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Science serves your farm and home.

A. H. VanLandingham

Science

SERVES YOUR FARM AND HOME

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Science

Serves your farm and home

Annual Report of A. H. VanLandingham, Director, West Virginia University Agricultural Experiment Station

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Science Serves Your Farm and Home wil be sent free to any resident of West Vir ginia in response to a written request t the Director, Agricultural Experimen Station, West Virginia University, Mor gantown, West Virginia 26506.

In This Issue . . .

On The Calendar . . .

MARCH

25-26—Water Research Symposium, Morgantow

APRIL

Mar. 30-1—West Virginia Farm and Home Elec trification Conference, Jackson's Mill
2-3—Science Writing Symposium, Morgantown
8-9—National Intercollegiate Flower Judgin Contest, Morgantown
16-18—West Virginia University Easter Recess
30-May 1—West Virginia Home Economics Association Meeting, Jackson's Mill

MAY

7—College of Agriculture, Forestry, and Hom Economics Honors Convocation, Morgan town
7-9—West Virginia University Greater West Virginia Weekend, Morgantown
30—Memorial Day
31—West Virginia University Commencement Morgantown

on the cover

Construction of the new Forestry Building, foreground, is pro ceeding according to schedule and the first classes will meet in th building with the beginning of the fall semester in September. (A future issue of *Science Serves Your Farm and Home* will carry a stor on the new building.) At left are the Twin Towers dormitories no under construction and scheduled for use also this fall. Center back ground is the West Virginia University Medical Center.—*The Editors*

New Research Projects

A. H. VanLandingham, *Director*

NEW research projects investigating the use of West Virginia land and resources are being developed by the Agricultural Experiment Station. Under major consideration are forest and pasture lands, which represent great resource potential for West Virginia.

Seventy-four per cent of the land surface in West Virginia is in forest, an increase of 10 per cent in the last fifteen years. This forest land represents the largest single renewable resource in the State and considerable opportunity for the already important hardwood lumber industry.

However, another use of forest lands which offers great potential is the recreational use of these lands. The Bureau of Outdoor Recreation recognized this potential in its survey of the State's recreational facilities. At present, the Agricultural Experiment Station, in cooperation with other state experiment stations in the Northeast Region, is studying the recreational use of forest lands. Research is planned on possible uses of these lands for recreational purposes such as hunting, fishing, camping, hiking and related activities. Hunting and fishing provide a great potential for future development in outdoor recreation, at the same time representing opportunity for great economic returns to landowners.

Another resource being investigated is the 2.5 million acres of open land suitable for grazing. Much of this land has been overgrazed, poorly managed, and abandoned because of low productivity. Such land can be improved with good management and with the use of lime and fertilizer. Only about one-fourth to one-third of available grazing land has been treated with lime and fertilizer, but with its use the carrying capacity of these pastures can be increased two or threefold. The production of forage has been an important part of the research program of the Agricultural Experiment Station for many years. However, the production and use of pastures will receive increased emphasis in the future. At present, a new project on the use of bluegrass and white-clover pastures, supplemented with gall grasses, is being developed.

Fertilizers and Forage Quality

R. L. Reid
Associate Nutritionist

ANY improvements in the utilization of West Virginia's pasture and forage resources must involve an increased and wise use of fertilizers. Earlier studies at the West Virginia University Agricultural Experiment Station showed, for example, that the application of lime and complete fertilizer to pasture could result in increases in yield of up to 125 per cent. In the use of fertilizers on pasture and hay crops, however, farmers in this State have generally lagged behind others; 1959 estimates show that in West Virginia the percentage of acreage of permanent pasture fertilized with nitrogen, phosphorus or potassium was approximately 3 per cent; in Virginia, the comparable percentage was 9 per cent; in Maryland, 17 per cent.

Figure 1. Application of nitrogen fertilizer gives marked increases in dry matter yield of grass hay corps. Fertilized orchardgrass in Harrison County produced three tons of dry matter per acre in the first cutting.

The problem of deciding whether and how to fertilize forage crops is a complex one. Not only the question of expected increases in yield must be taken into consideration, but also the related problems of economic return for increments of fertilizer applied, changes in pasture composition, nutritional quality of the forage produced, and the possibility of toxic or growth-depressing effects in animals on forages treated with unduly high levels of fertilizer. Considerable data on the relationship between fertilization and the yield of different pasture and hay crops have been

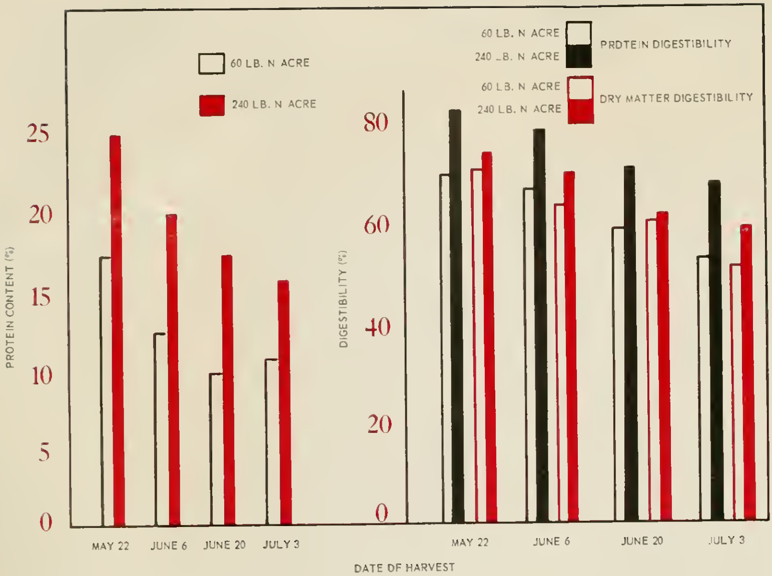

Figure 2. This figure shows the effect of nitrogen fertilization on protein content and protein and dry matter digestibility of a Kentucky bluegrass pasture at different stages of maturity.

obtained at experiment stations in the Northeast Region. Much less is known of the effect of fertilizer treatments on the nutritional quality of the forages.

The nutritive value of a pasture or of a forage product may be expressed in different ways. Some measure of animal production per acre is frequently used in pasture evaluation; this estimate may, however, be markedly influenced by animal variation and by the type of pasture management practiced. In more quantitative terms, forage quality may be expressed in terms of three components: digestibility of nutrients, intake of feed, and, under certain circumstances, palatability. Cooperative studies between the Departments of Animal Industry and Veterinary Science and Agronomy and Genetics during the last few years have indicated that fertilization may affect all three of these factors.

On soils of normal fertility where adequate lime, phosphorus, and potassium have been applied, nitrogen is normally the element limiting the production of grasses for forage. This element can be supplied in a mixed pasture or hay by symbiotic fixation of nitrogen by the legume. Where the legume has gone out of a mixed seeding, or where conditions of soil and terrain make it impractical to maintain a legume crop, the application of nitrogen fertilizer is required for high productivity of the sward. Studies in the Northeast have shown that nitrogen-fertilizer grass pastures produce equivalent liveweight gains in beef animals to legume/grass swards.

Nitrogen fertilization increases both the yield of dry matter (Figure 1) and the percentage of protein in the forage. The digestibility of the protein appears to be related directly to the amount of protein present in the plant. This may be illustrated by a West Virginia experiment in which a Kentucky bluegrass sward was fertilized at two levels of nitrogen (60 lb. and 240 lb. N per acre) and maintained under two systems of management, frequent clipping and uninterrupted growth. Herbage was clipped from the plots daily throughout a first growth and aftermath cycle and was fed to groups of sheep equipped with harnesses for digestibility determinations. The marked effects of stage of maturity and level of nitrogen fertilization on the herbage protein content and on digestibility of the protein may be seen in Figure 2. The higher level of nitrogen fertilization raised the protein content of the herbage by 5 to 9 percentage units at all stages of maturity of the sward in the first cutting; this increase was accompanied by increases of from 9 to 16 percentage units in the digestibility of the protein. The levels of digestible protein at the higher fertilization rate are comparable to those found in a legume forage such as alfalfa and would easily satisfy the protein requirements of high producing dairy cattle or rapidly growing young stock. The very marked effects of stage of maturity of the sward on protein content and protein digestibility may also be noted. There was a drop in digestibility of the order of 0.35-0.50 per cent per day between the end of May and the beginning of July. Frequent clipping, to simulate grazing, maintained the protein content and digestibility of the herbage at an appreciably higher level.

The effects of nitrogen fertilization on the digestibility of energy, or dry matter, of forages are less clear. Undoubtedly the most important factor influencing the digestibility of energy is the stage of maturity, or date of cutting, of the forage (Table 1). Nitrogen fertilization trials at various stations in the Northeast Region have indicated that increasing the level of nitrogen had little effect on the energy or dry mater digestibility of grass hays. Experiments at Morgantown with fresh herbages fed to sheep showed that higher levels of nitrogen increased the dry matter digestibility of bluegrass slightly and had little effect on the digestibility of Sudangrass. For tall fescue, fed as chopped hay, increasing the nitrogen level had no significant effect on the dry matter digestibility of first-cutting forages, but increased the digestibility of the aftermath crop.

Digestibility is, however, only one of the factors influencing the productive value of forages. Recent work has shown that the amount of forage that cattle or sheep will voluntarily consume may be even more important. Few experiments have been carried out to determine how the application of fertilizer will affect the intake levels of pasture, hay, or silage. Earlier theories on the effects of pasture fertilization were based largely on observation of the grazing animal and the results were often conflicting. This may well have been due to differences in soil nutrient balance and element availability, type of fertilizer used, kind of livestock, forage species and stage of maturity, nutritional status of the grazing animals, and other reasons.

TABLE 1. CHANGES IN DRY MATTER DIGESTIBILITY DUE TO STAGE OF MATURITY OF SOME TYPICAL GRASSES GROWN AT MORGANTOWN

Forage	Stage of Growth					
	Vegetative	Boot	Heading	Early Bloom	Late Bloom	Seed
Kentucky bluegrass	72.4		65.9		62.6	59.6
Orchardgrass	75.0	71.6	68.4	63.0	59.4	56.1
Bromegrass	79.7	76.5	69.4	64.3	63.3	61.1
Timothy	77.2	72.5	67.9		60.7	
Tall fescue	68.5	68.8	66.5	62.5	60.8	60.1
Sudangrass	74.4	71.9		65.5	62.0	60.8

In a number of trials carried out from 1961 to 1964, the intake of fresh clipped grass or of grass hay by stall-fed sheep was found to be barely affected by the type (N, P or K) or level of fertilization when the animals were given no opportunity to select between fertilizer treatments. This would approximate the situation normally found in zero-grazing herbage or in the winter-feeding of hays. The comparative lack of effect on intake was observed with orchardgrass, tall fescue, and Sudangrass and is in agreement with results for first-cutting timothy hay reported by the Maine and Rhode Island experiment stations and for bromegrass by Pennsylvania. The Delaware station has, however, noted that nitrogen fertilization increased the acceptability of orchardgrass hay, while Pennsylvania reported a marked decline in acceptability of this grass when fertilized with nitrogen.

Figure 3. Grazing sheep are equipped with collection harnesses to determine intake and digestibility of pasture.

The grazing animal may be exposed to a very different situation from that of the stall-fed sheep. It has already been noted (*Science Serves Your Farm and Home,* April, 1964) that where animals have an opportunity to choose between forages of different species or fertilized in different ways, they show very marked and specific selection patterns. Under these circumstances, a first study with tall fescue hay indicated that sheep had a definite preference for hay fertilized with superphosphate or a low level of nitrogen, while they tended to ignore hays treated with medium (150 lb./acre) or high (450 lb./acre) levels of nitrogen. A subsequent study with first and aftermath cuttings of orchardgrass again showed that sheep regulated their selection of individual hays in a free-choice system in accordance with the level of nitrogen applied to the grass. The zero level of nitrogen was most preferred; the high nitrogen (400 lb./acre) was virtually ignored.

This type of experiment is of interest in that it may help to explain the behavior and performance of grazing cattle and sheep. The ani-

(*Continued on Page* 12)

Weed Control

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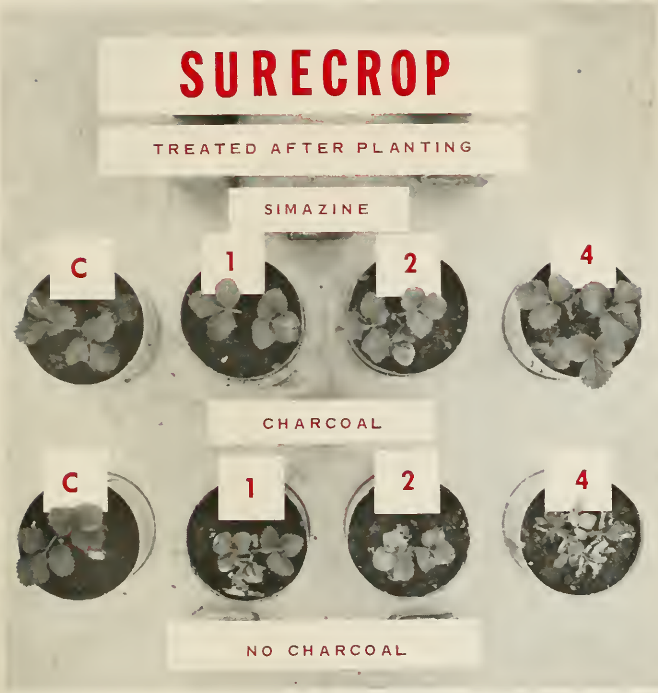


WEEDS present a considerable deterrent to the expansion of the strawberry industry in West Virginia. Until 1950 the only real method of control of weeds was cultivation—an excessively expensive procedure even if suitable labor is available.

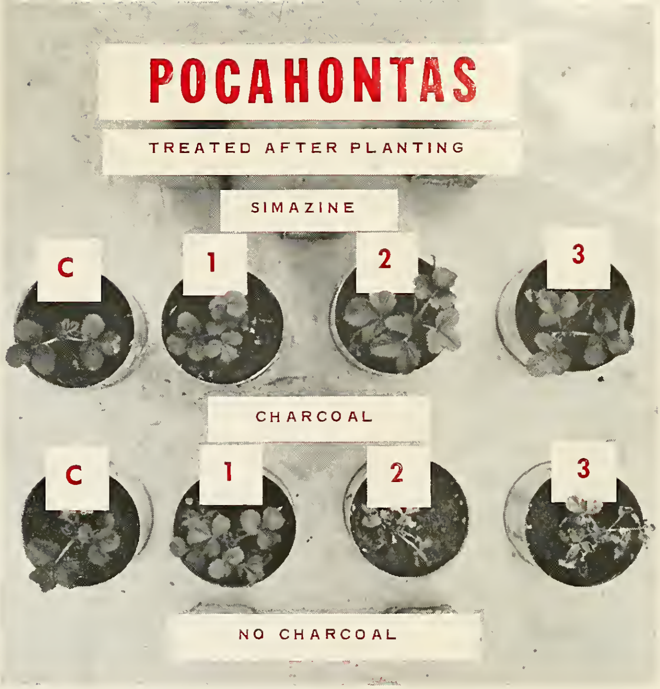
Since that year, however, the herbicide Sesone (originally Crag 1) has been widely applied in strawberry plantings. Sesone has a relatively short-term effect and, therefore, often requires as many as six applications during the growing season. In addition, Sesone frequently interferes with rooting or runner plants, therefore its use has to be discontinued for about six weeks while early runners are rooting. As a result, the use of Sesone involves a number of applications, in addition to a period in which cultivation has to be used for weed control. While Sesone is an improvement over some of the other methods of controlling weeds in strawberries, it is far from the "ideal."

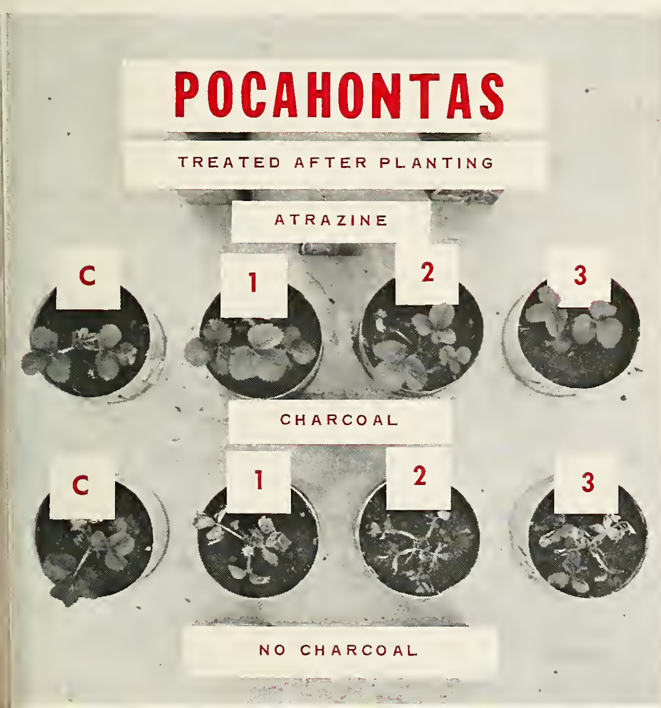
In 1961, W. H. Childs, Experiment Station horticulturist, found that a mixture of Eptam (5 lb. a.i. per acre) and Simazine (1 lb. a.i. per acre) gave excellent weed control with little or no injury to the strawberry plants. However, the major disadvantage of the Eptam-Simazine mixture is that it should not be applied until six weeks after setting. Application at the time of setting results in injury to the strawberry plant. Therefore, the grower using this herbicidal treatment still

Strawberries

ıre

must control weeds by costly cultivation methods for the first six weeks. However, despite this disadvantage, the Eptam-Simazine mixture is the best herbicidal treatment for strawberries so far devised, and it is presently being used in almost all commercial strawberry acreage in West Virginia. Application of the mixture, on the other hand, still falls short of Dr. Child's definition of an "ideal" strawberry herbicide—a herbicide which will control weeds for the entire season with one application and will not injure the plants.





Recently, Robinson in Northern Ireland found that Simazine could be applied at the time of plant set without injury to the plants if their roots were coated with activated charcoal prior to setting. As a result of this information, the series of greenhouse experiments reported here were carried out at the West Virginia University Agricultural Experiment Station in the winter of 1963-64. These confirmed Robinson's work and indicated wide scale applicability of the charcoal dip technique.

Strawberry plants were grown in a fine-sandy-loam soil in No. 10 cans. Simazine at rates of 1, 2, 3, and 4 pounds a.i. per acre was applied as a soil drench prior to plant set. The varieties used in this experiment were Surecrop, Catskill, and Pocahontas. The roots of half of the plants in each variety were dipped in fine-powdered activated charcoal (aqua-nuchar) prior to setting; the other plants were set without this dip. Simazine at a rate of one pound per acre caused injury to the plants, and with Catskill and Pocahontas, the 2-, 3-, and 4-pound rates killed the plants. On the other hand, when the roots were dipped in charcoal prior to planting rates up to 4 pounds per acre had no detrimental effect on the growth and vigor of the plants. Twenty weeks after setting the plants, there still was little or no injury in treatments where the roots had been dipped in the charcoal prior to planting.

Ten weeks after setting the last experiment a second one was set up with four varieties of strawberries—Surecrop, Midway, Catskill, and Pocahontas. The plants were again set in No. 10 cans, half of the plants receiving the charcoal dip and half untreated. The treatments used were Simazine 1, 2, and 4 pounds a.i. per acre, Atrazine 1, 2, and 3 pounds a.i. per acre, and Eptam-Simazine mixture consisting of 4 pounds of Eptam and 1 pound of Simazine per acre. Two sets of treatments were used. In one case herbicides were applied before setting, and in the other case the treatments were applied after setting. Each treatment was replicated five times.

Figures 1-4 show the effects of Atrazine and Simazine on Pocahontas and Surecrop two weeks after planting. Again it may be noted that plants dipped in charcoal (top row) are not affected by the herbicidal treatment even at the high rates (4 pounds a.i. per acre of Simazine and 3 pounds a.i. per acre of Atrazine), whereas non-charcoal plants (bottom row) show injury at the 1 pound rate for either chemical and for all four varieties.

From final observations of these plants, the following conclusions seem justified: 1. Under the conditions of these experiments the charcoal dip prevented injury from Simazine and Atrazine applied at a rate of 2 pounds a.i. per acre. 2. Application of the herbicide after setting results in less injury than before set applications. More recent field trials indicate that the application must be made immediately after setting and before the plants break dormancy. When the plants are treated after the breaking of dormancy, considerable injury develops.

These experiments indicate that it is possible to use Simazine and possibly Atrazine in strawberries at the time of planting and thus eliminate the need for cultivation associated with the present Eptam-Simazine recommendation. However, before this can become a commercial practice, the rates of Simazine for the field and commercially feasible method of applying the charcoal must be determined. For that reason, the Experiment Station is continuing with these studies. The method is in the experimental stage, but it would appear that the use of Simazine or Atrazine in combination with a charcoal dip may be the "ideal" herbicide treatment for 1966.

Financial Statement for the Year July 1, 1963 to June 30, 1964

Classification of Receipts and Disbursements	Hatch	Hatch RRF	Title II	McIntire-Stennis	Non-Federal Funds	TOTAL
RECEIPTS						
Received from the Treasurer of the U. S.	$601,089.00	$100,589.00	$ 2,000.00	$ 18,955.00	....	$722,633.00
State appropriations:						
Main Station	....	....	....	....	$449,168.85	449,168.85
Special:						
Oak Wilt Research	....	....	....	....	10,000.00	10,000.00
Forest Products Development	....	....	....	....	29,538.07	29,538.07
Special endowments, fellowships and grants:						
Industry:						
Private Corporations	....	....	....	....	7,615.58	7,615.58
Farm and trade associations	....	....	....	....	14.00	14.00
Fees	....	....	....	....	13,623.31	13,623.31
Sales	....	....	....	....	193,061.25	193,061.25
Balances forward July 1, 1963	....	....	2,500.00	....	114,400.77	116,900.77
Total Available	$601,089.00	$100,589.00	$ 4,500.00	$ 18,955.00	$817,421.83	$1,542,554 83
DISBURSEMENTS						
Personal services	$477,360.48	$ 79,676.32	$ 2,574.43	$ 3,947.36	$419,884.00	$983,442.59
Travel	8,690.72	2,917 28	199.80	418.35	7,202.63	19,428.78
Equipment	55,847.56	7,638.73	....	....	78,957.22	142,443.51
Personnel benefits	10,491.68	15 59	....	136.62	3,615.85	14,259.74
Supplies and materials	37,982.87	8,106.70	195.39	55.85	109,854.39	156,195.20
All other	10,715.69	2,231 59	30.38	....	81,124.81	94,102.47
Total Disbursements	$601,089.00	$100,586 21	$ 3,000.00	$ 4,558.18	$700,638.90	$1,409,872.29
Reverted Balances	....	$2.79	....	....	....	$2.79
Unobligated Balances Available for 1964-65	....	....	$ 1,500.00	$ 14,396 82	$116,782.93	$132,679.75

These station projects are active in the year 1964-65

(Abbreviations of funds supporting projects and other abbreviations: AMS-Agricultural Marketing Service; ARS-Agricultural Research Service; CES-Cooperative Extension Service; CSRS-Cooperative State Research Service; ERS-Economic Research Service; H-Hatch Funds; MS-McIntire Stennis Funds; NE-Northeastern Regional Research; NEM-Northeastern Regional Marketing Research; S-State Funds; SCS-Soil Conservation Service; USDA-United States Department of Agriculture).

Administration

General administration of federal-grant fund research (H 1)
Planning and coordination of cooperative research (H 2)

Agricultural Biochemistry

The mechanism of action of hemicellulases and the structure of hemicelluloses (H 157)
Serum nutrient distribution following test meals of different composition (H 160; coop. Home Economics)
Utilization of amino acids from proteins (H 174, NE 52; coop. Home Economics)
Mineral metabolism in chicks using radionuclides calcium^{45} and sulfur^{35} (H 175)
Miscellaneous chemical investigations (S 5)
Radionuclide mineral metabolism of chicks which differ genetically (S 124)
Determination of the level of gamma irradiation and desired time to irradiate for controlled reproductive performance in chickens and turkeys (S 136; coop. Animal Industry and Veterinary Science)

Agricultural Economics and Rural Sociology

The economics of broiler production on West Virginia farms (H 85; coop. CES)
The effects of population change and migration upon agriculture and rural community life in West Virginia (H 102, NE 31)
The effect of advertising and promotion on milk sales (H 114)
Input-output relationships of forage production on dairy farms in West Virginia (H 134; coop. Agronomy and Genetics)
Improving farm income from apple sales through changes in market organization and structure (H 137)
Economics of reducing the frequency of retail milk delivery (H 138, NEM 25)
Adjustments needed to enhance the competitive position of West Virginia in marketing broiler products (H 151)
Analysis of trends pointing to future consumption and market potential for meats in West Virginia (H 162, NEM 28)
Economics of marketing floricultural products in non-florist outlets (H 163, NEM 8; coop. ERS, CSRS, USDA)
Evaluation of alternative enterprises for West Virginia farms and the determination of optimum livestock and crop systems and scale of operation (H 165)
Structure and development of the retail market for ornamental nursery products (H 177, NEM 15)
Alternative marketing systems for eggs in the Northeast (H 185, NEM 21)
Social and economic consequences of changes in employment upon selected Northeastern communities (H 186, NE 47)
Milk assembly, processing and distribution systems and practices (H 187, NEM 25)
Determine the marketing adjustments and developments needed to enable small scale producers of small fruits and vegetables to compete on the wholesale market (Title II, ES 834; coop. CES, State Department of Agriculture)
The agronomic and economic effects from fertilizer applied by airplane to hill land pasture (S 138; coop. CES, SCS)

Agricultural Engineering

Agricultural climatology of West Virginia (H 105, NE 35; coop. Reymann Memorial Farms, Ohio Valley Experiment Farm, Weather Bureau, U. S. Department of Commerce)
Curing and handling of burley tobacco (H 123; coop. Agronomy and Genetics, Ohio Valley Experiment Farm)
Hydrology of watersheds on shale soils (H 130; coop. Agronomy and Genetics, ARS, SCS)
Equipment for permanent hillside pastures (H 156)
Effect of temperature, humidity, and drying time on hay (H 158, NE 13; coop AERD-ARS)
Influence of solar energy and light on poultry house environment (H 170, NE 8; coop. Animal Industry and Veterinary Science)
Preliminary and exploratory investigations pertaining to agricultural engineering (S 97)

Agronomy and Genetics

Corn genetics and breeding (H 29; coop. Reymann Memorial Farms)
Crop rotation experiments (H 43; coop. Ohio Valley Experiment Farm)
Alfalfa breeding and genetic investigations (H 66)
Some chemical properties of the major soil types of West Virginia (H 81)
Nutrient availability in relation to soil structure (H 106)
The production of burley tobacco (H 108; coop. Ohio Valley Experiment Farm)
The chemical nature of soil organic nitrogen (H 112, NE 39)
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The life cycle of yellow rocket (*Barbarea vulgaris*) as related to its control as a weed (H 128, NE 42)
The microclimate and soil moisture regime in forested soil as affected by topography and its effect on site productivity in mixed oak stands (H 140)
The performance of several alfalfa varieties grown under different climate conditions with emphasis on the influence of fall cuttings (H 141)
The influence of cutting and fertilization treatments on the productivity and persistence of orchardgrass and timothy (H 142)
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Physiological responses of weed and crop plants to herbicides (H 161; coop. Horticulture)
The control of weeds for pasture and forage production (H 169)
Morphological and physiological responses of perennial forage grasses (H 173, NE 29)
Nature and inheritance of root and stalk rot resistance in *Zea mays* (H 179; coop. Plant Pathology, Bacteriology, and Entomology)
Phosphorus fixation in West Virginia soils and its influence upon plant development (H 181)
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Field crop variety testing (S 6)
Soil survey work in West Virginia (S 8)
The establishment, testing, observation and evaluation of grass and legume species and strains for surface mine reclamation and soil conservation on critical areas (S 87; coop. SCS, CES)
Preliminary investigations in soil science (S 94)
Preliminary investigations in crop production and genetics (S 128)

Animal Industry and Veterinary Science

The influence of genetics and environment on milk and meat production in Ayrshire cattle (H 7)
Breed as a factor in the production of ewes retained for flock replacement and for the production of market lambs and wool (H 23; coop. Reymann Memorial Farms)
Comparison of young bulls with proven bulls in artificial breeding (H 27; coop. W. Va. Artificial Breeder's Coop., CES)
The use of type and production records as a basis for dairy cattle improvement program (H 35; coop. Ayrshire Breeder's Association)
Methods to increase non-protein nitrogen utilization by ruminants (H 45)
Measuring the nutritive value of forage crops (H 46, NE 24; coop. Agronomy and Genetics)
Respiratory diseases of poultry (H 53, NE 5; coop. Reymann Memorial Farms)
Breeding for efficient production of eggs and meat (H 74; coop. Reymann Memorial Farms)
Avian infectious anemia-synovitis (H 88)
The effects of early versus delayed breeding of dairy heifers (H 107)
The effect on hatchability, chick viability and growth rate of fortifying chick embryos (H 111)
The pathogenicity of infectious agents for the uterine mucosa (H 127, NE 40)
Nutrition, soil and herbage interrelationships in syndrome resembling hypomagnesemia tetany in ruminants (H 131; coop. Agronomy ond Genetics)
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Evaluating crisscross breeding of poultry (H 144)
Increasing genetic variation in poultry for selection purposes through the use of gamma radiation (H 155; coop. Agricultural Biochemisty, Statistics)
Indirect calorimetry studies with dairy cattle (H 159)

The effects of two systems of selection of breeding stock on beef cattle performance (H 166; coop. Reymann Memorial Farms, Agricultural Economics, Statistics)
The acceptance of beef from carcasses of different characteristics (H 167; coop. Agricultural Economics)
Dairy cattle breeding—milk composition (H 168, NE 46)
Alternative management systems for lamb production (H 171; coop. Reymann Memorial Farms, Agricultural Economics)
The effect of gamma radiation on the genetic variation in turkeys (H 176; coop. Agricultural Biochemistry)
Thyroid stimulating factor(s) in foods and feeds (H 182)
Genetic relationships between enzymes and egg production traits (H 183, NE 51; coop. Agricultural Biochemistry)
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Exploratory or preliminary investigations on diseases, feeding and management of farm animals (S 89)
Miscellaneous investigations of dairy products (S 90)
Selecting for milk production in Jersey cattle (S 106)
Increasing the utilization of low quality hay in wintering beef cattle in West Virginia (S 111)
Methods of feeding growing-fattening pigs for the economical production of lean carcasses (S 113; coop. Agricultural Biochemistry)
Chemical inhibition as a means of preserving bovine sperm (S 114)
Studies on infectious synovitis (S 117; coop. Agricultural Biochemistry)
Development of economical broiler rations (S 130; coop. Reymann Memorial Farms)
Nutrition of egg producers (S 131)
The efficacy of certain anthelmintics in the control of sheep parasites (S 132)
Factors that affect the solids-not-fat content of milk (S 134)
A comparison of the wastage of feed by various types of swine self-feeders (S 135; coop. Agricultural Engineering)

Forestry

Efficient forest management practices for West Virginia cut-over and burned-over hardwood forest lands (H 36; coop. W. Va. Conservation Commission)
Timber management for the market demands in southern West Virginia forests (H 56; coop. Island Creek Coal Co.)
Factors affecting natural regeneration in upland oak types (H 67; coop. Plant Pathology, Bacteriology, and Entomology)
Production of plantation-grown Christmas trees in West Virginia (H 119; coop. W. Va. Conservation Commission, W. Va. Christmas Tree Growers' Association, Maryland Departments of Research and Education and Forests and Parks)
Revegetating spoil banks with forest tree species (H 120; coop. SCS)
Marketing lumber in West Virginia (H 125, NEM 24; coop. U. S. Forest Service)
Quality control of lumber dimension in West Virginia hardwood sawmills (H 129)
Population studies of forest small mammals in West Virginia (H 147)
Forest fire protection through public interest in game management in southern West Virginia (H 149; coop. Island Creek Coal Co., W. Va. Conservation Commission)
Selection, propagation, and silvicultural regeneration of superior genotypes of valuable Appalachian hardwood tree species (MS 1)
Wood characteristics of hardwood species which may be susceptible to genetic change (MS 2)
Utilization of sprout black cherry (MS 3)
Plantings of forest trees and shrubs at Greenland Gap (S 56)
Determination of optimum growth of West Virginia hardwoods (S 60)
Silvicultural management of Virginia pine in West Virginia (S 126)
Growth and yield of West Virginia hardwoods as affected by stand density and site quality (S 139)

Horticulture

Nutrition of apple trees in West Virginia (H 16; coop. University Experiment Farm)
Selection, breeding and propagation of nursery crops (H 59; coop. Reedsville Experiment Farm)
Effects of hebicides on tree fruits and small fruits (H 116)
Post-harvest physiology of pomological fruits (H 180, NEM 27; coop. Agricultural Engineering)
Post-harvest physiology and handling of strawberries (H 184)
Miscellaneous horticultural investigations (S 27)
Variety test of tree and small fruits (S 29)
Variety of strain studies of vegetables (S 31)
Lily bulb production trials (S 61; coop. ARS)
Propagation and selection of edible nut-bearing trees suitable to West Virginia (S 98)
Testing azaleas (S 112; coop. Reedsville Experiment Farm, ARS)
Turf trials for home lawns (S 116)
The improvement of Geranium, *Pelargonium hortorum*, through breeding (S 121)
Studies of the effect of certain cultural practices on the cost of production for commercial strawberries in West Virginia (S 137; coop. Ohio Valley Experiment Farm)

Plant Pathology, Bacteriology, And Entomology

The microbiology of strip mine spoil (H 13)
Decay as a factor in sprout reproduction of yellowpoplar (H 14; coop. Forestry, U. S. Forest Service, W. Va. Dept. of Natural Resources)
Factors influencing losses from root rots of forage legumes (H 51, NE 45)
Biology and control of tree-wilt pathogens (H 57, NE 25; coop. W. Va. Dept. of Agriculture, U. S. Forest Service, W. Va. Dept. of Natural Resources)
The symbiotic relationships betwen microorganisms and insect vectors of plant diseases (H 62)
The structure and function of specialized tissues in insects (H 63)
Biology and control of nematodes affecting fruit trees and forest seedlings (H 72, NE 34)
Diseases of forage grasses (H 78)
The control of livestock pests in West Virginia (H 79; coop. Animal Industry and Veterinary Science, Reymann Memorial Farms)
Cereal and forage crop pests—their distribution, incidence and control in West Virginia (H 80; coop. Agronomy and Genetics)
The microbiology of farm ponds (H 132)
The physiology of microorganisms important in food and dairy science (H 178)
The physiology and genetics of fungi (H 192)
Host-parasite interrelationships of diseases of vegetable crops with emphasis on those caused by species of *Phytophthora* (H 193)
The biology and control of insects and nematodes affecting forest tree plantations in West Virginia (H 194)
Miscellaneous plant disease investigations (S 19)
Miscellaneous insect and insecticide studies (S 24)

University Experiment Farm

Apple and peach insect control (S 91; coop. Bureau of Entomology and Plant Quarantine)
Delicious budsport evaluation test (S 115)

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November 1964

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Miscellaneous

J. M. Baremore, B.S., Head Office of Business Relations and Records
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Receives Grant

N. O. Olson, Animal Industry and Veterinary Science, has received a grant to continue research on arthritis in poultry. The grant, for nearly $60,000 during a three-year period, was awarded by the Public Health Service, United States Department of Health, Education, and Welfare. K. M. Kerr, Station research associate, is aiding in the research program.

Authors of Paper

C. E. Main, former graduate assistant, and M. E. Gallegly, Plant Pathology, Bacteriology, and Entomology are authors of a scientific paper, "Disease Cycle in Relation to Multigenic Resistance of Potato to Late Blight," printed in December, 1964 in the "American Potato Journal."

new publications

Bulletins

496T. B. W. Moore, H. Patrick, J. R. Johnson, and H. M. Hyre. Composition and Production of Poultry Manure. June 1964.
497. V. O. Shanholtz and W. H. Dickerson. Influence of Selected Rainfall Characteristics on Runoff Volume. June 1964.
498. James H. Brown. Effect of Time of Summer Pruning on Bud Set, Limb Development, and Shoot Growth of Sheared Pines. June 1964.
499T. Anthony L. Pavlick. Towards Solving the Low Income Problem of Small Farmers in the Appalachian Area. June 1964.
500. Donald E. Nelson. Marketing of Lumber Through Retail Outlets in West Virginia. June 1964.
501. D. J. Horvath and K. C. Elliott. Comparison of Wastage of a "Complete" Meal Mixture in Various Swine Self-Feeders. September 1964.
502. D. E. Nelson and W. H. Reid. The Market for Industrial Lumber in West Virginia and in Surrounding States. December 1964.
503. E. H. Tryon and R. P. True. Relative Susceptibility of Appalachian Hardwood Species to Spring Frosts Occurring After Bud Break. December 1964.
504. Science Serves Your Farm and Home. Annual Report of A. H. VanLandingham, Director. March 1965.

Circulars

113. C. K. Dorsey, H. E. Kidder, C. J. Cunningham, and C. B. Boyles. Livestock Pest Control in West Virginia. July 1964.

FERTILIZERS AND FORAGE QUALITY

(*Continued from Page 5*)

mal on pasture has a problem of selection which may be affected by differences in botanical composition of the sward, availability of pasture, stage of maturity of the herbage, and chemical composition of the plant. English workers have shown that nitrogen fertilization increased the palatability of herbage, particularly the grasses, and similar claims have been made for phosphorus and potassium. Current research has been designed to determine the effect of different fertilizers and quantities of fertilizer on the digestibility, intake, and palatability of various pasture and hay grasses by free-grazing sheep. These experiments involve the use of animals equipped with special harnesses (Figure 3) and a regular analysis of pasture and fecal samples for digestibility and intake "indicators." Palatability is determined by allowing the sheep access to a pasture strip fertilized in different ways and by recording both the amount of herbage harvested from the areas in a given period and the length of time that animals spend grazing on specific plots (Figure 4).

Trials with tall fescue pasture have so far indicated a relationship between palatability and fertilizer treatment quite different to that obtained with penned sheep fed clipped grass or chopped hay. In grazing periods covering an early growth phase in May and June, and again after defoliation of the experimental plots in July, sheep showed a decided preference for herbage grown at high levels of nitrogen or at a high phosphorus and nitrogen level. The reasons for the difference in behavior between grazing and indoor animals must remain speculative at present, but it is apparent that further work with a number of forage species under a variety of feeding conditions will be required before the relationship between fertilizer treatment and forage acceptability is clarified.

A final point to consider in developing a forage fertilization program is the possibility of inducing nitrate toxicity in animals by application of excessively high levels of nitrogen to forage crops. However, it is presently impossible to define what is a potentially toxic level of nitrate in plants. Levels as low as 0.4 per cent in hays have been reported to reduce weight gains in calves, while Illinois experiments have shown that nitrate can be fed to a level of 3.9 per cent in the diet over a period of months without affecting the health or growth rate of lambs. Certain plants have a definite tendency to accumulate nitrate and this accumulation may be influenced to a marked degree by such factors as plant species, stage of maturity, soil moisture, light intensity, and level of nitrogen fertilization. A New York study showed that the concentration of nitrate in oats would increase with levels of nitrogen fertilizer up to 800 pounds (approximately 2.7 per cent nitrate at the vegetative stage; 1.3 per cent at the dough stage). Perennial forage grasses tend to accumulate nitrate to a lesser degree than do annual plants. Nevertheless, nitrate levels in a tall fescue hay harvested at the heading stage rose from 0.3 per cent at the zero level of nitrogen to 1.6 per cent when 450 lb. N/acre was used. Similar levels were recorded in the aftermath crop. There was no apparent effect of nitrate on the well-being of the lambs, but it is as yet uncertain whether the nitrate content could be a factor in determining acceptability of the forage. Pennsylvania experiments have indicated no evidence of nitrate toxicity when orchardgrass fertilized with 50-300 lb. N/acre was fed to sheep.

To summarize, animal trials at West Virginia have shown that nitrogen fertilization of grasses will increase yield, protein content, and apparent protein digestibility; neither nitrogen, phosphorus, nor potassium fertilization has been shown to affect the digestiblity of energy very markedly. Fertilization has been found to alter intake to a minor degree when sheep were given no choice of forage. Under a free-choice system, the type and level of fertilizer may affect the animal's selection of forage markedly and different factors may be involved in determining the acceptability of forages by free-grazing and stall-fed animals. It is not yet possible to decide whether the application of high levels of nitrogen fertilizer will create a nitrate toxicity problem for livestock farmers.

Figure 4. Acceptibility of grass treated with different fertilizers may be measured by observation of animals on pasture and by determination of the amount of herbage consumed from each plot. These animals are grazing an aftermath orchardgrass strip fertilized with 100 pounds of nitrogen per acre.