′ x 2′), constructed of 13-gauge welded wire (2″ x 4″ mesh), were randomly placed within each plot immediately after the crops were planted. The restraining pens were left in position throughout the fall and winter months.

Observations at weekly intervals continued through the seasons until the last of March. During the first week of April, the restraining pens were removed and all of the vegetation within the 4′ x 4′ enclosure was clipped one inch above ground level and weighed. Grab samples of each were taken, weighed immediately, and placed in an oven heated to 70° centigrade for a twenty-four hour period to determine the dry weight matter produced on the ungrazed portions. This same procedure was followed on similar randomly selected 4′ x 4′ plots within each crop to determine the amount of dry weight matter existing where grazing had taken place. The data from inside the restraining pens and that from similar areas outside of the pens were converted to reflect the pounds of dry weight matter per acre.

This study was to cover a period of three years, but, unfortunately, the data for one year were lost when the samples were accidentally charred in the oven. Thus the forage crop data presented represents an average of those taken during the first and third years of the study.

The amount of dry weight matter produced within the restraining pens was considered as reflecting the total amount produced. The difference between production within pens and that on similar grazed areas outside of pens was considered as the amount utilized. Percentages of the amounts utilized, as compared to total production, were computed for each crop. Also computed was the percent of each crop consumed as compared to the total amounts consumed of all eight plantings. All data were converted to per acre basis. Due to the size and irregular shape of the narrow plots selected for study, it was deemed impractical to isolate parts of the plots from deer browsing so as to determine the relative amounts of forage consumed by each of the two species utilizing the areas (utilization by rabbits, etc., in the middle of the plots was considered negligible). The total production and utilization of the forage crops varied considerably during the two years due to excessive cold weather during the 1959-60 winter. Consequently, and for brevity purposes, the data presented herein represent an average for each planting over the two-year period.

Findings and Analyses

From a production standpoint the three clovers produced much more dry weight forage than did the grasses (Table 1). Ladino Clover and giant white Dutch Clover were consistently high in production on both test plots during both years. The high amount of Ladino and white Dutch Clover produced (1575 and 1815 pounds, respectively), is more significant when realizing that these clovers, when ungrazed, are reported to lose most of their foliage by dying of the leaves. These leaves die when about 40 days of age. Regular clippings at 30-day intervals would have eliminated this source of error and at the same time provided a growth stimulant much the same as that created when plants are grazed. The reseeding Crimson Clover, however, maintained a high production level due to the excessive high production realized during the first year. The reseeding of this clover in the upper Piedmont area became worse each year and, consequently, the succeeding stands were poor.

Table 1. Dry weight production and utilization of eight domestic forage crops by deer and wild turkeys during the fall and winter months of 1959-60 and 1961-62, along with the analyses of protein and total digestible nutrients consumed. (Pounds per acre basis.)

Crop Studies	Production In Pounds	Utilization In Pounds	Percent Of Production Utilized	Percent Dry Matter*	Estimated Digested Protein In Pounds*	Estimated Total Digested Nutrients In Pounds*
Crimson Clover	2304	917	39.80	17.4	121	596
Ladino Clover	1575	947	60.13	16.6	188	707
White Dutch Clover	1815	994	54.77	17.8	229	721
Fescue, Kentucky 31	741	310	41.84	25.0	40	221
Oats (Victor Grain)	867	158	18.22	14.1	27	103
Rescue, Chapel Hill	615	223	36.26	28.9	30	156
Ryegrass, Perennial	531	163	30.70	26.6	12	110
Wheat (Anderson)	1415	619	43.75	19.8	113	397

* From "Feeds and Feeding" by Morrison.

Annual wheat ranked almost as high as the clovers in production (1415 pounds), whereas the production of oats, the other annual grass, was much lower than anticipated (867 pounds). This has been attributed to a number of factors including the late planting dates for oats, excessive cold weather throughout most of the winter seasons involved and the use of victor grain oats which since 1957 has been very susceptible to diseases. In general the production of forage was lowest in the perennial grass plots of fescue grass, rescue grass and rye grass. Rescue grass is herein considered a perennial plant although such is a weak characteristic.

The utilization of the various forage crops by deer and wild turkeys was considered from two approaches: namely, the percent of production of each crop that was utilized and the proportion that each crop was represented in the total amounts consumed from all of the plantings in both study areas (Table 1). From both standpoints the Ladino and giant white Dutch Clover appeared to be most preferred. Over one half of the forage produced by these two crops were utilized by the deer and wild turkey. Also these two clovers, along with reseeding Crimson Clover, comprised over 65 percent of the forage consumed from the entire test plots.

Wheat and Kentucky 31 fescue were apparently the most utilized of the grasses in regards to availability. However, there is some indication from general observations that much of the fescue recorded as being utilized was actually lost due to tramping and cutting of the grass by deer hoofs. Close observations of the fescue plantings noted that considerable foliage was cut as the thick foliage was pushed into the soil by deer hoofs. Little browsing of upright blades of fescue were noted. Such losses in other plantings were not so apparent.

The production and utilization of rescue grass, rye grass, and oats were lowest of all plants tested. Perhaps the study areas were not adapted to the production of these plants. It should be noted, however, that the early grazing of some of these grasses could have increased forage production by causing plants to "stool." Also the oats and the wheat, specifically, produced grain which was attractive to deer and turkeys for later use.

The analyses of forage crop utilization should include some references to the amounts of nutrients found in each of the forage crops studied. This analysis is limited to the consideration of the percent dry matter, the digestible proteins and the total digestible nutrients, although the presence or absence of one specific mineral may have had an influence on the amounts of each crop that were utilized.

The percent dry matter, which indicates the amount of moisture within the forage, is often considered a good index to the palatability of the forage. From these data, the three clovers along with oats and

wheat would appear to be most palatable. This compares favorably with preferences for the various crops as reflected by the relative amounts of each consumed. The clovers and wheat supplied over 80 per cent of the total foods consumed from the eight plantings. An exception to this per cent dry matter and utilization comparison is that of oats. Oats, for example, contains a high percentage of moisture, yet was consumed in the least quantity. The low consumption of this crop is believed to be due to low production and slow growth during mid-winter when the crops were utilized the most. The higher percentages of dry matter in the three perennial grasses (fescue, rescue and rye grass) also compares favorably with the low utilization of these grasses (Table 1).

Further indication of the greater value of clovers as winter foods is evidenced by the estimated amounts of digestible proteins and the total digestible nutrients obtained from these crops. Computations on a per-acre basis shows that each of the three clovers contained much more digestible proteins and total digestible nutrients being consumed. Of course, the larger consumption is due partly to the computations being related to the total utilization in pounds. Actually, the per cent of total protein and total digestive nutrients per pound of green forage is of significance. The total digestible protein varied from 1.9 per cent in rye grass to 4.1 per cent in white Dutch Clover. Wheat also contained a high percent of digestible proteins (3.6 percent), as did rescue grass (3.9 percent) (percent figures from Morrison's Feeds and Feeding).

When considering the total digestible nutrients there is more variability in the amounts supplied by each of the crops tested. Rescue grass ranked first with 20.2 percent of the green weight being considered as digestible nutrients, while oats with 9.2 percent total digestible nutrients, was the lowest (percent figures from "Feeds and Feeding" by Morrison).

The high amounts of digestible proteins or the total digestible nutrients alone cannot be considered as a criteria of the value of these crops for deer and turkey foods. Highly nutritious foods are of no value if not consumed by the animals. Consequently, it appears that palatability, or moisture content, is of more significance as long as the forage contains fair amounts of such nutrients. Such has been the case in these tests where the succulent clovers, with median amounts of protein and total digestible nutrients were consumed in much greater quantities. The estimated nutrients consumed from each crop on a per-acre basis is shown in Table 1.

Production Costs

The cost of producing and the maintaining of the forage crops was computed over a 5-year period. This hypothetical length of time was selected since two of the crops tested, Ladino and white Dutch Clover, must be re-established approximately every five years. Two of the crops, Crimson Clover and rescue grass, had to be re-established every three years. The annual grasses, oats and wheat, had to be replanted each year, whereas plots of fescue grass are known to persist up to 10 years with little or no maintenance. Perennial rye grass persisted throughout the three-year study period and appeared as if it would perpetuate itself for at least five years.

Cost records included the initial cost of establishment, maintenance, and re-establishment of crops when necessary. Proportional cost of the re-establishment of certain perennial crops, as well as the cost of planting the annual crops every year, were included so as to make such costs comparable. Crop maintenance was computed on a three or four-year basis on the assumption that the crops needed no maintenance during the first growing season after establishment. The costs of crop maintenance and crop re-establishment have been combined in this report. This cost, along with the initial cost of establishment, represents the total cost of producing these crops over a 5-year period.

The initial cost of establishment included the cost of land preparation, liming, fertilizing, seed, inoculation (where needed), and seeding. The cost of machinery used in these operations, as well as that used in the maintenance and the crop re-establishment, are custom rates computed by the Agricultural Economics Department of Clemson Col-

lege for the type of machinery used. The cost of seeds, lime, fertilizer, etc., are the same as those prices paid during 1959. All labor was computed at $1.00 per hour.

The cost of re-establishment was the same as the initial cost, less the cost of lime, etc., that was not required. Lime, however, was applied to all crops every three years and the prorated cost was included. The maintenance cost was limited to the mowing once each year for four years in the crops that persisted for five years, while the other perennial crops were mowed only during those years when initial establishment or re-establishment was not taking place. Oats and wheat required no maintenance cost as they had to be re-established each year.

The initial cost of crop establishment varied very little among the eight crops studied. Such differences were due entirely to the differences in the cost of the seeds and seed treatments. This cost per acre varied from $29.90 for Ladino Clover to $35.80 for rescue grass (Table 2).

Table 2. Cost* per acre of establishing and maintaining selected forage crops projected over a 5-year period.

Forage Crop	Initial Establishment Cost/A	Maintenance and Re-establishment Cost/A	Total Five Year Cost/A	Average Cost/A Per Year
Crimson Clover	$33.80	$ 32.00	$ 65.80	$13.16
Ladino Clover	29.90	16.93	46.83	9.37
White Dutch Clover	30.70	16.93	47.63	9.53
Fescue, Kentucky 31	31.80	60.73	92.53	18.51
Oats (Victor Grain)	32.40	107.93	140.33	28.07
Rescue, Chapel Hill	35.80	66.16	101.96	20.39
Ryegrass, Perennial	30.60	60.73	91.33	18.27
Wheat (Anderson)	30.30	99.53	129.83	25.97

* Actual cost of seed, fertilizer, lime, etc., is supplemented by operational cost, including depreciation of equipment, etc., computed by personnel of the Department of Agricultural Economics, Clemson College.

The cost of maintenance, to include re-establishment when necessary, varied considerably. Ladino Clover and white Dutch Clover were the cheapest to maintain as mowing once a year for four years and a prorated cost of lime placed thereon between the third and fourth years were all the costs involved. Such costs for Crimson Clover was somewhat higher since it required replanting during the third year (Table 2).

The oats and wheat were most costly during the five-year period since these plants had to be replanted every year.

The cost of maintaining fescue grass and perennial rye grass was identical in that they received the same fertilizer, mowing, etc. Rescue grass was a little higher than the other perennial grasses as the cost of seed and re-seeding of the plot after the third year were included, and one year of maintenance was eliminated.

Average annual cost of forage production was found to be much lower for the clovers, with the production cost of Crimson Clover being slightly higher than that of the two white clovers. The average production cost of grasses was highest in the oats and wheat that had to be replanted every year.

Since the cost of production and the total amount of forage produced varied between each crop, it is believed that a cost-production comparison for each crop would be significant. Thus the average annual cost of production for each crop has been compared with the average annual production. The data are presented in Table 3 as the average cost of producing 100 pounds (dry weight) for each of the crops studied.

The cost of producing 100 pounds (dry weight) of each of the clovers was much less than that of the grasses. Ryegrass was the most costly to produce ($3.44 per 100 pounds), while the cost of producing oats and rescue grass was almost as high. This high cost,

however, is due partially to the low yields found in these crops. The cost to produce 100 pounds (dry weight) of any of the clovers was less than sixty cents (Table 3).

Table 3. Average cost of producing 100 pounds (dry weight) of the various forage crops.

Crop	Production In Pounds/A	Average Cost of Production/A	Average Cost per 100 Pounds of Forage
Crimson Clover	2304	$13.16	$ .57
Ladino Clover	1575	9.37	.59
White Dutch Clover	1815	9.53	.53
Fescue, Kentucky 31	741	18.51	2.50
Oats (Victor Grain)	867	28.07	3.23
Rescue, Chapel Hill	615	20.39	3.32
Ryegrass, Perennial	531	18.27	3.44
Wheat (Anderson)	1415	25.97	1.84

INSECTS FOUND ON FORAGE

Technique

The preliminary work to determine the summer insect populations within forage plots took place during the summer of 1959. Attempts to sample forage dwelling insects simultaneously with soil dwelling insects were unsuccessful. Forage dwelling insects were too often flushed while attempting to project a mil-acre cylinder into the top layer of soil. A plastic bag attached to the top of the cylinder was supposed to collect the forage insects inhabiting the vegetation directly above the mil-acre plot. Considerable time was also spent with techniques devised for separating the soil dwelling insects from the sod. No one method proved satisfactory for all types of animal life.

Since observations noted that turkeys using the plots during the summer months were consuming only the forage dwelling insects, it was decided to limit insect population studies to those inhabiting the leafy portion of each crop. Consequently, the sampling of insect populations during the following two years was limited to the use of a sweep net.

Sampling of insects was initiated in June, 1960, by making fifteen sweeps of the net on each of the different plantings within both study areas. In sweeping each planting, an attempt was made to adequately sample all growth conditions. This was done by moving diagonally across the plots. After sweeping each patch, the lower portion of the net, along with insects caught, was placed in a one-quart ethyl acetate killing jar for sufficient time to kill or immobilize the insects. Afterwards, they were placed in screw-top jars, labeled with date and plot number, and carried to the laboratory for identification. Identification of insects was made down to families, but is presented herein only to the orders.

The insect samples recorded herein were taken monthly during July, August and September of 1960 and 1961. Samples were taken usually around the hours of nine to ten o'clock in the morning so as to allow sufficient time for the dew to dry and yet before the heat drove some of the insects under cover. Efforts were made to collect all samples under as similar weather conditions as possible with no sampling being undertaken on rainy or unreasonably cool mornings.

Findings and Analyses

The various insects found to be inhabiting each of the forage crop plantings, as shown in table 4, is only a relative index to the insects present. Sampling was limited to that of a single collecting technique, e. g., the use of a sweep net within each crop. It should be pointed out also that the insect study was secondary to the forage crop study and that the manipulation of the various plantings followed those recommendations advocated for the continued production of forage for graz-

Table 4. Relative numbers* of insects and spiders found inhabiting different domestic forage and grain crops during July, August and September of 1960 and 1961.

Major Groups of Spiders and Insects Found	Crops								Averages for all Crops
	Oats***	Wheat***	Crimson Clover**	Ladino Clover	W. Dutch Clover	Rescue Grass	Fescue Grass***	Perennial Rye Grass	
Spiders (ARACHNIDA)	8	12	5	10	8	3	14	8	8.50
Grasshoppers, crickets, etc. (ORTHOPTERA)	11	11	10	16	18	6	14	23	13.62
True Bugs (HEMIPTERA)	11	42	10	41	77	13	47	65	38.25
Leaf Hoppers, Aphids, etc. (HOMOPTERA)	42	136	96	626	648	42	111	110	226.37
Beetles (COLEOPTERA)	58	29	25	26	23	18	25	36	30.00
Moths & Butterflies (including immatures) (LEPIDOPTERA)	2	4	15	6	9	5	3	6	6.25
Flies (DIPTERA)	25	51	34	56	43	36	36	41	40.25
Bees, Wasps, Ants, etc. (HYMENOPTERA)	2	11	10	14	24	5	7	32	13.13
Miscellaneous Insects	0	1	0	0	0	0	1	0	.25
TOTALS	159	297	205	795	850	128	258	321	376.62

*Relative numbers represent the total number of insects and spiders collected in 15 sweeps with a collecting net during July, August and September on two areas in 1960 and/or 1961.

**At the time of sampling for insect populations, the reseeding Crimson Clover had been succeeded by volunteer brown top millet.

***Were not sampled in 1960 as crops had been mowed as part of the foliage production tests.

ing. Oats and wheat plantings, for example, were mowed in early August, 1960, in preparation for replanting for fall and winter forage. The rescue grass was inadvertently mowed at the same time. Consequently, the data secured from these plantings represents only one year's data, this being taken on both study areas during 1961. Samples taken from Crimson Clover plots were actually from Brown Top Millet which reseeded after Crimson Clover died out in early summer.

Realizing the impossibility of adequately analyzing the original data, where the entire insect sample would be made up of individuals of many insect families, it was decided to reconstruct the data for both years. This was accomplished by the grouping of all the insects into major classifications according to Phylogenetic Order. This regrouping of insects and spiders collected, with certain limitations, gives a better picture of the relative numbers and major types of animal life collected during the summer months from the forage crop study plantings. This information is presented in Table 4. (Identification of all animal life collected down to the families is available in the Job Completion Report filed with the South Carolina Wildlife Resources Department, Columbia, South Carolina.)

In observing the data presented in Table 4, it is readily apparent that the Leaf Hoppers, Aphids, etc (Homoptera), were the most prevalent insects and that such insects were more available in the Ladino and White Dutch Clover plantings. This relatively high leaf hopper and aphid population also accounts for the higher number of insects collected in these two crops.

Flies (Diptera) and the true bugs (Hemiptera) were next in importance from the standpoint of numbers collected. Each of these orders of insects were fairly well distributed throughout all of the crops sampled.

Grasshoppers, etc. (Orthoptera), and beetles (Coleoptera), two orders of insects known to be good sources of turkey foods, were found in all crops in varying proportions. However, the sampling technique was not the most practical for sampling beetles, which are often at or below ground level, and grasshoppers, which are easily flushed ahead of the sweeping net.

The data does, however, point out the presence of a variety of insects that would be available in unsprayed forage and grain crops during the summer months when young poults depend on insect material for a large part of their diet. This may explain in part why old fescue plantings are frequented by turkeys during the late summer at times when observations noted that there was absolutely no evidence to suggest turkeys were grazing on the tough fescue grass.

During the summer months of both years, observations of one entire study area were made from a blind erected on a twenty-foot tower. The observer would spend three to four hours in the blind during late afternoons. The observations during 1960 indicated that turkeys were utilizing the forage as well as insect material, whereas the 1961 observations noted considerably more chasing of insects by the young poults. As the monthly data (not shown) did not reflect any greater amount of insects available in 1961, it is conceivable that insects alone may not have been the attractant. The condition of the succulent clovers, as well as the possible absence of sufficient insect foods in nearby habitats in 1961, could have caused a differential in the type of utilization by turkeys.

It is now believed that such insect population studies should be of primary nature and not subject to conditions which were planned with other research as the major objective. It is also believed that the sampling of insect populations should involve a number of techniques, and that such sampling should be made more frequently. In this manner, much of the bias results due to weather conditions, soil moisture relationships, and other meteorological factors could have been eliminated. Also, the population trends of insects inhabiting the various forage crops could have been better determined. Due to the lack of such detail information, the statements on insect population, that are included in the summary, are more general than specific.

SUMMARY

Tests to determine the production and utilization of various domestic forage crops by deer and wild turkeys were conducted during 1959-60 and 1960-61. The study also included the sampling of insect populations that inhabited these crops during the summer months when plots were being utilized as a source for insect material by the young turkeys.

Results of the study showed the clovers were more productive and were more utilized than were the grasses. The annual grasses were more costly to produce than the perennial grasses.

An analysis of the total digestible proteins and the total digestible nutrients within each forage crop indicated that they were not entirely related to the amounts utilized. The percent dry matter, however, which is often considered as an index to palatability, was closely associated with the amounts consumed. Consequently, it is believed that the differences in the utilization of these plants by deer and wild turkey is due to a combination of factors, which includes the moisture content and perhaps some minerals, as well as the total digestible nutrients available.

A production-cost analysis showed that the annual cost of maintaining clover plots was much less than that required for the production of grasses. Ryegrass, rescue grass, and oats were the most costly of the plants to produce when compared to the amount of forage produced on these plots. The production on these plots, however, was believed to be a little below normal.

Insect population studies indicated that the two white clovers harbored the most insects during the summer months. This is due in part to the large number of aphids, etc., found on the succulent vegetation. Fescue grass, however, was found to support more grasshoppers during August and September.

AN ANALYSIS OF THE DEER-BEAR DAMAGE STAMP FUNDS IN VIRGINIA

BY

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Wildlife literature is filled with reports of the many problems brought about by the increase in the deer herds in the past 20-30 years. One of these problems is the damage caused by deer and inconvenience caused to man as a result of the increasing damage.

With the exception of those special areas where the purpose is the production of wildlife, most of our wildlife is a by-product of the land. Elk and buffalo which once inhabited our eastern states are practically gone — they would not, or do not fit into our land use in these eastern states today. Deer on the other hand, and bear to a lesser degree, have adapted themselves to our changing environment.

As an outgrowth of our adoption of English common law (1), it is accepted that "wild game is owned by the State in its sovereign capacity in 'trust' for the people of the State." As such the State's ownership is not that of a proprietor, but of a trustee for the benefit of all the people in common. The State's right of trust is to regulate and control the harvests and preservation of game; and the State is not responsible for damages caused by game.

McDowell and Pillsbury (2) collected data from all States in 1957 on those paying costs for crop damage. Those ten states reportedly making payments are shown in Table No. 1.

It is noted in Table 1, that Virginia is one of the ten states paying for wildlife damages. In the case of Virginia, damage payments are made for deer, bear and elk and are administered by the counties.

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