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Severe Newcastle Disease Outbreak Causes Serious Losses to Utah Poultry Industry

Station Veterinarians Outline Control Program

By WAYNE BINNS, H. M. NIELSEN, and M. L. MINER

NEWCASTLE disease of chickens, in all its virulence, caught up with the poultry industry in Utah this past summer and fall. The poultry industry of Utah, as well as that of the rest of the United States, had been coasting along on the belief that Newcastle disease would not cause such devastation here as it does in European and Asiatic countries.

Newcastle disease, more properly called pneumoencephalitis, is a respiratory and nervous disorder of chickens and other fowls. In previous outbreaks it usually started with the chicks and chickens gasping and wheezing. They all had difficulty in breathing. There was some nasal discharge. In laying hens there was always a rapid drop in egg production to almost nothing. Quite often these were the only symptoms noted and the birds recovered in about ten days to two weeks. Egg production was not back to normal for 4 to 8 weeks. Quite frequently brooder and range age chicks showed nervous symptoms. The birds lost control of the legs, or the head and neck were twisted over the back or under the breast. Death loss of these young birds sometimes reached 10 to 15 percent.

In the 1948 outbreak, the disease has been much more destructive. These same symptoms have occurred, but in greater severity. The most unusual thing has been the occurrence of a high percentage of paralyzed and prostrate birds in mature hens or nearly mature pullets. The death losses in these mature flocks have been around 50 percent. In younger birds of about 10 weeks of age, losses have reached 85 percent. Death losses were higher if coccidiosis was also present in the flock. This type of virulent Newcastle disease has not been reported in other parts of the United States. The accompanying table shows how it has behaved in several flocks in Salt Lake County.

This virulent type of Newcastle disease first came to the attention of the Veterinary Science Department in the latter part of June in flocks in the southwestern part of Cache Valley. At about the same time, reports came in from Utah County and the Draper area of Salt Lake County. During the months of July, August, September, and October, severely affected laying flocks and broiler flocks were reported in Cache, Salt Lake, Weber, and Utah Counties. Less severe cases were reported from Sanpete, Sevier, Juab, Millard, and Beaver Counties.

Athough in November and December the disease apparently lost some of its virulence, it did not lose its ability to spread. It continued to travel into new areas. For instance, the western part of Salt Lake County escaped the initial outbreak during the summer, but it occurred there in the fall months. Box Elder County escaped with no cases until the fall months.

The question arises as to how the disease spreads from place to place. In many instances, the disease was introduced onto a premise by the owner purchasing infected stock, also by contaminated equipment. Visitors or caretakers could carry it on their clothes. Yet to have reached some isolated flocks where nothing was introduced, the only answer seems to be that it was carried in the air. There is much evidence that the virus is carried on dust particles in the air.

A few weeks before this epizootic occurred, a live virus vaccine was introduced on the market. The virus in the vaccine is modified so as to be apparently incapable of producing the disease in serious form. Many flocks in Salt Lake and Cache Counties were vaccinated during the height of the epizootic.

Flocks vaccinated at least 10 days prior to exposure were protected. If

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RECOMMENDATIONS CONCERNING NEWCASTLE DISEASE VACCINATION FOR 1949

1. Do not vaccinate day old chicks. Try to obtain chicks from immune parent stock.
2. Vaccinate chicks for laying and breeding flocks after 4 weeks of age and up to 12 weeks, the age depending on health conditions of the flock and the nearness of Newcastle disease in the locality.
3. Vaccinate chicks for broilers at 4 weeks of age whenever there is a serious outbreak of Newcastle disease in the locality.
4. Do not vaccinate chicks when the birds are sick from some other disease, especially coccidiosis.
5. Do not vaccinate chicks for Newcastle disease simultaneously with other vaccinations such as for fowl pox or laryngotracheitis. Preferably vaccinate for Newcastle disease about two weeks before other vaccinations.

DR. WAYNE BINNS is head of the Department of Veterinary Science. DR. M. L. MINER is associate professor and a specialist in poultry diseases. PROF. H. M. NIELSEN is assistant professor.

Professor Laval S. Morris, head of the Department, is a graduate of the U. S. A. C., received his M. S. degree from Michigan State and his M. L. A. from Harvard. He was head of the Department of Landscape Architecture at the B. Y. U. before coming to the College. During the war Professor Morris worked as a consultant in landscaping and camouflage for the Army

HOME AND FARMSTEAD PLANNING

HOME and farm life can be greatly enriched by taking advantage of the principles of landscape design. In the Department of Landscape Architecture and Planning these principles of design and organization are applied to the smallest home or farm, to the school and church, and to all other phases of land planning for use, safety, and living.

Communities and towns are planned in the department even before the smaller parts are designed. Home and farm as important units of the community are given careful consideration.

The accompanying study of a farm shows a building group arranged for convenience. The service area for the farm buildings is graded for surface drainage and covered with gravel. Asphalt is even better.

Research in this department is concerned with study in the adaptability and propagation of native and imported plants for landscaping in Utah.

Students majoring in landscape architecture receive background training in agriculture, engineering, architecture, and art. Certain phases of agriculture are studied for an understanding of soils in relation to plant growth. Engineering is essential for topographic surveying, and cut and fill problems in relation to grading. Architecture is important to landscape work because the two are so closely interrelated. An understanding and a technique in art are important because students first learn to work out compositional effects on paper and later are taught to translate these same effects to ground forms.

NEWCASTLE DISEASE OUTBREAK

(Continued from page 1)

vaccination was practiced after exposure, the severity of the disease was not lessened to any appreciable extent. In some flocks with well-separated pens, it was possible to vaccinate ahead of exposure and protect part of the flock.

Vaccination is not without a definite reaction in the chickens. About 7 to 10 days after vaccination the chickens show evidence of sickness with a decrease in feed consumption and a general listlessness. Producing hens show a sharp decline in egg production. The higher the production, the sharper the decline. The birds recover from the reaction in a few days, but it takes up to four weeks for egg production to reach normal. Sometimes less than one percent shows nervous symptoms. If growing chickens are vaccinated when other diseases are present, especially coccidiosis, considerable death loss is encountered.

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Table 1. Effect of Newcastle disease on some flocks in Salt Lake County

Flock number	Date of onset	Age of birds	Total no. birds	Total mortality	No. culls 6 to 8 weeks later	Total loss death & culls	Percentage loss
1	Aug. 1	17 weeks	600	450			75.0
2	Aug. 8	10 weeks	1100	950			86.5
3	Aug. 30	Yearling	1234	515	71	586	47.5
		23 weeks	2449	1106	117	1223	50.0
4	Sept. 10	6 months	1800	945		945	52.5
5	Sept. 10	6 months	750	290		290	38.0
6	Sept. 15	2 years	189	80	15	95	50.0
		Yearling	317	137	15	152	48.0
		6 months	800	384	15	399	50.0
7	Sept. 28	11 months	1100	458	50	508	46.0
8	Oct. 5	Yearling	1500	648	80	728	48.5
		6 months	1800	650	95	745	41.5

Investigations Show Variations in Grading in Turkey Processing Plants

Study Shows That Heavy Varieties Should Dress Out About 13 Pounds for Hens and 23 Pounds for Toms to Grade Out with High Percentage in Prime Grade

By R. H. ANDERSON

IN 1947, 72 percent of the turkeys processed in Utah were graded prime or grade A, 23 percent graded choice, and 5 percent graded commercial, according to a study of turkey processing plants made by the Utah Agricultural Experiment Station. For all plants studied 79 percent of the hen turkeys, but only 64 percent of the tom turkeys were of prime grade. However, the proportion in prime grade varied considerably among the various plants (fig. 1).

There was a close relationship between the proportion of hens in prime grade and the proportion of toms. Plant M was the lowest of all the plants in the proprtion of hens and toms of prime grade.

Possible reasons for the variation in grades of turkeys in the various plants are: (1) variation in turkeys grown in different parts of the state, (2) difference in method and care in processing, and (3) variation among the graders located at the different plants. Since there was considerable variation among plants in the same general area of the state and turkeys from some flocks were actually processed in more than one plant, it would seem that the first reason would account for little, if any, of the variation in grades between plants. The two remaining reasons, variation in processing methods and variation in graders among the various plants, are probably the most important causes for variation in grades. This question is being studied further this year.

Importance to Turkey Growers

Prices received for prime turkeys by growers in Utah in 1947 were from 2 to 3 cents above the price received for choice or grade B birds, and 5 to 7 cents above the price for commercial or grade C birds. Based on this price differential turkeys processed at a plant where the lowest grade was obtained would bring from ½ to ¾ cents per pound less than those processed at a plant with the highest grade. An average Utah turkey grower, producing about 3,500 birds, would receive about $400 less for his birds by having them processed in plant M than he would receive if processed in plant D.

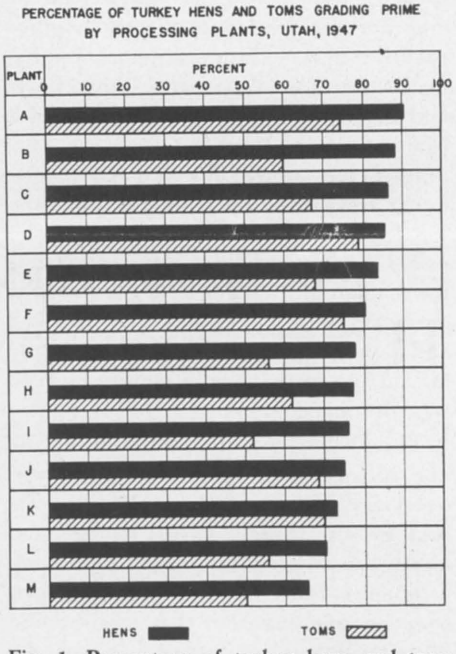

Fig. 1. Percentage of turkey hens and toms graded prime by processing plants in Utah, 1947

Table 1. Weight of hen and tom turkeys relative to grade

Grade	Average weight	
	Hens	Toms
Prime	13.6	23.2
Choice	12.4	21.3
Commercial	11.4	18.6

In the last 15 or 20 years turkey production in Utah has increased from about a quarter of a million to more than a million birds per year and represents about 10 percent of the cash farm income in the state. In 1945, the peak year of production, more than two million turkeys were produced in Utah. Along with the increase in relative importance in recent years the turkey industry has shifted from small farm-flock production averaging less than 100 birds per flock to a highly specialized industry with average flocks of more than 3,000 birds. A relatively few years ago turkeys were processed on the farms where raised but in recent years practically all have been processed in modern plants with the aid of modern machinery and assembly-line methods. The processing plants have been established on a custom-processing basis whereby the grower retains the ownership of his birds until they have been processed. Some cooperative processing plants have sales outlets through which growers may sell their turkeys but selling through the cooperative is not compulsory and many are sold to independent buyers.

Relation of Grade to Weight

It is difficult while turkeys are alive and full-feathered to determine what grade they will make when dressed. Since finish and fleshing are important factors influencing grade, and since turkeys, unlike other kinds of livestock, are unable to put on finish until maturity has been reached, the grade may be roughly determined by the weight of the birds. There was considerable relationship between grade and weight for both hen and tom turkeys in the plants studied (table 1). Prime hens, on an average, weighed about one pound more than choice hens and two pounds more than commercial hens. The difference in weight between grades was greater for toms than hens; prime toms weighed about 2 pounds more than choice and 4.6 pounds more than commercial toms. There was a greater variation in weight of both hen and tom turkeys in the lower grades.

According to these data growers of heavy varieties of turkeys should dress their birds when the hens weigh an average of 13 pounds or more (dressed basis) and toms weigh 23 pounds or more in order for them to grade out with a high percentage in the prime grade. To feed turkeys after they have reached a prime condition is expensive since these gains are added, only at high rates of feed consumption per pound of gain. "When they're prime it's killing time," is a good rule to follow.

DR. ROICE H. ANDERSON, associate professor, is one of the newer members of the staff in agricultural economics. He came here over a year ago from the University of Wyoming.

FARM AND HOME SCIENCE

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SIXTY YEARS OF AGRICULTURAL RESEARCH

IT WAS just 61 years ago on March 8 that the territorial legislature passed the Lund Act "to establish an agricultural college and experiment station." This and subsequent acts of the state and federal government have specified that studies should be made of the basic laws and principles of agriculture. The purpose of these studies was to assist the farmer in solving his problems, and to establish a more permanent and prosperous agriculture.

The actual work of the Experiment Station has now been under way for 60 years. On this anniversary it may be well to glance back over the years to see if the Station is accomplishing the purposes for which it was established. Has it helped to solve the problems of agriculture and contribute to the welfare of the rural people of the state?

A review of the work of the Station to find an answer to these questions shows a favorable record of accomplishment. There is scarcely a farm practice or a crop or animal grown that has not been improved or benefitted from the research conducted at this or one of the other state agricultural experiment stations. Many volumes would be required to describe all the contributions of the Station to Utah's agriculture, but one example might be taken to illustrate the progress made.

Prior to 1925 Utah was one of the leading states in alfalfa seed production. Approximately 40 percent of the nations's total crop was produced by Utah growers. The yield averaged 320 pounds of seed per acre.

Soon after 1925 the acre yields of seed began to decline. They dropped to one-third or one-fourth of those formerly attained. For the 17-year period, 1929 to 1945 the state yields averaged only 100 pounds per acre. This was a serious loss to the alfalfa-seed growers of Utah—and to the agricultural income of the state. Furthermore Utah lost its position as an important alfalfa seed-growing state.

An appeal was then made to the Agricultural Experiment Station to determine the causes for this decline in seed production and what could be done to restore the seed industry to its former status. An agronomist and an entomologist were immediately assigned to investigate this problem. Experiments were set up in the Uinta Basin and in other alfalfa seed-growing areas. Many cultural experiments were conducted but these did not contribute much toward solution of the problem. Finally it was determined that a tiny insect, the lygus bug, was responsible for damaging the alfalfa flower and seed parts. Flowers that had been attacked and punctured by the lygus bug would fall off the plant. Consequently no seed was produced.

Then followed a detailed study of the life history of this insect. This was necessary to determine how it could best be controlled. Clean culture and management practices looked promising as a control measure at one time, but it soon became apparent that this method of control was ineffective. It was decided it would be necessary to resort to the use of insecticides.

Numerous experiments were conducted with a great variety of insecticides and a fair degree of control was obtained with some of them, but their use was too expensive. When DDT became available during the war it was included in the tests. Its powerful effect in controlling lygus was soon demonstrated. Further experiments were then conducted to determine just how to use DDT, when and how often to apply it, and in what concentrations.

In all these tests it was observed that when lygus bugs were controlled, both honeybees and wild bees visited the alfalfa flowers more frequently. As a result the flowers were pollinated and seed was produced. On experimental plots yields of seed were obtained as high as 700 pounds per acre. During the period 1941 to 1948 all experimental plots, numbering between 300 and 400 that were treated with insecticides for lygus control averaged 350 pounds of seed per acre. On 19 demonstration farms where DDT was dusted as it would be applied under normal farm conditions the seed yields have averaged 376 pounds per acre.

Several seed growers have now adopted the practice of dusting their alfalfa fields for lygus control. One farmer has obtained yields averaging from 305 to 380 pounds per acre on 160 to 200 acres of alfalfa during the past three years. A number of instances are known where farmers using DDT for lygus control have produced enough seed in a single season to pay the cost of the land. As a result of the adoption of this practice state average yields have already doubled in the last four years. In 1948 the total seed production in the state was approximately 2 million pounds more than it formerly was. This is worth at least a million dollars to the growers.

Research studies at the Experiment Station found the cause of alfalfa seed decline and then found a way to overcome it. As a result the alfalfa seed industry has been restored. Already this research is worth a million dollars a year to the growers. The value of one year's increase in alfalfa seed would be five to ten times the cost of all the research conducted on this problem over a period of 20 years. And the growers have the assurance of a seed crop for years to come.

Many examples of this type are available to show that the research conducted by scientists of the Agricultural Experiment Station is making the farmers of Utah more secure in their undertakings and it is contributing to their success on the land. This results in a more prosperous agriculture and in the general improvement of rural life.

The state of Utah is now paying only slightly more than one-third of the total cost of the research program of the Experiment Station. The remaining cost is paid by federal funds and research grants by farm organizations and private concerns. The expense of conducting the research is not a cost to the state, but an investment which pays rich dividends in farm income and better rural living.—R. H. W.

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Max E. Robinson has recently been appointed assistant professor of range management. Prof. Robinson received his B. S. degree at this institution, and his M. S. degree from Oregon State College. He was on the staff of the University of Arizona doing teaching and research in range management before coming to Logan.

Red Clover Produces Both a Forage and a Seed Crop

Clover Can Be Grown in Areas Too Wet for Alfalfa

By R. J. EVANS

RED CLOVER is a crop well adapted to Utah conditions, especially to some of the wetter low lying valley lands which do not produce alfalfa so well. It requires no more water than alfalfa, yet will tolerate soils with higher moisture content. It will produce both a hay and a seed crop the same year. In tests of 30 leading strains conducted by the Utah Station in various parts of the state, Midland, Cumberland, Cornell 148, Common, and Scott strains were found superior to others under Utah conditions.

For many years, red clover was the most important legume hay in America. Even now it is surpassed only by alfalfa. Most of the clover acreage is located in eastern and midwestern states, where it is difficult to get clover to produce seed successfully. The development of new improved varieties made it necessary for those states to obtain quick seed increases to supply their needs. They naturally looked to the Intermountain area to produce this seed, since this region had been so successful in producing alfalfa and other seed crops. Farmers in Utah became interested and sent many inquiries to the Agricultural College relative to the adaptation of red clover to Utah conditions and to its productivity. In order to answer some of these questions, the Agricultural Experiment Station started a pilot test in 1940, with a limited number of red, white, and alsike clover varieties. This first trial showed that all three of these clovers could be successfully grown as forages in Utah, but red clover appeared to be most promising as a combined hay and seed producer. To investigate its possibilities further a new test was started in 1942. Twelve varieties including the new varieties, Cumberland, Midland, and most of the lines which make up these synthetic varieties, were included, along with commercial alsike clover. Seeding was done without a nurse crop and one crop of hay was harvested the first year. In the second and subsequent years, a hay crop was harvested in June and a seed crop in September.

The results of this test showed that most of the varieties could be successfully grown for hay and seed in Cache County, but some responded better than others. Experiment Stations were continually bringing out new strains. The results pointed out the need for a more comprehensive test in which a greater number of these strains could be tested. A new series was therefore started in 1944 in which 30 of the leading varieties and strains were included. During

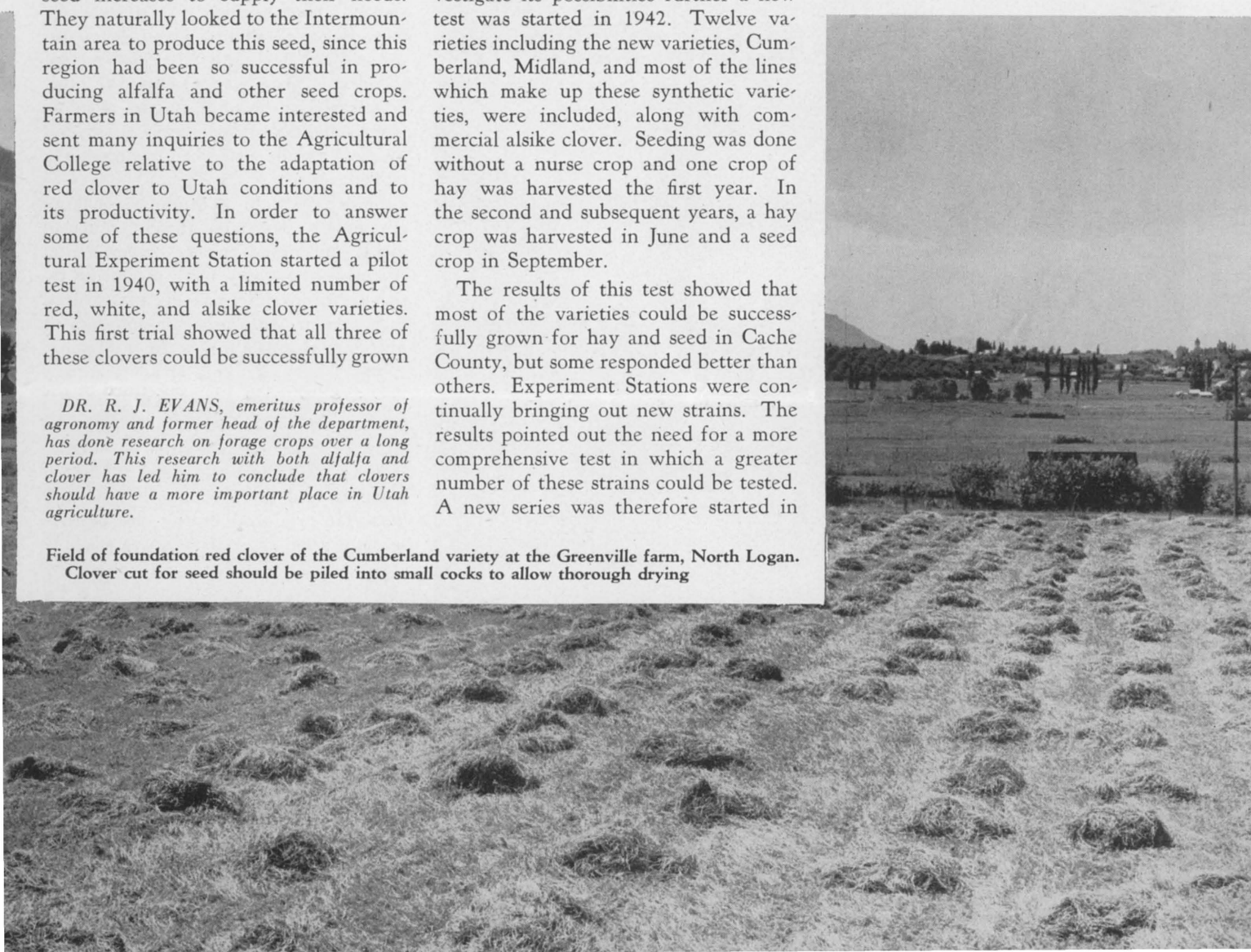
(Continued on page 19)

Table 1. Yield and value of forage and seed, red clover strains Logan, 1943

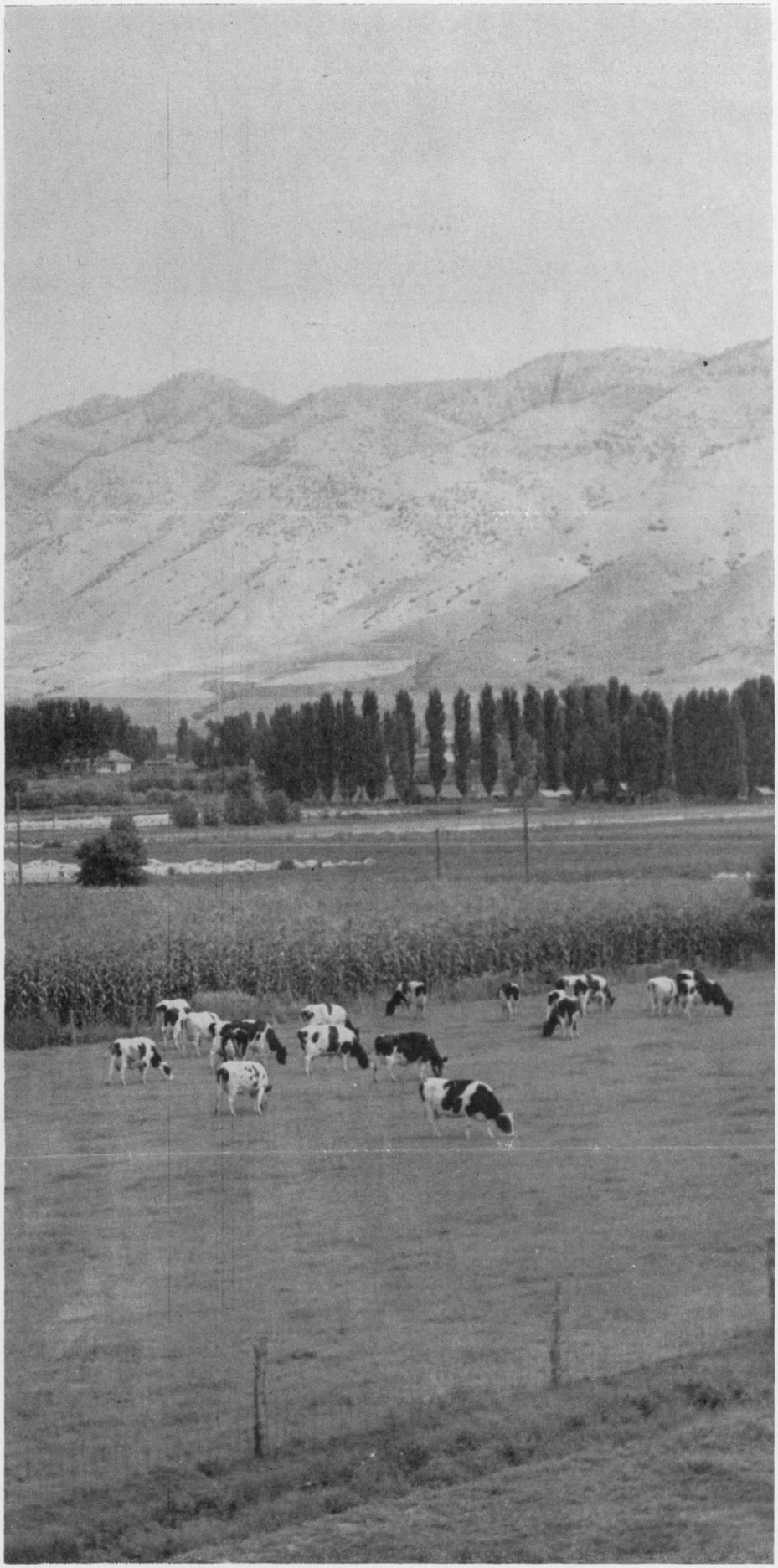
Strain	Hay yield	Value*	Seed yield	Value†	Total value
	tons	*dollars*	*pounds*	*dollars*	*dollars*
Common Red	5.73	85.95	328	131.20	217.15
Van Fossen	5.74	86.10	323	129.20	215.30
Cumberland	6.12	91.80	280	112.00	203.80
Michigan Shan	5.38	80.70	304	121.60	202.30
Poland Red	5.94	89.10	296	118.40	197.50
Midland	5.97	89.55	261	104.40	193.95
Ky 215	5.94	89.10	261	104.40	193.50
Disease Resistant	5.40	81.00	280	112.00	193.00
Kirch Red	5.69	85.35	244	97.60	182.95
Emerson	3.82	57.30	295	118.00	175.30
Mammoth	6.20	93.00	79	31.60	124.60
Grahams Mammoth	5.81	87.15	27	10.80	97.95
Alsike	5.67	85.05	54	21.60	106.65

*Hay valued at $15.00 a ton
†Seed valued at 40 cents a pound

DR. R. J. EVANS, emeritus professor of agronomy and former head of the department, has done research on forage crops over a long period. This research with both alfalfa and clover has led him to conclude that clovers should have a more important place in Utah agriculture.



Field of foundation red clover of the Cumberland variety at the Greenville farm, North Logan. Clover cut for seed should be piled into small cocks to allow thorough drying



PASTURES are potentially much more productive than has been generally realized. Investigation at the College Dairy Experiment Farm have shown through actual grazing trials with dairy cattle that the returns from pastures are as great as from the commonly grown cultivated crops. Grazing trials on new pasture grass-legume mixtures the last two years have given higher yields than old mixtures formerly recommend. The new mixtures under actual grazing, when measured by clipping strips through the plots immediately before each grazing, have significantly and consistently outyielded the old standard mixture growing in the same pasture under similar management with relation to grazing, amount of fertilizer applied, and number of irrigations.

During the grazing seasons of 1947 and 1948 a number of mixtures significantly outyielded the old standard mixture. The palatible, high-yielding plants that make up these mixtures are orchard, tall oat, and bromegrass, when planted in combination with the legumes, ladino clover, red clover, and alfalfa. A number of grass and legume species commonly used in irrigated pastures have consistently given low yields in our studies, and are not recommended. They are: Kentucky blue, perennial rye, meadow fescue, meadow foxtail, white clover (any of several sources), and alsike and strawberry clover.

Since 1938, in addition to making clippings to determine the difference in yields of forage in the experimental pastures, the total feed produced by the entire pasture has been measured each year to determine the amounts of nutrients the pastures were producing.

This was accomplished by weighing the milking herd as it went into the pasture and when taken out. Records were kept on the amounts of supplementary feed fed the herd while on pastures, and the amounts of milk and butterfat produced during the pasture season. From these data it was possible

Earlier reports of the pasture research work will be found in the March and December 1947 issues of Farm and Home Science. This work is cooperative with the U. S. Bureau of Plant Industry, Soils, and Agricultural Engineering. DR. WESLEY KELLER is a geneticist with that bureau working on grass breeding and selection. PROF. BATEMAN is associate professor of dairy husbandry and in charge of the Dairy Experimental Farm where the pastures are planted. MR. PACKER is research assistant in dairy husbandry.

Actual Grazing Trials Prove New Pasture Mixtures Potentially High Producing

by GEORGE Q. BATEMAN, WESLEY KELLER, and J. ELMO PACKER

to calculate the amount of total digestible nutrients each acre of pasture supplied the milking herd during the year.

Before 1946, the pastures were seeded to standard mixture no. 1. (see table 2 for constituents of this mixture). The first four years of the experiment after seeding (1938-1941) no fertilizers were used. The next five years (1942-1946) these same pastures were fertilized with manure and phosphate every second to third year, the average amount applied per acre being approximately 5 tons of manure, containing a large part of the urine, and 87 pounds of treble superphosphate, 43 percent P_2O_5.

A new series of pasture studies was started in 1943. This was an exploratory study to appraise a large number of grass and legume species. It consisted of 36 mixtures in plots 25 x 25 feet.

By the end of the second grazing season most of the species had so clearly differentiated themselves as to high or low production that it was possible to formulate a series of 30 mixtures containing only high-yielding, palatible species. This series, plus standard no. 1 and an additional check-mixture 22, was seeded in the spring of 1946 in plots 22½ feet square replicated 12 times. *(Continued on page 17)*

Table 1. Per acre yield from pasture as determined by grazing trials with Holstein cows

Year	Mixtures	Fertilizer treatment	Number of irrigations	Total digestible nutrients	Standard cow days of grazing*	Alfalfa hay equivalent	Relative productions†	
							Milk 3.5%	Butter fat
				pounds	*days*	*tons*	*pounds*	*pounds*
1938	Standard No. 1‡	None	6	2430	152	2.42	3086	108
1939	" "	None	9	3390	212	3.37	4286	150
1940	" "	None	8	2946	184	2.93	3714	130
1941	" "	None	8	2918	182	2.90	3686	129
4 yr. avg.	" "	None	8	2921	183	2.90	3693	129
1942	" "	Avg. 5 ton	8	4041	253	4.01	5114	179
1943	" "	manure and	8	3929	246	3.91	4971	174
1944	" "	87 lbs. phos-	7	4178	261	4.15	5286	185
1945	" "	phate fertilizer	5	4296	268	4.27	5429	190
1946	" "	per year	7	4111	256	4.08	5200	182
5 yr. avg.	" "			4111	257	4.08	5200	182
1947	New seeding	" "	5	5342	334	5.31	6743	236
1948	(Avg. 32 mixtures)	" "	6	5066	317	5.03	6400	224
2 yr. avg.		" "		5204	325	5.17	6571	230

*A standard cow-day of grazing is pasture supplying 16 pounds of total digestible nutrients for a 24 hour period.
†The relative milk and butterfat production is based on cows producing at the rate of 366 pounds of butterfat per year.
‡Standard mixture No. 1 is itemized in table 2.

Table 2. Productive new mixtures compared with standard no. 1
(Experiment D grazed during 1947 and 1948)

Mixture no.	Species and pounds of seed used per acre	Green weight yield		2 year average yield	Yield relative to:		Legume percent 1948
		1947	1948		Standard no. 1	Mean of 32 mix.	
		tons per acre			*percent*		
24	Smooth brome (8), tall oat (8), ladino clover (2), red clover (3)	19.28	14.84	17.06	170	123	58
12	Smooth brome (4), orchard (3), Reed canary (3), tall oat (4), ladino (2), red clover (3), alfalfa (3)	19.19	14.57	16.88	168	122	46
22*	Smooth brome (4), orchard (3), tall oat (4), tall fescue (4), alfalfa (3), ladino clover (2), red clover (3)	19.05	14.47	16.76	167	121	51
31	Tall oat (16), ladino (4)	18.14	14.59	16.36	163	118	62
32	Timothy (4), ladino (2), red clover (3)	18.54	13.95	16.24	162	118	66
6	Smooth brome (10), Reed canary (3), ladino (2), red clover (3)	18.38	13.73	16.05	160	116	63
Standard no. 1	Smooth brome (4), orchard (3), Kentucky blue (4), meadow fescue (4), perennial rye (3), alsike (2), white clover (3)	10.42	9.69	10.05	100	73	35
	Mean of all 32 mixtures	15.48	12.16	13.82	138	100	52

*This mixture has consistently produced well but is not recommended because alta fescue, one of the grass components, has proved to be low in palatability.

Fig. 1. A typical high irrigation canal, Lewiston area, that contributes to water logging soils

IRRIGATION AND DRAINAGE PROBLEMS IN THE LEWISTON AREA

By J. STEWART WILLIAMS, J. HOWARD MAUGHAN, and O. W. ISRAELSEN

MUCH of the 28,000 acres irrigated by the Cub River Irrigation Company is in need of drainage. The need is much greater than the drainage service thus far available. Four drainage districts at Lewiston provide inadequate drainage for 6,200 acres, and several small privately-owned drainage systems in Utah and Idaho serve only small areas.

Drainage began in the East Lewiston district about 1910. A decade later, when water was first pumped from Bear River for late-season irrigation the need for drainage extended rapidly. In 1921, drainage engineers proposed the inclusion of 12,000 acres south of the Idaho line in a single drainage district. They recommended that all lands contributing to the drainage problem be included in the district and participate in the drainage costs.

Lands of the Lewiston area are naturally productive. Originally, crop yields were notably high, but the rising water table and increasing salinity of the soils have caused a gradual decline in crop production.

Installation costs of open drains in the four Lewiston drainage districts total about $54,000. Operation and maintenance costs during a quarter century are over $100,000, making the total cost about $150,000. However, these combined costs are not all. The greatest drainage costs to farmers in the Lewiston area are represented by decreased crop yields and the narrowed range of crop production on this potentially highly productive farm land. If crop yields since 1920 on the 28,000 acres served by the Cub River Irrigation Company have been down 10 percent, the loss in crop production is not less than $2,500,000 or nearly $90 per acre.

DR. J. STEWART WILLIAMS is professor and head of the Department of Geology, Utah State Agricultural College. J. HOWARD MAUGHAN is an economist with the Division of Irrigation and Water Conservation, Soil Conservation Service collaborating with the Utah station, and DR. O. W. ISRAELSEN is professor of irrigation and drainage, Utah Agricultural Experiment Station.

The causes for drainage need are unmistakable. The high water table in the Lewiston area is the result of irrigation on the peculiar geological formation of soils and subsoils. Before irrigation there was no drainage problem; nor was it serious until water became abundant. When water was pumped from Bear River, the rising water table caused an almost immediate need for drainage. These two events were nearly simultaneous and drainage activities were soon increased—pumping from Bear River began in 1917; organization to drain 5,748 acres began in 1921.

Before Man Came

Lewiston area lands were undoubtedly dry in their native state, before man came, with no tendency to swamping except in the low areas. The geology of the area is such that waterlogged soils are the inevitable result of irrigation. The simple geologic feature that brings this result is a bed of impermeable clay, over 100 feet thick, that underlies the whole area. This clay was deposited in Lake Bonneville, the great Ice Age lake that occupied northwestern Utah for thousands of years, and which shrank away only 25,000 years ago, leaving its bed to become Utah's best agricultural land.

The lake covered the Lewiston area with about 700 feet of water for thousands of years. Bear River, the principal stream entering the lake, brought not only the largest tribute of water, but also the largest load of sediment. The coarser sediment, principally sand, was dropped at the edge of the lake east of the site of Preston, and there accumulated as a delta that in time grew to the west side of the valley and southward toward the present Utah state line. Meanwhile, the finer sediments, principally clay, settled steadily to the bottom of the lake beyond the front of the delta, ultimately reaching a great thickness.

Much geological evidence, which cannot be detailed in a short article, indicates that Lake Bonneville shrank and disappeared from Cache Valley in a comparatively short time. As the level of the lake fell, Bear River cut deeply into the large sand delta near Preston, dropping its heavy load of sand southward toward the shore of the shrinking lake. Adjacent to the main channel of the river the sand accumulated as natural levees, burying the lake bottom clays. Short-lived channels to the south and east spread the sand layer eastward as far as the site of Lewiston. These levee deposits of sand reach a maximum thickness of about 15 feet near the stream channels and thin to nothing away from the channels. In this way the Lewiston area came to have a thin layer of sand over a much thicker layer of clay.

Early Settlement

The settlers homesteaded the sandy flats and soon were bringing the waters of the Cub River southward onto the rich sandy soils of the Lewiston area.

Water flows with comparative rapidity through the sandy soils—probably 10,000 times as rapidly as it flows through the clay. The result is the accumulation of water on the clay layer to produce a perched water table. Since the sand layer is thin, the water table is everywhere perilously close to the surface. The perched body of ground water is fed not only by the downward flow of irrigation water spread in the field to water the crops, but also by excessive seepage from canals. It is also augmented by natural precipitation, especially by the melting of snow in the springtime.

The peripheral areas, where the sand is thin, were doubtless swampy in prehistoric times, for there has always been a low water table in the sand. With irrigation the water table has risen, and more and more of the sand levee area has required drainage. Any increased use of irrigation water under present methods will carry with it a corresponding increase in need for drainage, because the storage capacity of the sand for water is very small, and there is no chance for escape of water through the clay layer. This must be born in mind as the residents of the Lewiston area and their neighbors and irrigation company stockholders look forward to the development of the best and most economical methods of solving their irrigation and dainage problems.

Looking Forward

The intimate physical relationship between irrigation and drainage in the Lewiston area should be clear to leaders and laymen. Irrigation cannot be divorced from drainage in the area. The drainage problem stems primarily from the practice of irrigation.

The solution of this poblem seems to lie in the united action of all parties concerned. Strength of organization offers a means of dealing more equitably with the common problems of the area, and strength of organization surely points the way toward greater efficiency in irrigation and drainage. All of the land owners are interested in the prosperity of the area—all are responsible.

The Basic Irrigation Problem

The storage capacities of unsaturated soils as reservoirs for water available to plants are of tremendous importance to irrigators. Even more important to every Lewiston-area irrigator is this question: How can I irrigate so as to fill the available water reservoir and lose little or no water by deep percolation into the saturated soils below?

It is probable that the capacity of unsaturated root-zone soil of the Lewiston area for available water is from one to two acre-inches per acre. With the average irrigation stream of 3 cubic feet per second, each irrigator must either irrigate 1.5 acres or more per hour or lose water by deep percolation, and increase the need for drainage.

Deeper Drainage Essential

Good drainage of Lewiston Area soils requires a static water table depth of 7 feet that may be up to 6 feet not more than 30 days of the year. Lands having average water table depth of 6 feet and up to 4 feet for 30 days are considered fair; up to 2 feet 30 days poor, and less than 4 feet much of the time are bad.

In sandy soils underlain by heavy compact clay, as in the Lewiston Area, the flow of ground water from the soil into the drain increases rapidly with increase in depth of drains. Doubling the depth makes the flow 4 times as large, and tripling the depth increases the flow by about 9 to 1. Deeper drainage increases the available water capacity of the root-zone soil and thus helps to solve the basic irrigation problem.

The Irrigator's Yardstick

Every Lewiston Area irrigator can use to his own advantage, and to the advantage of the community, a convenient yardstick to measure the depth of water which he applies in each irrigation. The following symbols, quantities, and units will help to clarify the use of this yardstick:

Symbol	Quantity	Units
q	size of stream (ac-in/hr)	c.f.s.
t	time of application	hours
a	area of land irrigated	acres
d	depth of water applied	inches

Then:

$$qt = da$$

(a) $d = \frac{qt}{a}$ (b) $a = \frac{qt}{a}$

For example, if the irrigator finds by his present method when using a stream of 3 cfs (acre-inches per hour) it takes him 20 hours to cover a 10-acre tract, then, according to equation (a) above, the average depth of water application is 6 inches. This is probably three times the volume of water that his root zone soil will absorb and retain. In other words, 4 inches depth of water will either flow off the surface or percolate into the water table and complicate the drainage problem. On the other hand, if with shorter irrigation runs, larger streams, improved methods, the irrigator can cover the 10 acres in 5 hours, then his average depth of application is 1½ inches. All of this water, if spread uniformly, will be held in the root zone soil—none will percolate to the ground water table.

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The efforts of three agencies will be directed toward pushing the soil survey work in Utah during the coming summer. To assist in this program, the Bureau of Plant Industry, Soils and Agricultural Engineering has transferred Vern K. Hugie, soil technologist, to Logan. Daniel F. Trussell represents the Soil Conservation Service in this work, and Dr. D. S. Jennings is in charge of the part done by the Utah Station.

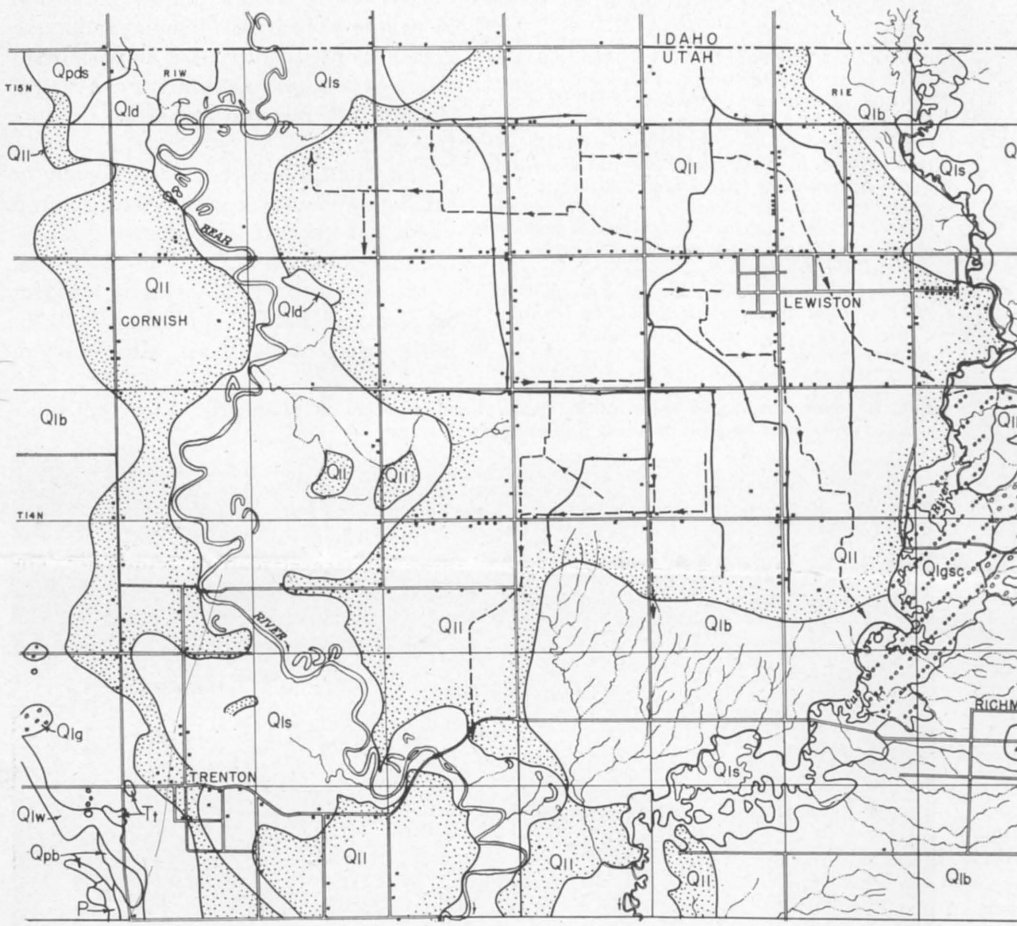


Fig. 2. Geologic map of the Lewiston area. Area of sand in natural levees stippled at edge and marked Q11. Lake bottom clays marked Q1b. Major irrigation ditches solid lines. Major drainage ditches broken lines

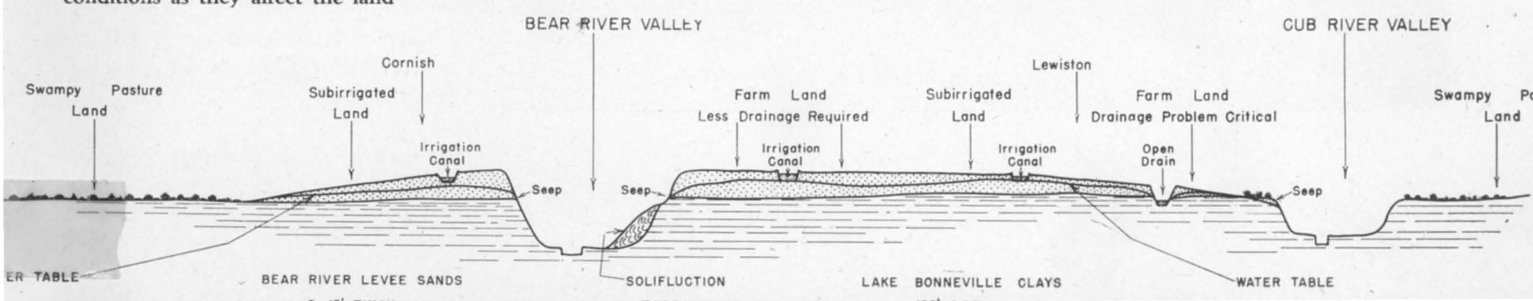


Fig. 3. Diagrammatic cross section through the Lewiston area showing ground-water conditions as they affect the land

Removal of Salts by Leaching Found Feasible and Economical at Delta

By D. F. PETERSON, JR., R. C. REEVE, and L. E. ALLISON

SALINE or alkali areas may sometimes be economically reclaimed simply by leaching with large amounts of irrigation water. In other instances amendment by application of gypsum or other chemicals in addition to leaching is required.

Experiments were conducted by the Utah Station to determine under what conditions leaching of saline soils may be feasible and profitable. It was found that small decreases in salt content at low concentrations greatly increased yields. Even though mildly saline land may be productive, it is believed that leaching may sufficiently increase yields to be economical.

Non-productive areas caused by salinity or alkali frequently occur on farms in arid regions. The farmer must pay taxes, interest charges, and often water and drainage costs for these lands. Every acre on the farm should at least pay its own way and contribute to the profit if possible. Profits from the productive areas should not be dissipated in paying fixed costs for non-productive areas. Consequently, it is important to know how saline-alkali areas can be reclaimed and restored to normal production.

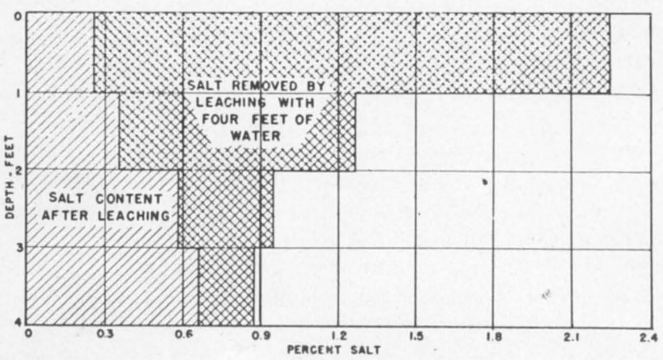


Fig. 1. Distribution of salt in the root zone prior to leaching and following leaching with four feet of water

Salts in the soil root zone, even in small amounts, may greatly reduce crop yields. If the area is generally saline, the individual farmer may not be aware of the extent to which yields on his farm are reduced because of salts or alkali. Since adjacent fields are also affected, no camparison with production at low-salt levels is afforded. In regions subjected to salinity or alkali the cost of removing salts from the rooting zone of the soil will be repaid many fold in the form of increased crop yields and additional profits.

Effects of Salinity

A large part of the land in the Delta Area has poor drainage, salinity, and alkali. The relief is flat, the soil is heavy, and the water supply is relatively saline. As plants and evaporation remove water from the root zone the salts are left in the soil. Unless these salts are removed by leaching, the soil solution becomes more and more saline and crops do not produce economic yields; in fact, may even fail to germinate and establish an adequate stand. When fields stand idle and the water table is near the surface, rainfall will not normally be sufficient to wash down the salts left by the water rising through the soils and evaporating from the surface. Once the salts are removed by thoroughly leaching the soil enough excess water may be applied during normal cropping and irrigation to prevent their further accumulation in harmful quantities in the root zone.

Another insidious effect of alkali or sodium salts is to decrease the permeability of the soil when leaching or irrigation is attempted. If alkali soils are irrigated with fairly fresh water, these soils "seal up," and little water flows through them. Removal of the salts, in this event, is difficult or impossible. Gypsum or, in some cases, sulfur, must be applied to make the soil "open up" and allow the water to soak in freely. Fortunately the Delta soils do not require chemical treatment.

Leaching Experiments

The Utah Agricultural Experiment Station, the U. S. Regional Salinity Laboratory, and four Milliard County drainage districts, have conducted field experiments in an attempt to answer these questions:

1. Under what conditions is reclamation of saline-alkali soils by leaching feasible?

DR. DEAN F. PETERSON is associate professor of irrigation and drainage, Utah Agricultural Experiment Station, RONALD C. REEVE is associate irrigation and drainage engineer, and L. E. ALLISON is associate soil technologist, U. S. Regional Salinity and Rubidoux Laboratories, Riverside, California. *The work reported here was cooperative among these agencies and four Delta Area irrigation companies. A more technical and detailed report of this research has recently been published by the Utah Station as bulletin 335. "Reclamation of saline-alkali soils by leaching, Delta Area, Utah." This publication is available on request.*

Fig. 2. Non-productive saline-alkali spots. Land adjacent is productive. Taxes and other fixed costs must be paid on these non-productive areas

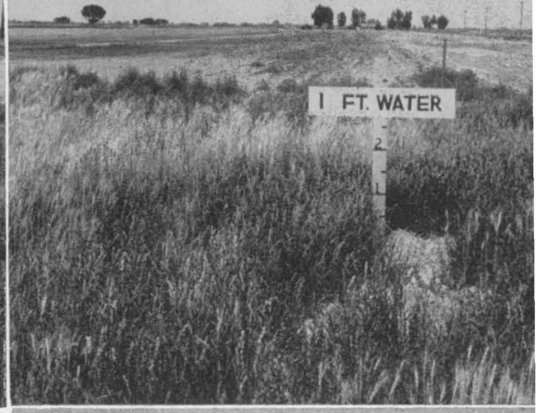
2. How should the land be prepared for flooding?
3. What chemical amendments are necessary or desirable?
4. What is the relationship between the depth of water applied for leaching and the amount of salt removed from the soil?
5. What is the relationship between th amount of salt in the soil and production of crops?

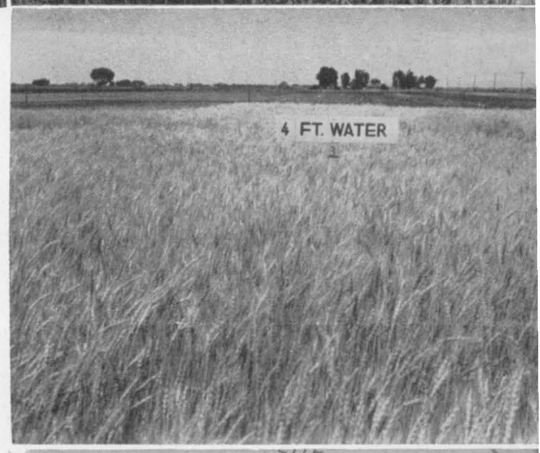
With these questions in mind, twenty experimental basin plots, 30 feet by 40 feet, were prepared at three different locations in the Delta Area. These locations are referred to as A, C, and D. The experimental treatments tried were: (1) no treatment; (2) leaching with 1 foot of water; (3) leaching with 2 feet of water; (4) leaching with 4 feet of water, and (5) leaching with 4 feet of water and 5 tons per acre of gypsum amendment. Each treatment was repeated four times at each experimental site. Site A was located on Woodrow clay loam, C on Oasis silty clay loam, and D on Gordon clay.

The leaching was conducted during the summer of 1946. Water was measured onto the plots with a Parshall flume, and applied as fast as the soil could take it. In order to ascertain if gypsum was necessary, the rate at which the water percolated into the soil was also measured for both untreated and gypsum-treated plots.

Soil Sampling and Cropping

The effect of the leaching treatments was measured by soil samples taken prior to leaching, after leaching, and at three subsequent times. After the leaching was completed the border dikes were leveled and the entire area was sown to fall wheat in September 1946. The crops were irrigated once immediately after sowing and twice during the following spring. Yield samples were taken prior to harvesting in July 1947.





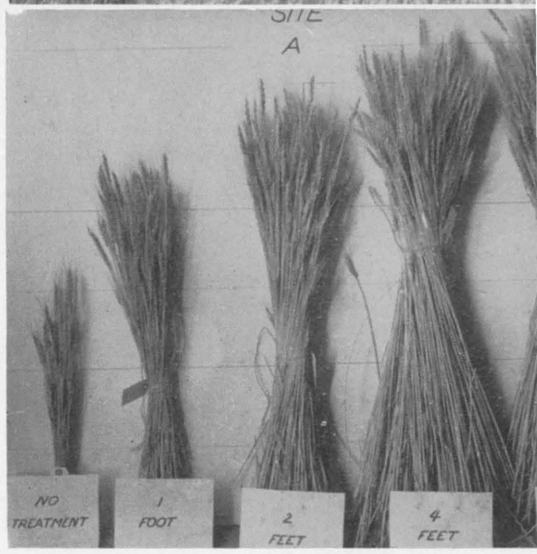


Fig. 3. Condition of wheat at time of harvest at site A. The amount of leaching water applied is indicated by the signs. In addition to the leaching water from one and one-half to two feet of irrigation water was applied

Fig. 4 (bottom). Grain samples from site A. Each bundle, except that labelled no-treatment represents the grain from 5 one-square yard quadrats or from 45 square feet. The no-treatment bundle represents all the grain or the entire plot of 1200 square feet. To be comparable the no-treatment bundle should be reduced by 1/27th

The depths to the water table throughout the experiment were measured by piezometers installed at various points at each side.

Results

The results of the infiltration tests at sites A and C indicated that application of gypsum did not improve infiltration rates. This evidence is not clear-cut, since infiltration may have been limited by poor drainage. At site D, infiltration was definitely improved by the application of gypsum. Natural gypsum exists in large quantities in the surface foot of the soil at sites A and C, but is somewhat limited at site D. Infiltration rates were sufficiently high in all cases, however, so that the use of gypsum as an amendment to facilitate leaching even on the Gordon clay (site D soil) is not warranted.

Leaching caused marked reduction in salinity, especially in the upper horizons. The distribution of salt throughout the upper four feet at site A prior to treatment and following the four-foot leaching is shown graphically in figure 1.

Table 1. Average yields* of wheat at sites A, C, and D in relation to leaching treatments

Site	Leaching treatment — feet of water applied				
	0	1	2	4	4 + gyp.
	bushels wheat per acre				
A	0.7	13.6	23.4	42.6	37.8
C	5.2	23.7	31.3	43.1	37.8
D	28.7	25.9	33.8	41.1	41.1

*Averages of four replicates

Response of Crops

The response of crops to the treatment was quite definite. At site A, production of grain on the control plot was nil, while on the plots leached with four feet of water the average yield was 42.6 bushels per acre (fig. 3). The average yield at each site for each treatment is shown in table 1. The wheat grown on the less saline plots was of higher quality, as indicated by test weights, than that grown on the controls and the more saline plots. At site A, the average yield without leaching was 2.1 bushels per acre. The yield increased at the rate of 10.2 bushels per acre for each foot depth of leaching water applied.

(Continued on page 17)

Quality and Yield of Winter Wheat Only Slightly Affected by Use of 2,4-D in Weed Control

By D. C. TINGEY

APPLYING 2,4-D at 3 pounds per acre considerably reduced weeds in dry land winter wheat infested with Romeria poppy, but only dwarfed the weed growth on an area infested with biscuitroot. Acre yields of wheat, weight per bushel, and protein content of wheat at Beaver Dam on Roemeria poppy plots were not affected by the 2,4-D treatments. At Cove there was a slight increase in acre yield (2 bushels) and in percentage protein. With the one-half and one pound applications of 2,4-D the increase in protein was 0.4 percent and at three pounds the increase was 0.5 percent.

2,4-D in Weed Control

When 2,4-D first became available in commercial quantities, there was little factual information concerning its use. The fact that a growth regulating substance, such as 2,4-D, in small quantities, would kill plants was a new idea. Fantastic claims for this new weed killer, its relatively low cost, high farm prices, and scarcity of farm labor produced a situation highly favorable for its immediate acceptance by the public.

During the few years that 2,4-D has been used in weed control, research men have been working overtime trying to determine how and where it could be used to advantage. Experiments on its use have been in process at the Utah Agricultural Experiment Station since the summer of 1945. Results of these experiments have pointed the way to its more efficient use. They have resulted in large savings to farmers and others using 2,4-D.

PROFESSOR D. C. TINGEY had a general article on weed control in the December issue. This article is especially important because it reports results of the use of 2,4-D on wheat very different from those reported by the Idaho station. They reported material increases in the protein content of wheat by the use of 2,4-D. These tests did not verify their results.

Control of Weeds in Winter Wheat

Winter wheat produced under the system of alternate wheat and fallow, practiced in this area, provides an opportunity during the fallow years to control weeds by tillage methods, which are reasonably satisfactory. However, there are conditions where weeds become troublesome. Their control by the use of 2,4-D offered a possibility because of the high resistance of wheat to the chemical.

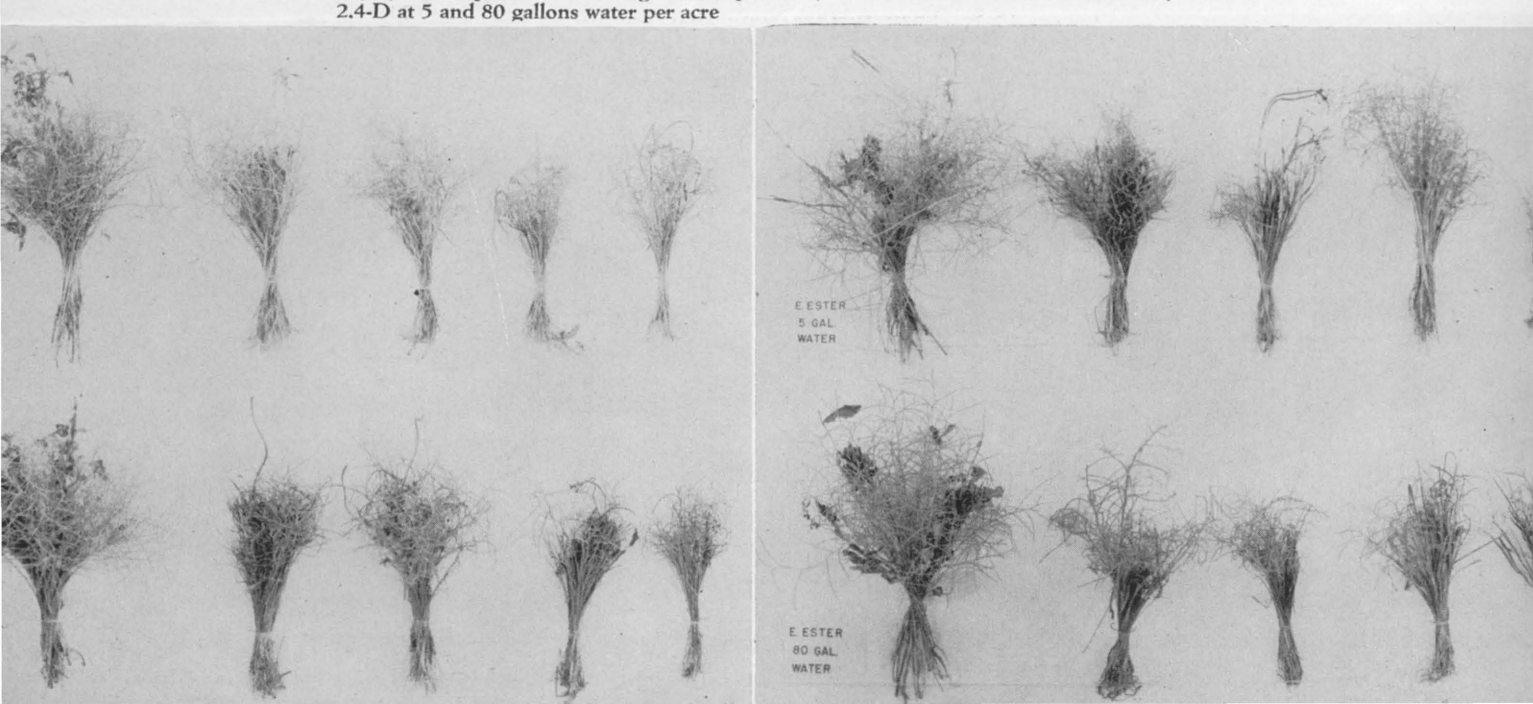
Experiments on Dry-Land Wheat

Two experiments were conducted, one at Beaver Dam, the other at Cove, Utah. At Beaver Dam, the wheat was infested with Roemeria poppy **(Roemeria refracta)** (Stev.) DC. and several weeds common to winter wheat; namely, cow cabbage, green tansy mustard, wild lettuce, tumbling mustard, and false flax.

Counts made of weeds in the experimental area averaged 12.3 Roemeria poppies and 2.3 of all other species per square foot, making a total of 14.6 weeds per square foot. At Cove, the wheat was infested with biscuitroots **(Lomatium leptocarpum)** (T. & G.), (C. & R.), tumbling mustard, and green tansy mustard. Counts made of the weed population averaged 2.9 biscuitroots per square foot and 9.2 other weeds, making a total of 12.1 weeds per square foot. Such a weed population should provide a good test of the value of 2,4-D in weed control in dry-land winter wheat.

At Beaver Dam, three 2,4-D products were used, one of which was a powder of the ethyl ester, the other two were triethanolamine salt, and the liquid form of ethyl ester. Each of the three materials was applied at rates of one-eighth, one-half, one, and three pounds per acre of active ingredient. Untreated plots were left as checks. In addition, the triethanolamine salt and ethyl ester (liquid) were each applied in 5 and 80 gallons of water per acre. The wheat was in the stooling stage when the 2,4-D was applied. At Beaver Dam, the weeds were mostly in the bud stage and at Cove they were in early bloom. Each plot was 12 feet x 22 feet 8 inches (equivalent to approximately 1 square rod in area) and each treatment was replicated 4 times. Weed counts were made on 4 areas (6 inches x 3 feet) in each plot or a total of 6 square feet in the 4 samples. Weed counts were made from 5 to 6 weeks after the 2,4-D was applied. Yield of wheat was determined from 4 meter samples taken from each plot and a sample of wheat from each

Total weeds from a 6 square foot area in wheat at Cove, Utah, treated at different rates (0, 1/8, 1/2, 1, and 3 pounds active ingredients per acre) with triethanolamine salt and ethyl ester of 2.4-D at 5 and 80 gallons water per acre



plot was used in making the protein determination.

At Cove, the treatments were the same as at Beaver Dam, except the sodium salt of 2,4-D was used in place of the ethyl ester powder.

Effect of 2,4-D on Weed Control

On the area infested with Roemeria poppy at Beaver Dam, the ethyl ester (liquid) at one-half pound or above was considerably more effective than either the ethyl ester powder or the triethanolamine salt. There was a progressive increase in effectiveness in weed control with an increased rate of application of 2,4-D. Three pounds of ethyl ester (liquid) eliminated Roemeria poppy completely and reduced the other weeds to an average of less than one per three square feet. It is obvious that, considering the number, poppies were more susceptible than other species to 2,4-D. A rate of one pound of ethyl ester reduced the poppy to an average of one per square foot and the other weeds were reduced to about two per square foot. Furthermore, the poppies and other weeds that remained on the 2,4-D treated plots were dwarfed in growth and had few pods and seeds. Rates of one-eighth and one-half pound were not enough to give satisfactory control of either poppy or the other weed species.

The 5 gallons of water used in applying the 2,4-D resulted in as satisfactory weed control as where 80 gallons were used. At Beaver Dam the wheat growth was very dense at the time the treatments were made.

At Cove, the 2,4-D was not nearly as effective in killing weeds as at Beaver Dam. The effect was largely one of dwarfing the weed growth rather than killing the plants. There were nearly as many plants left on the 2,4-D plots as on the non-treated.

At Cove, the ethyl ester was no more effective in killing weeds than the triethanolamine salt or sodium salt.

It will not be possible to determine the permanent effects on biscuitroot, which is a perennial, until next summer. The heavier rates of 2,4-D did kill the tops of this weed.

Effect of 2,4-D on Yield of Wheat

There was no differential effect of the treatments in the acre yield of wheat at either Beaver Dam or Cove. Untreated plots yielded just as high as the 2,4-D treated and the light application of 2,4-D yielded just as high as the heavier application. At Beaver Dam, the average acre yield was about 30 bushels and at Cove about 23 bushels.

Total weeds from a 6 square foot area in wheat at Beaver Dam, Utah, treated at different rates (0, 1/8, 1/2, 1, and 3 pounds active ingredients per acre) with triethanamoline salt and ethyl ester of 2,4-D at 5 and 80 gallons of water per acre

Effect of 2,4-D on Quality of Wheat

The treatments had no differential effects on weight per bushel of the harvested grain. At Beaver Dam, the wheat averaged 62 pounds per bushel and at Cove 61 pounds per bushel.

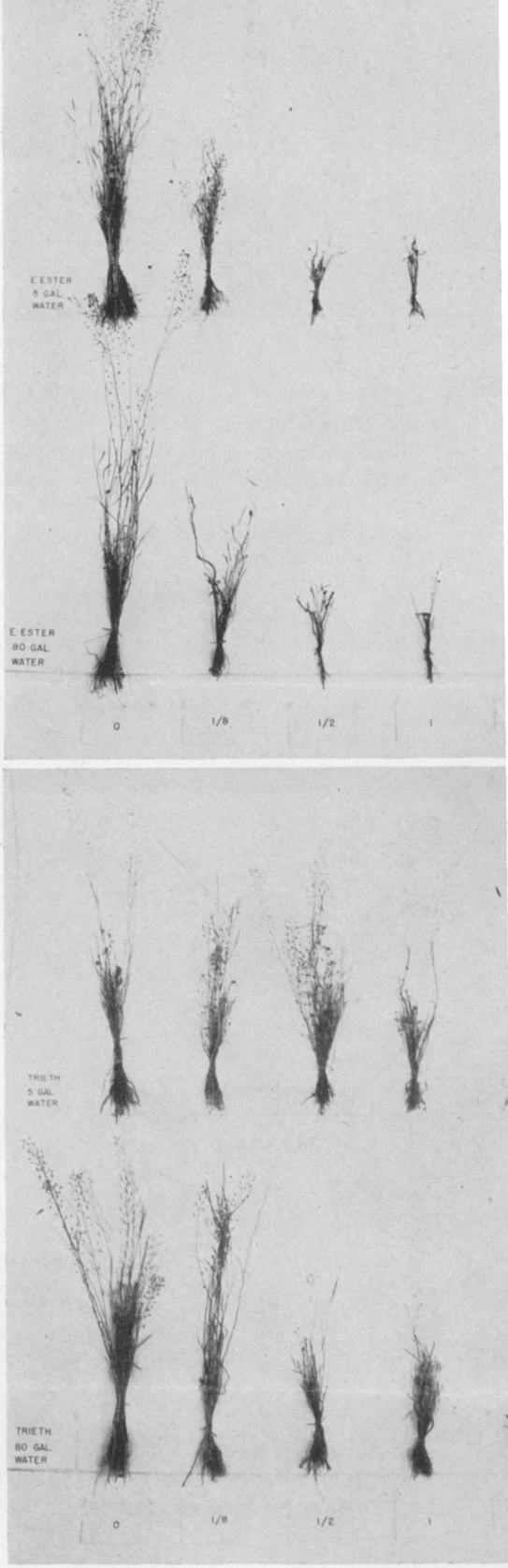
Percentage Protein

At Beaver Dam there was no differential effect of the treatments on protein. The grain averaged about 11 percent protein. The non-treated plots and the light applications of 2,4-D all had as high protein content as the heavier treatments.

At Cove, there was a slight increase in protein percentage for the one-half, one, and three pound rates of 2,4-D over the non-treated. The increase in percentage protein for the one-half and one pound rates over the non-treated was .4 plus or minus .7 and for the three pound rate over the non-treated .5 plus or minus .17. The average protein in the wheat at Cove was about 12 percent.

These data on the effects of 2,4-D on proteins in harvested grain are interesting in view of some recent data from Idaho. Erickson, Seeley, and Klages reported in volume 40 of the Journal of the American Society of Agronomy the following percentages of protein in wheat for different amounts of 2,4-D: untreated 10.9, .6 pounds of 2,4-D 11.6, 1.4 pounds of 2,4-D 12.7, 2 pounds of 2,4-D 13.8, and 4.6 pounds of 2,4-D 15.5. They further state that the increase in protein content occurred with all types of material, whether or not weeds were present and regardless of decreases or increases in grain or straw yield, weed competition, variety, dry land or irrigated conditions, or stage of growth prior to heading.

Data herein reported from two experiments in northern Utah are markedly different from those reported from Idaho. These conflicting data should caution farmers on the use of 2,4-D to increase protein content of winter wheat until the factors responsible for these differential results are better understood.



Prof. A. F. Bracken returned to the college at the beginning of the winter term after a two-year leave of absence, a year and a half of which was spent in Syria as adviser to the Department of Agriculture.

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Eldon G. Hanson, assistant professor of irrigation and drainage and agent of the Soil Conservation Service has accepted a position with the Soil Conservation Service at State College, New Mexico.

Dipping Gives Better Control of Sheep Ticks Than Dusting

Preliminary Studies of Life History of Tick and Methods of Its Control May Aid in Working Out Program for Control of this Troublesome Insect

By TED TIBBETTS and C. J. SORENSON

DIPPING proved much more effective than dusting in controlling sheep ticks in tests conducted during the winter of 1947-48 at the Utah Station. It is realized, however, that in cold weather dipping of range sheep may be impractical and dusting may be the only practical practice. DDT, rotenone, chlordane emulsion, and benzene hexachloride were all effective in controlling ticks on sheep when used as a dip. The same insecticides used as a dust did not give satisfactory control. Rotenone dust gave the best control.

The sheep tick **Melophagus ovinus** (Linn.) is a serious external parasite of sheep, feeding on the blood and causing great irritation, discomfort, and reduced vitality. Sheep that are heavily infested by this pest refuse to eat normally. This results in retardation of growth, impairment of the health and general condition of the sheep. There may be also a loss of wool resulting from the sheep rubbing themselves in efforts to relieve tick irritation. In addition to these injurious effects, the sheep tick is suspected of transmitting certain disease organisms in sheep.

This article summarizes the research done by the senior author, TED TIBBETTS, graduate student as partial fulfillment for the requirements for the M. S. degree. As there is so little information published on the control of sheep ticks this summary of Tibbetts' work was prepared for Farm and Home Science by PROFESSOR C. J. SORENSON, professor of entomology, who supervised the research.

Description of the Sheep Tick

The sheep tick is not a true tick, but a wingless, degenerate fly. It has 6 legs, whereas true ticks have 8 legs in the adult stage. The adult (see figure) is about ¼ inch long, of a reddish or brown color, and covered with short, bristly hairs. The head is rather inconspicuous, having the sharp, piercing-sucking mouth parts situated on its front. The fore part of the body is relatively small in comparison with the large abdomen, especially when the insect is gorged with blood from its host or is carrying a well-developed larva. Ticks move rapidly when disturbed, running either forward, sidewise, or backward. The legs are rather long and strong, and terminate in 2 powerful, long claws.

The pupa (see figure), sometimes popularly called a "nit" or "egg," of the sheep tick is rather round or somewhat barrel shaped, light brown in color, and seed-like in appearance. This object is not an egg, however, but the pupal case which encloses the larva while it transforms into the adult tick.

Distribution of the Sheep Tick

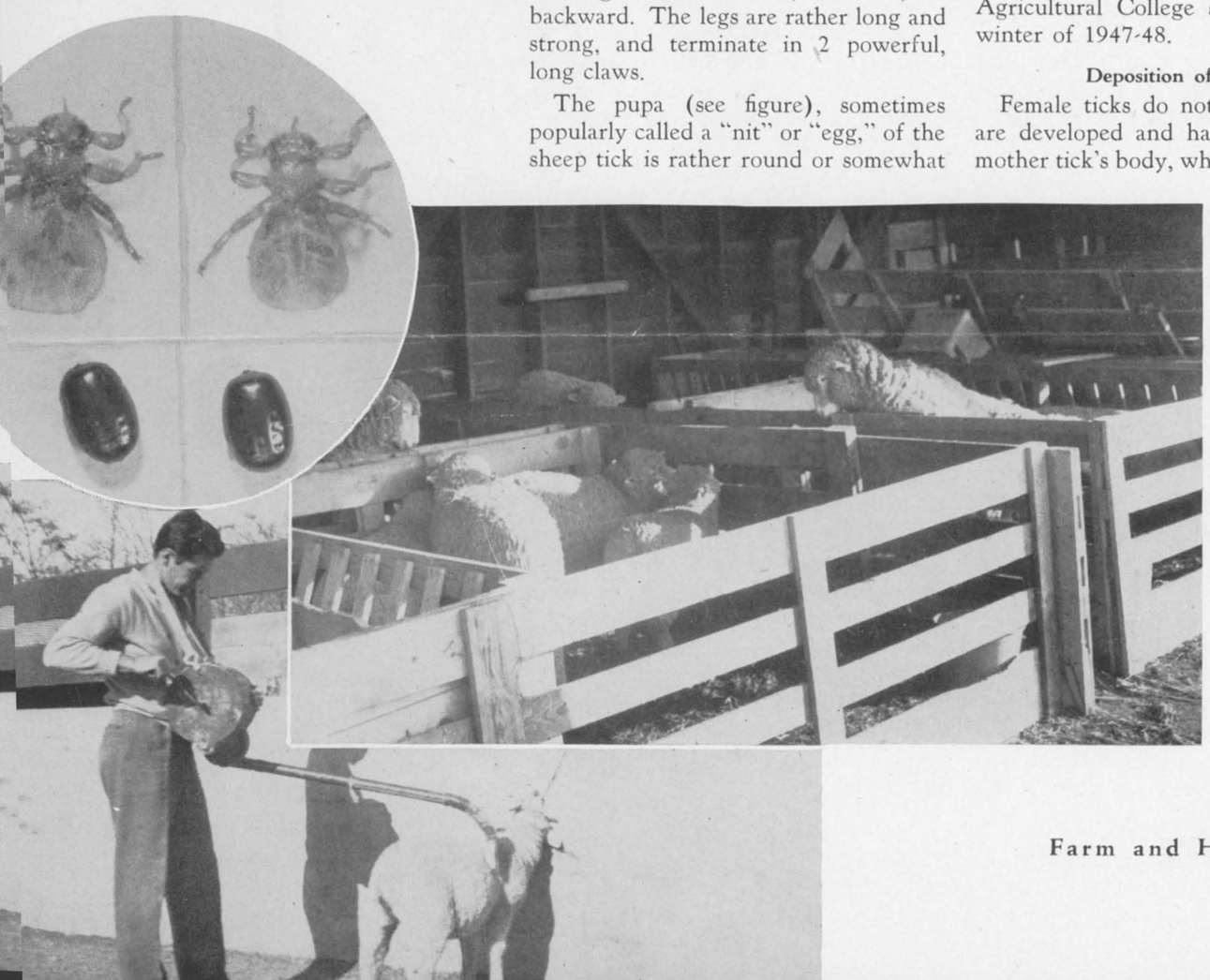
The sheep tick is widely distributed over practically all sheep-raising areas of the world, including the United States. It is more abundant in the western United States, where approximately 70 percent of this country's sheep are raised. In Utah this insect pest occurs on sheep and lambs of both range and farm flocks. When a flock is heavily infested the ticks may be found on any part of a sheep's body; however, they usually select those areas where the wool is thin, and lodge in greater numbers on the neck, breast, shoulders, abdomen, and flanks; where they are protected from the efforts of the sheep to dislodge them.

Life History Studies

Studies of the life history of the tick were made on adult sheep at the State Agricultural College sheds during the winter of 1947-48.

Deposition of Larvae

Female ticks do not lay eggs. They are developed and hatched within the mother tick's body, where the young are



Circle. Adult male (left) and female (right) sheep ticks, and pupae (bottom). Upper picture. View of sheep pens showing the partitions to prevent migration of ticks from sheep to sheep by contact. Bottom. Tibbetts uses hand duster to apply the insecticidal dusts to sheep

nourished until they are full grown larvae (worms), at which time they are born and become glued to the sheep's wool by a sticky covering secreted by the mother tick.

Pupation of Larvae

When born each larva is covered with a soft white membrane. After about 12 hours it turns brown and becomes a hard, shell-like pupal case, which encloses and protects the pupa (see figure) while it transforms into a full-grown tick. This transformation requires about 3 weeks, after which the adult tick emerges and becomes active on the sheep's body.

Length of Life of the Female Tick and Number of Young Produced

During this study several attempts were made to determine the life-span of the adult sheep tick, but all ended in failure. Other investigators report that the female only lays one larva at a time, and there are but four or five produced in the course of a year.

A careful study of the number of pupae deposited by groups of ticks during their lifetime was made in Wyoming by Swingle, who found that: "The ticks that lived at least 36 days produced, on the average, two pupae each; those that lived 131 days, 11.45 pupae; those living 137 days, 13.46 and the one living 150 days, 14.72 pupae. Counting from the time the ticks began to lay pupae we find that the average time required for a tick to develop and lay a pupa was 7.89 days."

Movement of Sheep Ticks from Host to Host by Contact

On December 14, 1947, 2 sheep, 1 tick-free and the other heavily infested, were placed together in a pen. Weekly examinations were made on the tick-free animal to ascertain the number of ticks, if any, that had migrated from the infested animal.

At the end of the first week, 9 ticks were found on the previously tick-free sheep, indicating that the ticks had migrated from the heavily infested animal. These ticks were transferred to the heavily infested sheep, again leaving the other animal tick-free. During the following week the temperature dropped to freezing and the tick-free animal was again examined. No ticks were found. Freezing temperatures existed from December 9, 1947, to January 1, 1948, during which time 3 examinations were made but no ticks were found, indicating that in cold weather the ticks apparently do not migrate. On warm days the ticks were observed moving freely over the surface of the wool and passing easily from host to host by contact. On cold days they remained close to the skin and were only slightly active.

NEW PUBLICATIONS

Bul. 333. Drainage districts in Utah, their activities and needs, by J. Howard Maughan, Orson W. Israelsen, and Eldon G. Hanson. Department of Irrigation and Drainage in cooperation with the Division of Irrigation and Water Conservation, Soil Conservation Service. 64 p.

This bulletin outlines the development of drainage districts in Utah, methods used in the financing and construction of drains, and their success. It also suggests methods whereby drainage may be more successful.

Bul. 335. Reclamation of saline-alkali soils by leaching, Delta Area, Utah, by R. C. Reeve, L. E. Allison, and D. F. Peterson, Jr. Department of Irrigation and Drainage in cooperation with the U. S. Regional Salinity and Rubidoux Laboratories, Riverside, California. 52 p.

This publication reports the results of a two-year study in the Delta Area in leaching the salts from the soil. Where drainage was adequate the amount of salt removed increased with the amount of water applied. Yields of wheat increased directly with the amount of leaching water applied. Average yields of 41 to 43 bushels per acre were obtained on the plots leached with 4 feet of water compared to yields of 1 to 29 bushels per acre where no leaching water was applied.

Bul. 336. Biennial report, Utah Agricultural Experiment Station, 1946-48. 50 p.

This report outlines briefly: the research program, including a list of projects which number 109, new lines of research, some accomplishments, service activties, and publications. It also lists the staff of research workers, and gives a financial statement.

Any of these publications may be obtained free from the Utah Agricultural Experiment Station

Movement of Sheep Ticks from Litter to Host

To find the length of time that ticks remain alive during winter weather, 20 were placed in a wire-screen cage containing straw litter. Ten ticks were exposed to temperatures ranging from 15 to 36 degrees F. for 3 days (Dec. 7 to 9). All of them survived during the first day, but 7 died on the second day, and 3 on the third. On April 17, 1948, 20 ticks were again placed in a wire-screen cage containing straw litter. Observations were made at 2 p.m. on subsequent days to determine the length of time ticks would remain alive in temperatures ranging from 72 degrees F. in the daytime to 30 degrees F. at night. On April 18 and 19, all ticks were found alive. On the following day, 10 ticks were dead, and on April 21, all of them were dead. These data seem to indicate that some sheep ticks are able to survive variations in weather better than others. During warm weather, they are able to remain active without a host for a longer period of time than in cold weather. Sheep ticks, dislodged from the wool of the host were found to remain active in straw litter for 2 to 15 days, varying with climatic conditions.

Control of the Sheep Tick

Old methods of tick control using lime-sulfur, coal-tar-creosote, or nicotine dips were not effective. However, the development of newer, more powerful insecticides give promise of more effective control.

Insecticides Tested and Experimental Setup at Logan

For the purpose of determining the relative effectiveness of rotenone, DDT, chlordane, and benzene hexachloride in the control of sheep ticks, 20 sheep were penned in 5 separate pens with 4 sheep in each pen (see figure). Each of the 4 insecticides was tested as a dip, a dust, and as a spray.

Dipping

In preparing the dip solution, each of the following insecticides was mixed with 100 gallons of water:

(1) Rotenone (5 percent) 4 lbs.
(2) DDT (50 percent wettable) 4 lbs.
(3) Chlordane emulsion (0.125 percent by weight) 1 quart
(4) Benzene hexachloride (10 percent gamma isomer) 45 to 47 percent emulsifiable concentrate 2 lbs.

Temperatures from November 8 to December 6 ranged from 10 to 47 degrees F., with a mean of 31.14. Because of these low temperatures, the sheep were placed in the Veterinary Science building after dipping until their fleeces were dry. Sixteen sheep were dipped on November 8, 1947, and a group of 4 sheep were not treated, but served as a control.

All sheep were examined thoroughly at weekly intervals following each treatment for a period of 4 weeks, in order to determine the number of live ticks present.

Results of Dipping

1. Dips prepared with each insecticide completely eradicated the sheep-tick infestation in one treatment.

2. Residue of all insecticides were effective in destroying all young ticks that emerged from pupae that were in the wool at the time of dipping.

3. Tick pupae that remained attached to the wool after dipping became dry and brittle within a week or 10 days.

4. No ill effects to the sheep or their fleeces from dipping in any of the test insecticides were apparent. The dipped animals dried off satisfactorily and there was no matting of the wool.

Spraying

The same insecticides and amounts per 100 gallons of water, as had been used in dipping, were used for spraying the sheep.

These materials were applied separately with a power sprayer which delivered 25 gallons per minute at 450 to 500 pounds pressure. The sheep were arranged in 5 groups of 4 sheep each. One group was not sprayed and served as a control.

The temperature from February 7 to March 6, 1948, varied from 2 below to 54 degrees above zero F., with a mean of 28.09.

Results of Spraying

Counts of the number of live ticks found per sheep were made and recorded 7, 14, 21, and 28 days after treatment. Surviving ticks were found distributed over the entire body of the sheep.

1. Seven days after spraying, all treated sheep carried some dead ticks. Many, but not all of these, were found dead 24 hours after treatment.

2. Length of wool at the time of spraying varied from 2 inches on the Hampshire breed to 4 inches on the Rambouillet. Better control was obtained on the Hampshire sheep with the shorter wool.

3. Surviving ticks, apparently afforded some protection by the long wool, did not migrate from the long-wooled to the short-wooled sheep but continued to multiply, except in a few cases.

4. All 4 insecticides were effective in reducing the adult sheep-tick population and holding it in check for a period of 28 days after spraying with a power sprayer.

5. Complete eradication of ticks was not accomplished, probably because of inadequacies in the methods of application and length of the wool.

Dusting

Many sheep in Utah often carry extremely heavy populations of ticks during the winter months. Dipping or spraying at this season of year is not advisable unless the sheep can be dried off in adequate shelters before being exposed to outside, cold weather. This is seldom found practicable with range herds. In view of this, an attempt was made to ascertain whether effective control of the sheep tick might be obtained by using in dust form, one of the four insecticides listed above.

A power duster was not available and so a hand-duster (see fig.) was used. On January 3, 1948, 4 sheep were dusted with 5 percent rotenone, 4 sheep with 5 percent DDT, 4 with 2 percent chlordane, and 4 with 10 percent benzene hexachloride (1 percent gamma isomer). One group of 4 sheep was not dusted, but served as a control. Local temperatures from January 3 to January 31, 1948, varied from 2 below to 50 degrees above zero F., with a mean of 26.14 degrees. Sheep were inspected for living ticks on January 10, 17, 24, and 31.

Results of Dusting

1. None of the 4 insecticidal dusts in one application gave satisfactory control of the sheep tick, although most of the ticks were killed. Rotenone dust gave best control.

2. Better control was obtained on the Southdown breed, probably because of their shorter wool.

3. No injurious effects to the sheep or to their fleeces were observable.

4. All 4 insecticidal dusts caused irritation to the mucous membrane of the nose and throat of the operator. Rotenone caused most discomfort.

Experimental Results Obtained Elsewhere

The following is a brief summary of results of some recent control tests performed in other states.

Cobbett and Smith dipped 6 lots of tick-infested sheep (Colorado and New Mexico) in concentrations of wettable DDT that varied from 0.1 to 1.0 percent by weight, and found that as little as 0.1 percent compared favorably with rotenone-bearing products. Dipping in a 1 percent concentration of DDT resulted in no apparent injury.

Schwardt and Matthysse reported (Cornell Bul. 844, 1948) that in New York, one treatment with a dip containing ½ pound of 5 percent rotenone powder, and 2 tablespoonfuls of a wetting agent will keep a flock largely tick-free for a year. "Dips containing from 0.07 to 0.25 percent DDT are also effective but somewhat more expensive."

INSECTICIDES NOT EFFECTIVE IN CONTROL OF CURLY TOP IN TOMATOES

CURLY-TOP disease of tomatoes, transmitted by the beet leafhopper, was not effectively controlled by application of insecticides to tomatoes. Utah Experiment Station collaborator entomologists, H. E. Dorst and W. E. Peay, report that although many of the insecticides tested during 1948 killed the insect, the leafhopper fed upon the tomatoes thus transmitting the disease before receiving a lethal dose. The following materials were tested as dusts, sprays, and emulsions; DDT, toxaphene, chlordane, parathion, benzene hexachloride, methoxychlor, and TDE. There was no reduction in curly top where the above insecticides were applied. Four applications were made at weekly intervals, beginning with date of planting and during the period of leafhopper movement. In some cases, actual increases in disease occurred following applications of insecticides. DDT 10 percent dust applied to double-hill planting definitely was followed by an increase in the percentage of curly-top tomatoes.

Double-hill planting, with plants placed 6 inches apart, again proved to be the best method of reducing losses from curly top. In 1948, at Las Vegas, Nevada, 70 percent curly top developed in the single hill plantings compared to only 60 percent in the double hill plantings. The 40 percent of healthy plants remaining in the double hills was equivalent to 80 plants out of every 100 planted in the single hills.

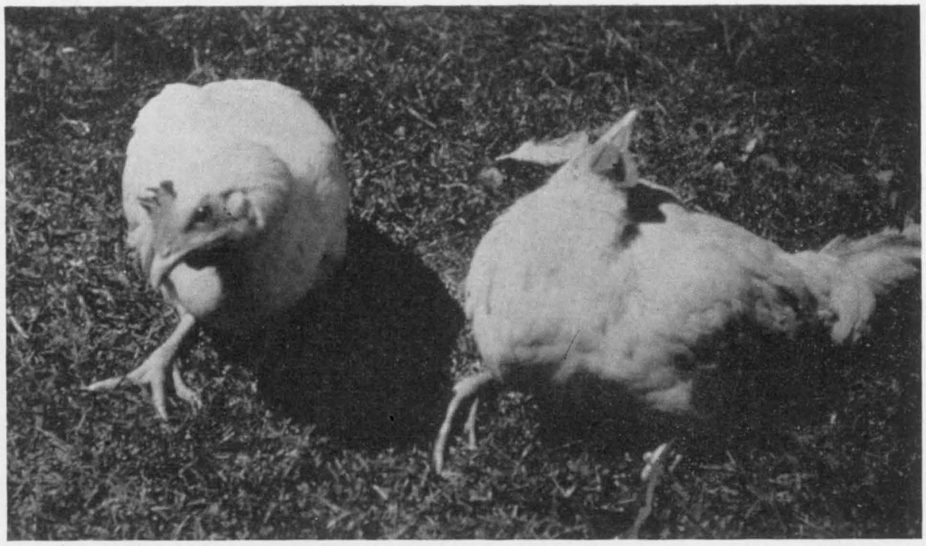
At Kaysville, Utah, in 1948, where only 5 percent curly top developed on canning tomatoes, double-hill planting produced 3.5 tons more tomatoes per acre than conventional planting. Size of fruit from double-hill plots was similar to tomatoes harvested from conventional planting.

NEWCASTLE DISEASE

(Continued from page 2)

Chicks originating from parent stock that have had the disease, or have been vaccinated, show immunity to Newcastle disease up to four weeks. Several instances were noted where such chicks exposed to the disease did not show symptoms until the fourth and fifth week. Conversely, chicks not carrying any parental immunity contracted the disease and severe losses occurred.

This epizootic was so widespread and traveled so fast that it was impossible to make laboratory diagnosis in every case. When it first started, the virus was recovered from several flocks to identify the disease positively. In addition, the hemagglutination inhibition (H. I.) blood test was made on numerous flocks. Positive results were obtained in many of them. Clinical diagnosis made from flock observation was made on other flocks. Since infectious bronchitis was also quite prevalent last summer, some infectious bronchitis outbreaks may have been called Newcastle disease.



White Leghorn pullets showing typical symptoms of Newcastle disease: the head and neck twisted over the back or under the breast

PASTURE MIXTURES

(Continued from page 7)

The acre yield of standard mixture no. 1 from 1938 to 1941 when grazed without applying fertilizer; from 1942 to 1946 when fertilizer was applied; and for the new mixtures (seeding the spring of 1946) for the years 1947 and 1948 with fertilizer applied is given in table 1. During the four years fertilizer was not applied the dairy herd harvested an average of 2,921 pounds of total digestible nutrients per acre. For the five years following when fertilizer was applied the same herd grazed an average of 4,111 pounds of digestible nutrients. During 1947 and 1948 the herd harvested an average of 5,204 pounds of total digestible nutrients per acre from the new mixtures. During the first five years standard no. 1 received fertilizer, the dairy herd harvested an average of 40 percent more nutrients than for the four years previous when no fertilizer was applied. Likewise the new mixtures provided the dairy herd approximately 25 percent more nutrients than did fertilized standard no. 1 for the previous five years. During the entire period covered by this report the methods used in collecting data, the management of the pastures, and the land have been the same, with little change in personnel.

The standard cow days of grazing, the alfalfa hay equivalent, and milk production per acre shown in table 1 are other unit measures of the production of the pasture.

The number of irrigations applied each season indicates that high production from pastures can be obtained without more frequent application of water than is required by some of the long-season crops.

Since the new seeding grazed in 1947 and 1948 (table 1) consists of 32 mixtures which themselves differ in productively the best 6 mixtures and standard no. 1 are itemized in table 2.

These data show that in this seeding the six most productive mixtures exceeded standard no. 1 by 60 to 70 percent and that these same six mixtures exceed the mean of the entire field by 16 to 23 percent. On the basis of these data the best components of the new seeding would be expected to increase the yield 16 to 23 percent over the 5,204 pounds total digestible nutrients produced by the new seedings as the average of the two years reported in table 1. Such a yield would be the equivalent of approximately 6 ton of alfalfa hay to the acre.

On the basis of the experimental pasture work done, giving careful consideration during the past five years to the contribution made by the different species to a pasture, it is questionable if there is such a thing as one best pasture mixture for irrigated land. Any of the high-producing mixtures presented in table 2 will most likely give satisfactory production if properly managed. For most conditions prevailing on good irrigated land in Utah the following mixture is recommended:

Orchard grass	3
Smooth brome	4
Tall oat	4
Ladino clover	2
Red clover	3
Wilt-resistant alfalfa	3

LEACHING

(Continued from page 11)

Actually, crop production is related to the salinity of the soil rather than the depth of leaching water. Valuable information concerning the relationship between soil salinity and yield was obtained in these investigations. The results show that crops are most sensitive to salt changes at the lower salt contents. If the salt content is low relatively small decreases in salt content cause large increases in yield. This indicates that leaching before cropping of even fairly productive saline soils may be amply repaid by greatly increased yields.

Costs and Returns

Cost studies indicate that the initial investment necessary to leach with 4 feet of water is approximately $28.30 per acre. The value of increased yields from leaching with 4 feet of water, based on the average 1913-1945 price of wheat of $1.03 per bushel, was $42.00 a year at site A, $36.24 a year at site C, and $19.36 a year at site D. Leaching should not, however, be undertaken unless adequate drainage is provided. The land should be carefully leveled and border dikes erected so that the water may be uniformly applied.

Surface Arsenic Occurrence on Some Plants Attractive to Bees

By T. C. YAO and G. F. KNOWLTON

HONEYBEE poisoning in Utah was particularly severe and extensive during the seasons of 1939, 1943, and 1944. Most such bee losses investigated up to 1946 were found to be caused by arsenic poisoning. Since 1946, death losses of honeybees have followed the large scale application of certain of the newer synthetic organic insecticides, especially when these have been applied to alfalfa in bloom.

Losses have been severe where bees have taken arsenic in nectar, either from fruit tree blossoms or from undercover blossoming plants. Such losses have been especially serious when orchards were sprayed during bloom. Loss of young adult hive bees, and not infrequently the complete killing out of colonies, has followed dusting of alfalfa in bloom with calcium arsenate. Where dusted alfalfa was not in blossom but the field contained blossoming yellow sweet clover or other clovers at the time of treatment, or where an abundant growth of grasses was present and producing pollen which was being actively collected by the bees, serious killing out of bees from nearby apiaries occurred. The most frequent losses of this type occurred during recent years in several localities of Sanpete County. In some instances, death losses occurred when the bees sipped water from orchard or other soils highly contaminated with arsenic. In Utah extensive poisoning of hive bees and the destruction of entire colonies have most commonly been associated with arsenic-contaminated pollen, brought into the hives by the bees.

Studies have shown that, in northern Utah, plants attractive to bees have commonly been contaminated by surface arsenic. The amount of such surface and blossom contamination has varied with the locality and the season. While in many cases the surface arsenic has come from application of agricultural dusts and sprays, surface arsenic has been present at considerable distances from any such chemical applications.

Industrial contamination of plant blossoms and pollinating plants attractive to bees is a factor in poisoning, particularly in the Jordan Valley of Salt Lake County; at Murray, Midvale, and Garfield. A fourth smelter operates in Tooele County, located at Lincoln, a few miles northeast of the city of Tooele, and approximately 18 miles southwest of the Murray and Midvale smelters. During recent years, these smelters have been equipped with both "baghouse" and "Cotrell" systems for removal of particles of arsenic and other metals. These systems remove large amounts of the arsenic from the smoke before it leaves the chimneys.

During earlier years, the smelting industry in Utah contributed substantially to the high soil arsenic condition which now exists in Salt Lake County and that in the area east of Tooele. Approximately twenty smelters operated previous to 1948, during the years when no method was practiced for removing arsenic or other metals from the flue smoke. Most of these smelters were closed by injunction following years of active operation. One important justification for the injunctions that closed each smelter was the extensive releases of flue arsenic on to agricultural crops. Dust from high arsenic soils, settling in blossoms and on foliage, appears to be an important source of surface arsenic in the old smelter areas.

A simple washing method has been employed in estimating the amount of surface arsenic present. This has consisted of two rinsings of the plant blossoms and leaves with one percent hydrochloric acid, at the rate of 50 ml. of the solution to each gram of dry plant tissue, for each washing. The two rinsings take approximately five minutes, plus about three minutes for decanting off the liquid. Commonly, 30 to 60 percent of the total arsenic has been removed from the plant material by means of the above washing process. Arsenic present on covered and uncovered plant blossoms and leaves, and that which had been deposited in seven days on oiled cards of the standard size of 3 x 3 inches, also have been compared, comparable data being obtained at several localities.

Much less fluctuation occurred in amount of surface arsenic present when plants were covered with Kraft paper bags for a period of from one to several weeks, than on nearby blossoms and leaves which remained exposed.

T. C. YAO was a graduate fellow in entomology, and is now a research assistant in chemistry. DR. KNOWLTON is professor of entomology.

The authors collecting plant samples for arsenic analysis. The top picture shows the oiled cards attached to plants to collect surface arsenic. The lower picture shows the covers used on certain plants. Arsenic content of leaves and flowers under these covers is compared with that of exposed plant parts

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Wallace R. Hanson, assistant professor of range management, has resigned to accept a position with a commercial company in Canada.

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Byron Alder, professor and head of the Department of Poultry Husbandry, is taking a six months' leave of absence. He is spending the time in study and travel.

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William H. Bennett, assistant professor of agronomy, was granted an 18 month leave beginning January 1 to study toward his doctorate at the University of Wisconsin.

RED CLOVER

(Continued from page 5)

the test, irrigation water was applied every two to three weeks for the hay crop and one to two applications were made for the seed crop. This experiment was terminated in 1947. The results showed quite clearly that certain strains of red clover are unadapted to Utah conditions, but that most strains can be grown with about equal success (table 1).

From the data presented, the following conclusions may be drawn:

1. The top 16 varieties had significantly higher hay yields than the average.
2. Scott's strain and Emerson (Harrisville) produced significantly higher hay yields than any other varieties.
3. There were 14 varieties whose hay yields were significantly below the average.
4. Cumberland 22918, Dollard, Cornell 141, and Otten were at the top as seed producers. Thirteen varieties had significantly higher seed yields than the average, and 7 were significantly lower than the average.
5. When considered on the basis of the combined value of the two crops (hay and seed) Midland rated first, Cumberland second, followed by Cornell 148, Common, and Scott's, in that order.
6. Most of the varieties showed acceptable returns but the value of the crops from the higher yielders was outstanding.

Stage of Cutting Important

When a seed crop is to be produced following a hay crop, the stage at which the hay crop is cut is important. Experiments conducted at Logan in 1946 on a field of Cumberland red clover showed that when the hay crop is cut when the plants are in about the ½ bloom stage, the maximum value from the hay and seed crops is obtained (table 3). When cut at the ½ bloom stage, there was sufficient time remaining to mature a good seed crop before danger from early fall frosts. It was also found that the hay crop contained the maximum yield of total digestible nutrients when cut in about the ½ to ¾ bloom stage.

The economy of growing red clover in Utah is beyond question. The crop is easily grown but is more difficult to cure and thresh than is alfalfa, but with proper methods it can be successfully handled either as hay or as seed.

Its feeding value when properly cured is unquestioned and its good effects on the soil are noteworthy.

In order to produce good seed crops, it is necessary to have bees within close range of clover fields.

Based on the results from these experiments the following conclusions can be drawn: (1) that many strains of red clover can be successfully grown in Utah; (2) that one hay crop and a seed crop can be produced the second and third years; (3) that the economical returns are good; and (4) that more red clover should be grown in Utah.

Below zero January temperatures have severely injured sweet cherry and peach flower buds according to S. W. Edgecombe, professor of Horticulture, U.S.A.C., Logan. Surveys in Cache and Weber Counties indicate that sweet cherries and peach buds are entirely killed in some orchards. In other peach orchards only 20 to 50 percent of the fruit buds are killed.

Table 2. Time of cutting Cumberland red clover as it affects profits from both hay and seed, 1946

Time of cutting hay	Hay yield	Value of hay*	Seed yield	Value of seed†	Combined value
	tons	*dollars*	*pounds*	*dollars*	*dollars*
Early bloom	4.54	68.10	181	72.40	140.50
¼ bloom	4.49	67.35	197	78.80	146.15
½ bloom	4.56	68.40	247	98.80	167.20
¾ bloom	4.51	67.65	187	74.80	142.45
Full bloom	4.83	72.45	211	84.40	156.85
Average	4.59	67.37	205	81.84	150.63

*Hay at $15.00 per ton

†Seed at 40 cents a pound

Table 3. Yields of forage and seed and relative rating of red clover strains according to forage and seed production (average of six replications)[1]

Variety[2]	Forage yield (one crop)				Seed yield (one crop)			
	1945	1946	1947	Total	1946	1947	Total	Rating
	tons per acre				*pounds per acre*			
Scott strain (Penn.)	2.72	3.53	3.22	9.47	109	89	198	12
Emerson (Harrisville)	2.21	3.88	3.33	9.42	108	83	191	15
Midland 22907	2.56	3.57	3.09	9.22	144	82	226	4
Midland 22904	2.55	3.61	3.05	9.21	92	83	175	20
Common	2.51	3.90	2.80	9.21	102	105	207	7
Cornell R148	2.70	3.56	2.94	9.20	114	110	224	5
Southern Selection	2.54	3.83	2.81	9.18	93	109	202	11
Emerson (Iowa)	2.54	3.72	2.89	9.14	64	95	159	22
Cumberland 22918	2.47	3.60	3.05	9.12	164	85	249	1
Altaswede	1.63	3.95	3.34	8.92	34	14	48	28
Cornell 176	2.82	3.62	2.39	8.83	104	102	206	8
Cumberland 22917	2.54	3.48	2.80	8.82	125	97	222	6
Dollard	2.36	3.73	2.68	8.77	127	111	238	2
Anthracnose Res. (Tenn.)	2.62	3.46	2.62	8.70	116	66	182	17
Van Fossen (Ohio)	2.32	3.53	2.82	8.67	79	126	205	9
Rahn Strain (Ill.)	2.30	3.44	2.61	8.35	135	69	204	10
Kirch (Ohio)	2.49	3.06	2.53	8.08	114	78	192	14
Wis. Composite	2.34	3.30	2.24	7.88	137	54	191	15
Cornell R141	2.45	2.99	2.38	7.82	117	121	238	2
Otten (Indiana)	2.50	2.58	2.69	7.77	118	115	233	3
Mildew Resistant (Wis.)	2.03	2.78	2.03	6.84	142	54	196	13
Least significant difference								
P .05	0.39	0.79	0.51	0.34* n.s.		35	39*	
P .01	0.52	1.04	0.67	0.45*		47	52*	

*For average, not total

[1]Data for Manhardy, Mich. (Harrisville), Louisiana, Wegener (Min.), Ottawa, Cornell R137, and R157, Kansas, Northern Neck (Va.), are not given here although included in the test. Forage and seed yields of these varieties were both low

[2]Listed in order of forage production

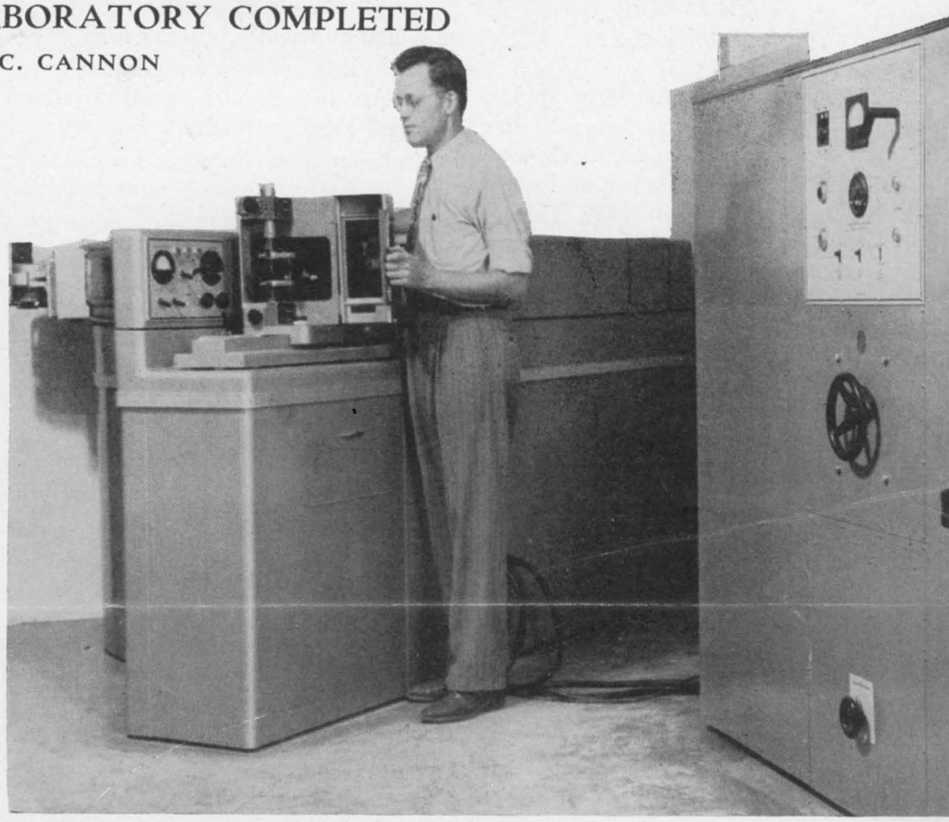
NEW SPECTROGRAPH LABORATORY COMPLETED

By MELVIN C. CANNON

THE Utah State Agricultural College has recently installed a new spectrographic laboratory, the most modern one of its kind in the intermountain region. The laboratory has a large (two meter) spectrograph and its auxiliary equipment, which will be used to analyze samples for the elements they contain, especially those present in minute or trace amounts such as copper, cobalt, or manganese, in plant tissue or soils. This can be done rapidly and with a relatively small sample and will greatly aid in the study of a variety of problems. For research involving the effect of trace elements in plant and animal nutrition and in deficiency diseases the scientist will find particular value in the solution of chemical problems by spectrographis means, since by proper handling, amounts of some of the elements as low as one part in ten million (0.00001%) can be determined.

Analysis by spectrographic means is based upon the fact that when any substance is heated to extremely high temperatures, that substance will emit light which is characteristic of and dependent upon the elements present in it. The familiar sodium lamp used to provide yellow light for highway lighting is an example of this principle. When light from the intensely heated sample is passed through the spectrograph it is dispersed by a prism or grating into a series of rays (visible, ultraviolet, and infrared) which when photographed yield a spectrum or pattern of lines characteristic of the elements in the sample. Thus, by studying the spectrum produced on the film one may identify the elements present.

The speed and efficiency attainable by this method is indicated by the experience of the steel industry where a complete spectrographic analysis of a steel sample for several elements is completed within four to eight minutes after receiving the sample from the mill. To obtain the same results by chemical methods might require as long as six to eight hours. It is anticipated that the spectrograph will aid not only in the solution of agricultural problems, but other Utah industries will likewise benefit from the use of this new analytical tool.



Dr. Melvin C. Cannon opens the compartment where samples are placed for analysis in the spectrograph. The triangular piece of equipment on the left is the spectrograph proper, while the one-ton piece of equipment on the right supplies the power

DR. MELVIN C. CANNON, associate professor of chemistry, joined the Station staff this fall. He will have charge of all spectroscopic analyses.

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SWIFT & COMPANY MAKES ADDITIONAL GRANT TO SHEEP NUTRITION STUDY

Swift & Company have added another $4,000 to the $20,000 original grant for studies on the nutritional deficiencies in range forage and the supplementary feeding of range livestock.

These studies have been in progress for about four years now at the Desert Range Experiment Station and in Wah-wah Valley in Beaver County. Wilford Wintch of Manti has furnished the sheep used in the study. The International Minerals and Chemical Corporation has also supplied funds and mineral supplements.

In this study, the composition of the plants eaten by the sheep was first determined and then supplements were supplied to take care of the deficiencies found in the forage. Progress on this work was reported in the September 1948 issue of Farm and Home Science.

The importance of supplementary feeding of livestock on the range has been tragically demonstrated to ranchers this past winter. Ranchers who had anticipated supplementary feeding and had feeds on hand suffered lighter losses and were not put to the expense of buying large amounts of feed at scarcity prices.

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