

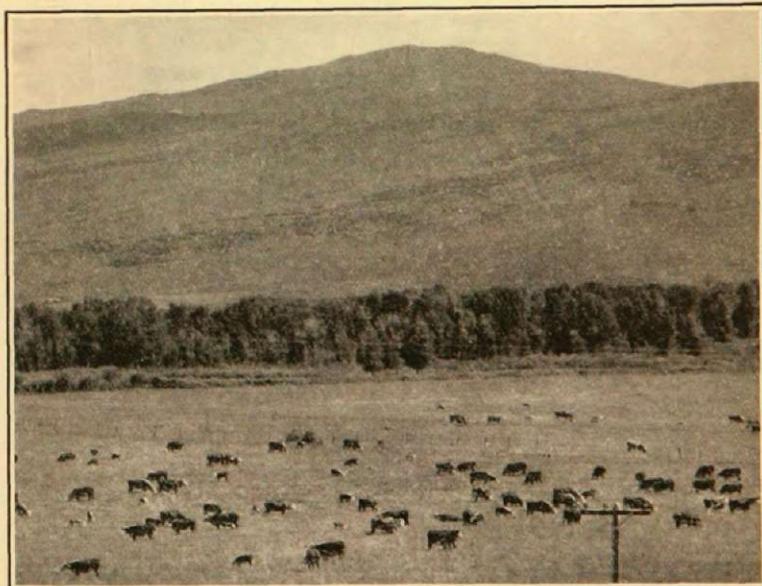
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EXAMINED AND CHECKLISTED

PASTURE AND FEED CROPS FOR IRRIGATED AND MOUNTAIN AREAS



Controlled breeding on tame grass pasture resulted in a 96 percent calf crop, more uniform calves and low bull costs on this ranch.



COLORADO AGRICULTURAL COLLEGE
EXTENSION SERVICE F. A. ANDERSON, DIRECTOR
FORT COLLINS

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PASTURE AND FEED CROPS FOR IRRIGATED AND MOUNTAIN AREAS

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Successful livestock production on ranch or farm in Colorado depends largely upon the economical production of feed. Grass is the cheapest and most satisfactory feed for cattle and sheep, *provided* a sufficiently high yield or carrying capacity is maintained.

Grass is a major crop in Colorado and grazing a major source of wealth. The total area of Colorado is 66,341,120 acres. In the 1930 census, 20,836,558 acres were classified as patented grazing land. This acreage does not include 8,000,000 acres of public domain and 13,330,832 acres in national forests or 355,192 acres of native hay land.

The grass crop is usually taken as a matter of course. In some areas outside of the national forests the grazing privilege is being abused. Desirable native grasses are diminishing on public domain as well as on privately owned or leased land because of overgrazing or continuous early grazing in the spring. Perhaps it is time for a state-wide effort on the part of stockmen to improve range and pasture conditions in the state because livestock profits depend, not only upon quality or breeding and management of the breeding herd or flock, but to a large extent upon access to *good* grass pasture and economical winter feed.

The time is right for a program of land classification and grouping of acreages as to use in Colorado, preceeding an organized effort toward grass improvement. Such a program should include:

1. Some system of control of unregulated public domain or other lands suitable only for grazing.
2. The adoption of a system of rotation and deferred grazing. (Write the Colorado Agricultural College for rotation-and-deferred-grazing plans.)
3. Providing supplementary pasture or feeds in order that the range or native pasture may be given a rest and allowed to reestablish itself. (The purpose of this bulletin.)
4. Range improvement by rodent control, reseeding, removal of brush or other growth. (Write Colorado Agricultural College for suggestions.)

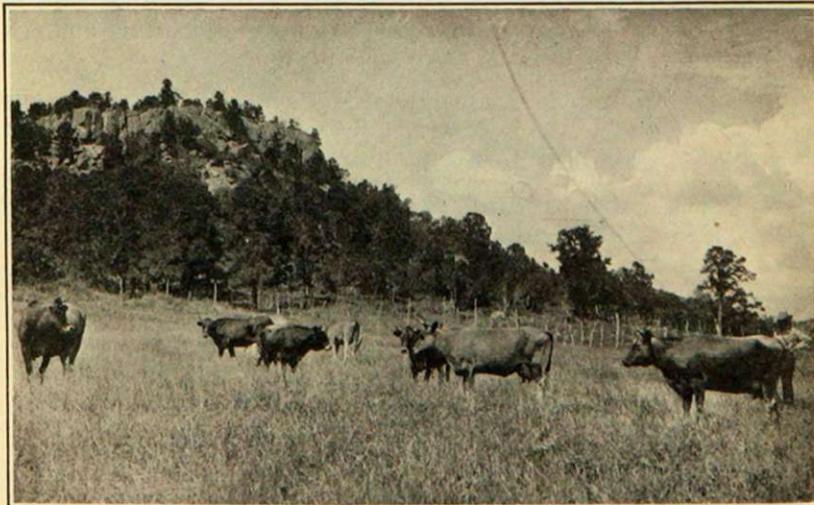
5. Meadow improvement by seeding Alsike or other clovers or grasses, renovation, fertilization or improved irrigation. (Write Experiment Station, Colorado Agricultural College, for suggestions.)

PASTURE SUGGESTIONS FOR IRRIGATED AREAS

On irrigated farms the problem is to produce a pasture with high-yielding or carrying capacity for 5 or 6 months in the year. The high yield or carrying capacity is necessary to allow for income from expensive irrigated land comparable to possible crop incomes. On every irrigated farm there should be some livestock.

Livestock worth keeping on farms is worth providing with pasture. Good pasture is the most economical and satisfactory feed for cattle, sheep or horses. For economical pork production nothing is quite equal to a good alfalfa pasture for the brood sows and young pigs.

On the stock ranch, meadows supply hay for winter feeding and grazing during the fall and early spring months. A major problem in ranching is to supply spring pasture from the time stock must be moved from the meadows or farms until allowed on the national forest. Since some tame grasses show a vigorous growth a month earlier than native grasses, a pasture or meadow might profitably be seeded with a grass mixture which includes some of these early grasses. The tame-grass pasture may be grazed until stock goes to the range, then one or two cuttings of hay will be possible, depending upon length of growing season and moisture supply.



Livestock worth keeping is worth providing with good pasture.

Improved pastures are useful in controlled-breeding practices on the stock ranch. Creep feeding of calves or lambs certainly can be carried on best in an improved pasture. Livestock losses from poison weeds can be reduced by providing improved early grazing.

Results of experiments with grasses and grass mixtures under irrigation at the Fort Collins Experiment Station, altitude 5000 feet, are offered as a guide for the stockman or farmer who is planning an improved pasture. A study of the yielding ability of single grasses and clovers was made under irrigation on the experiment station at Fort Collins, with the results noted in the accompanying table.

YIELD IN POUNDS OF OVEN-DRY HAY PER ACRE*

Name	Rate of Seeding	Ave. No. Irrigations	Total Crop Years Grown	Average Yield Pounds Per Acre	Cuttings	Remarks
Brome	15	4.5	12	2553	2	Stand thickened up even after 7 years of continuous production.
Slender wheat	15	4.5	11	2750	1-2	Bunch grass.
Orchard grass	30	4.5	13	2224	1-2	Stand too thick. 15-pound seeding rate sufficient.
Meadow fescue	25	4.5	8	2156	1-2	Stand too thick. 15-pound seeding rate sufficient.
Tall oat grass	40	4.5	13	3263	2	Low germinating seed.
Crested wheatgrass	10	4.5	3	1513	1	Stalky grass deceiving in estimation of yields.
Yellow sweet clover	10	1	4	3761	1	For best quality of hay cut in bud stage. Difficult to cure.
White sweet clover	10	1	4	4890	1	Same as yellow sweet clover.
Ladino clover	4	4.5	2	5488	2	Not a hay clover. Required frequent irrigations.
Alsike clover	4	2	2	4796	2	Produced plentiful seed supply.
Red clover	8	2	6	8345	2	Stand remained good for 3 years.
All alfalfa	10		16	8546	3	4 varieties used in this test.

*To determine air-dry hay yields, add 12 to 15 percent to each weight. Grasses cut with mower, raked with hand rake.

PERENNIAL GRASSES

BROMEGRASS (*Bromus inermis*) is a long-lived perennial which is ideally adapted to pastures in most sections of the state. It produces an even, dense sod after 2 years and is highly nutritious and palatable to all classes of livestock. Brome starts growing very early in the spring, is a fairly deep-rooted plant which persists thruout the summer even when hot and dry. Brome spreads by underground rootstocks, therefore has the ability to thicken up a thin stand in a few years. Bromegrass is grown successfully at 9300 feet altitudes in



Common Bromegrass is adapted to most sections of Colorado.

Teller county as well as at the lower altitudes of the state. A mixture of brome and alfalfa is being used as a sheep pasture in some sections of the state with very good results. A simple mixture of

brome and sweet clover has a wide adaptation thruout the state. Because of its sod-forming habit, brome withstands close grazing and trampling. After 6 or 7 years the roots may become sod-bound and renovation or disking on heavy soils with an application of manure may be decidedly beneficial.

Brome is a heavy seed producer. On ranches where considerable acreage is to be seeded, the production of seed on a smaller area may be found to be profitable. Undoubtedly there are excellent opportunities for a few careful growers of brome seed in the state.

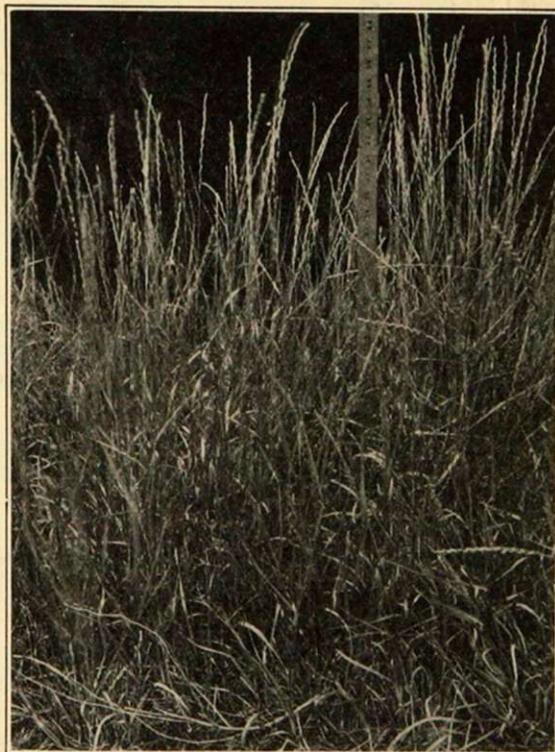
ORCHARD GRASS (*Dactylis glomerata*) is a bunch grass and for this reason is not well adapted for pastures where seeded alone. Close fall grazing, followed by a dry winter, is apt to destroy a stand of orchard grass. Orchard grass is not as drouth resistant as brome, is a deep-rooted, long-lived grass which, under favorable conditions, will produce well for 10 years or longer. Orchard grass can successfully be grown in the shade. It is not a very heavy seed producer. Starting growth early in the spring, it produces an abundance of leafy growth thruout the summer. It is best used in mixture with sod-forming grasses such as brome or Kentucky bluegrass.

MEADOW FESCUE (*Festuca elatior*) is a deep-rooted, long-lived grass adapted to most regions of Colorado under irrigated conditions or regions of moderate rainfall. Meadow fescue matures rapidly after seeding and is desirable in mixtures with some of the slower-growing species. Meadow fescue is slower to start in the spring than brome or orchard grass, furnishing a fine, palatable growth during the summer and late fall. It might be classed as a semi-sod-forming grass, being less aggressive in its sod-forming habit than brome or Kentucky bluegrass.

SLENDER WHEATGRASS (*Agropyron tenerum*) is a native of Colorado. It is a drouth resistant bunch grass well liked by cattle, sheep or horses. "In late summer, sheep or cattle greatly relish the mature seed and cured leaves, which, when mixed with other grasses or feed, aid in putting on hard, substantial fat." (C. L. Forsling and W. A. Dayton.)

Because of its ability to tolerate alkali* (C. L. Forsling and W. A. Dayton), it can be used with good results when mixed with sweet clover on alkaline soils. A simple mixture of slender wheatgrass, brome and yellow sweet clover is adapted to nearly all irrigated sections of the state.

TALL OATGRASS (*Arrhenatherum elatius*) is a succulent, high-yielding bunch grass. It is best adapted to irrigated conditions or



Slender wheatgrass is a native of Colorado.

areas having rather high rainfall. Tall oatgrass is apparently one of the better hay grasses. Its ability to withstand close grazing has not been definitely determined.

CRESTED WHEATGRASS (*Agropyron cristatum*) is an erect bunch grass reported to give excellent results at the Archer, Wyoming, dry-land experiment station, and in the foothill region near Fort Collins. It is considered by the Botany Department of the Colorado Agricultural College to be one of the most drouth-enduring and earliest-growing of the perennial grasses. Crested wheatgrass seeded at the Fort Lewis Experiment Station in 1927 did not make a sufficient growth in 1928, 1929 or 1930 to be harvested with a mower, tho yields in 1931 compared favorably with other grasses. Its range of adaptability has not been determined in Colorado, tho it is believed that crested wheat will make its best growth in the cooler regions of the state.

TIMOTHY (*Phleum pratense*) is a cooler-region, moisture-loving grass most widely grown as a hay grass. It makes a quick growth,

is not a sod former and is not a very long-lived grass where subjected to close grazing. Timothy does not produce a heavy leaf growth as brome, orchard grass or tall oatgrass. Therefore, the feed value of timothy alone is not considered to be very high. When mixed with alsike clover in hay meadows, excellent yields of high-quality hay are secured.

KENTUCKY BLUEGRASS (*Poa pratensis*) is primarily a grazing grass adapted to areas with a plentiful moisture supply. It is a very aggressive, shallow-rooted sod-forming grass. When planted in mixture under moist conditions it will usually crowd out all other species of grasses or crop plants except White Dutch clover. Unless continually supplied with moisture, bluegrass will die or produce very little forage during July and August.

REDTOP (*Agrostis palustris*) is another moisture-loving grass with the sod-forming habit of growth. Redtop will grow when kept under water for several days at a time. Shallow, vigorous rootstocks enable redtop to make a dense turf, crowding out other crop plants. It is one of the least palatable of the cultivated grasses. White Dutch clover, ladino clover or alsike may be grown in mixture with redtop to increase the value and palatability of the pasture.

CLOVERS

SWEET CLOVER (*Melilotus officinalis* and *Melilotus alba*) are biennials which depend upon seed production the second year for continued appearance in pastures. Yellow-blossom sweet clover is more apt to reseed itself than the white-blossom variety, because of the tendency to produce low branches which escape pasturing. When planted thick and cut for hay, sweet clover has not produced a satisfactory second cutting of hay on the experiment station farm at Fort Collins. Sheep are especially fond of the young growing tips of sweet clover and often prevent reseeding when sweet clover is closely grazed. Additional sweet clover seed can be drilled in a pasture mixture if necessary to maintain this crop in the mixture. Sweet clover is quite alkali resistant. White-blossom sweet clover yields more air-dry hay per acre than the yellow variety but the quality is inferior because of coarse stems.

WHITE DUTCH CLOVER (*Trifolium repens*) is the little white-flowered clover commonly grown with bluegrass in lawns. It is a long-lived, low-growing clover with creeping stems which grow along the surface of the ground and take root, thus forming new plants. This clover is a moisture-loving crop suitable for pastures where plenty of water is available for irrigation. It has the ability to withstand close grazing and will maintain itself in a pasture mixture by its rooting habit and ability to produce seed.

Irrigated mixtures included in experiments at the Fort Collins Experiment Station with the rate of seeding per acre:

No. 1	Rate of Seeding	No. 6	Rate of Seeding	No. 10	Rate of Seeding
Slender wheat	8 lbs.	Brome	10 lbs.	Brome	10 lbs.
Brome	8 lbs.	Orchard grass	6 lbs.	Orchard grass	5 lbs.
Yellow sweet clover	4 lbs.	Meadow fescue	5 lbs.	Tall oatgrass	5 lbs.
Total	20 lbs.	Redtop	5 lbs.	Redtop	5 lbs.
		Red clover	4 lbs.	Red clover	3 lbs.
		Total	30 lbs.	White Dutch clover	1 lb.
No. 2	Rate of Seeding			Total	20 lbs.
Slender wheat	8 lbs.	No. 7	Rate of Seeding		
Meadow fescue	4 lbs.	Brome	10 lbs.	No. 11	Rate of Seeding
Yellow sweet clover	4 lbs.	Orchard grass	6 lbs.	Brome	10 lbs.
Total	16 lbs.	Tall oatgrass	6 lbs.	Orchard grass	5 lbs.
		Alsike clover	2 lbs.	Tall oatgrass	5 lbs.
No. 3	Rate of Seeding	Red clover	4 lbs.	Redtop	5 lbs.
Brome	12 lbs.	Total	28 lbs.	Perennial rye grass	5 lbs.
Meadow fescue	8 lbs.			Total	30 lbs.
Yellow sweet clover	4 lbs.	No. 8	Rate of Seeding		
Total	24 lbs.	Kentucky bluegrass	5 lbs.	No. 12	Rate of Seeding
		Orchard grass	6 lbs.	Timothy	8 lbs.
No. 4—Morton's Mixture	Rate of Seeding	Tall oatgrass	6 lbs.	Redtop	8 lbs.
Brome	15 lbs.	Redtop	5 lbs.	Red clover	4 lbs.
Orchard grass	15 lbs.	Red clover	4 lbs.	Alsike clover	4 lbs.
Meadow fescue	10 lbs.	White Dutch clover	1 lb.	White Dutch clover	3 lbs.
Timothy	6 lbs.	Total	27 lbs.	Total	27 lbs.
Yellow sweet clover	4 lbs.				
Total	50 lbs.	No. 9—Modified Morton's Mixture	Rate of Seeding	No. 13	Rate of Seeding
		Brome	8 lbs.	Slender wheat	8 lbs.
No. 5	Rate of Seeding	Orchard grass	8 lbs.	Orchard grass	5 lbs.
Brome	10 lbs.	Meadow fescue	6 lbs.	Tall oatgrass	5 lbs.
Orchard grass	6 lbs.	Timothy	4 lbs.	Redtop	5 lbs.
Meadow fescue	5 lbs.	Yellow sweet clover	4 lbs.	Yellow sweet clover	3 lbs.
Perennial rye grass	5 lbs.	Total	30 lbs.	Total	26 lbs.
Red clover	4 lbs.				
Total	30 lbs.				

Yields of grass mixtures at Experiment Station, Fort Collins.
 Mixtures cut with mower when 6 inches high; 4 to 5 cuttings each year. Yields given in pounds per acre. All moisture dried out.*

Mixture No.	Year Planted	1924	1925	1926	1927	1928	1929	1930	Average Yield	Average yield all crop years
1	1923	3024	3568	3812	2657	1519	2009	1404	2622	2438
	1925			4328	2264	1925	2806	1708	2606	
	1926				4092	938	1701	901	1908	
2	1923	3677	2285	3903	2563	2066	1976	1639	2587	2558
	1925			4964	2225	1976	2769	1950	2777	
	1926				4092	2033	1695	1120	2235	
3	1923	4062	2177	3674	2617	1830	1966	1448	2539	2603
	1925			4859	2307	2008	3163	2103	2888	
	1926				4060	2131	2200	1044	2350	
4	1923	3659	1844	2805	2664	1454	2393	1020	2263	2280
	1925			4006	1919	1395	2141	1260	2264	
	1926				5862	1258	1394	820	2333	
5	1923	4393	3854	4661	2927	2066	2527	1242	3096	4275
	1925			5217	5340	4783	5887	3131	4872	
	1926				7520	5166	6460	3233	5595	
6	1923	2371	3555	4616	2202	1320	1990	1183	2464	3941
	1925			6683	5274	4268	5520	3500	5051	
	1926				7051	5093	5800	2017	5140	
7	1923	4318	4693	5230	3100	1937	2549	1203	3299	4704
	1925			8981	5012	4898	5887	3684	5872	
	1926				8184	5357	6284	2092	5704	
8	1923	4583	4652	5102	2888	1820	2202	1122	3196	4591
	1925			6840	5416	4791	6090	3381	5225	
	1926				8577	6240	6949	3203	6242	
9	1925			4849	6437	1552	2104	1346	3258	3168
	1926				5065	4093	1235	937	3058	

10	1923	5021	4162	5118	3077	1896	2292	1352	3274	4282
	1925			4905	5145	5047	5673	3376	4829	
	1926			7281	5256	5885	3078	5363		
11	1923	863	1815	3859	1470	765	1590	1027	1627	1594
	1925			3358	1281	1043	1891	1474	1809	
	1926			1164	1244	1193	1475	1269		
12	1923	4777	4990	5480	3007	1878	2337	1285	3393	4150
	1925			6799	5366	4938	3677	3346	4825	
	1926			6609	4338	5166	2406	4630		
13	1923	3798	1895	2986	2552	1073	1809	1050	2170	2503
	1925			6570	1927	1716	3421	1298	2986	
	1926			6065	1451	1517	888	2480		

*To get air-dry hay yields add 12 to 15 percent to each weight.

ALSIKE CLOVER (*Trifolium hybridum*) is best adapted to a cool, moist climate. Its greatest value is in the high, mountain, irrigated, hay meadows. It grows well on seepy areas or fields that receive excessive amounts of irrigation water. Alsike is longer lived than red clover, reseeds itself readily in pastures or hay meadows and will withstand fairly close grazing. The stems are less erect than red clover, therefore escape grazing.

RED CLOVER (*Trifolium pratense*) is grown principally as a seed crop in the Arkansas Valley and Western Colorado. Its value as a hay and pasture crop has not been proved thruout the state because of the ease of producing alfalfa in all sections. Red clover is classified as a biennial but in Colorado single plants have been known to live for 7 years. Good hay yields for 3 consecutive years have been produced from a single planting of red clover. Red clover has a wide range of adaptation under irrigation thruout Colorado at all altitudes. A simple mixture of red clover, brome and orchard grass would be adapted to most irrigated conditions in Colorado. Red clover in the pasture mixture is believed to cause more bloating in cattle or sheep than sweet clover in the same mixture.

LADINO CLOVER (*Trifolium repens latum*), when seeded alone, has proved to be very satisfactory as a pasture crop on areas where water is plentiful and alkali is not excessive. Ladino is a cool, moist-climate crop useful for pasture only. It is a giant white Dutch clover having the creeping habit the same as the white clover. Ladino will probably find its greatest usefulness along rivers or creek bottoms in shady places or in heavily irrigated or seeped areas. It will not survive competition of other plants, therefore must be planted only on well-prepared land. The seeds are very small. Four pounds per acre is considered to be a liberal seeding. Success in establishing a Ladino pasture depends largely upon the preparation of a firm seedbed, shallow covering of seed and liberal moisture at *the surface* of the ground for several weeks.

PASTURE OR HAY MIXTURES

A mixture of adapted grasses, together with one or two suitable legumes, seeded in a pasture makes greatest use of the soil fertility and moisture, therefore produces more feed of high quality thruout the season. Some grasses or clovers are deep-rooted, securing plant food from the deeper soil layers. Others feed entirely in the surface few inches of soil. Some grasses are early, others are late; therefore mixtures are to be preferred to single grasses or clovers.

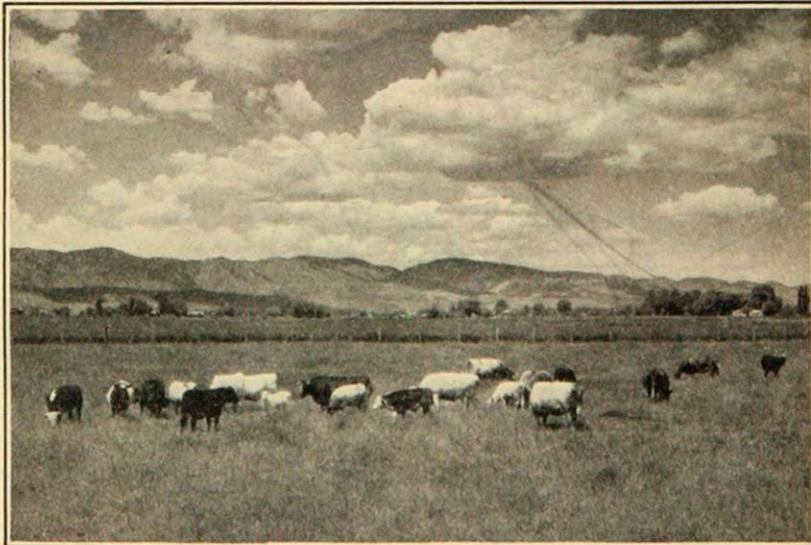
It is readily realized that no general recommendations of pasture mixtures can be made for Colorado irrigated lands because of the

great difference in soil, moisture and climatic conditions. A single field may have low, seepy areas as well as high, well-drained table land. Therefore, two types of grass mixtures may be necessary if the entire field is to be seeded.

Points to consider in selecting a mixture are :

1. Grasses or clovers best adapted to the soil and moisture conditions on your fields.
2. Cost of the seed and source of seed.
3. Yield of grasses in the proposed mixture.
4. Kind of livestock to be grazed.
5. Probable supply of water.
6. Permanence of the pasture.
7. Equipment for land preparation and seeding.
8. Your past experience with bloat in livestock.

The mixtures shown in this bulletin are offered simply as a guide for consideration of farmers or stockmen who may be interested in establishing an improved pasture. The grass mixtures used in these experiments *were not subjected to grazing*, therefore, the effect of *trampling* and *selective grazing* by livestock could not be studied.



Perhaps aged range cows with their calves or more farm beef herds and creep-fed calves should be kept on tame pastures on Colorado farms.

It is readily agreed that some plants included in these mixtures may cause bloat in livestock. Some plants, such as the tall oatgrass and orchard grass will not survive close grazing. Sweet clover in these mixtures did not produce sufficient seed for reseeding itself when the grass mixtures were cut four or five times in an attempt to simulate grazing conditions. It was necessary to broadcast sweet-clover seed on the pastures every 3 or 4 years in order to maintain this crop in the mixtures.

HAY YIELDS

It is convenient in many parts of the state to graze the improved pastures until late spring, then cut one or two crops of hay during the summer months. Hay yields were determined on the same pasture mixtures as were used in the frequent cutting or simulated grazing tests. Plants were allowed to reach near maturity before cutting. Two cuttings of hay each year with considerable growth before frost were possible.

PASTURE MIXTURE HAY YIELDS—Two cuttings each year, average yield all crop years, pounds of oven-dry hay per acre.*

Mixture No.	1	2	3	4	5	6	7	8	9	10	11	12	13
Yield	3606	3589	3323	3035	4341	6070	6391	6223	3330	4109	2214	6569	3155

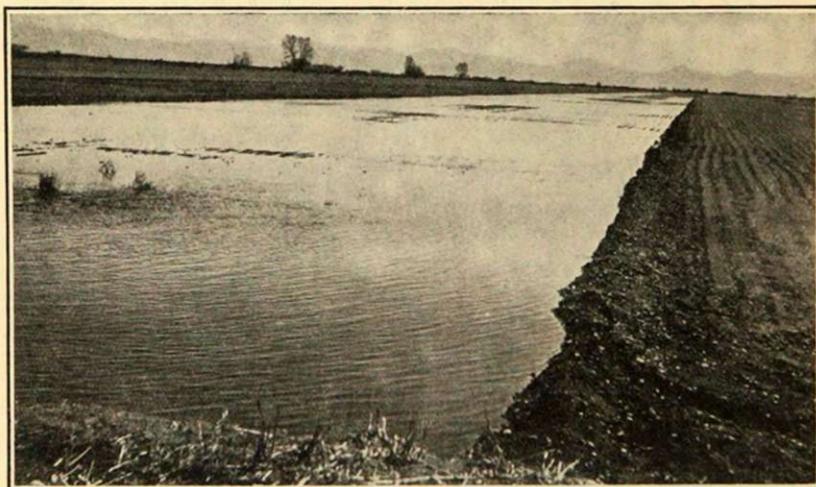
*To determine air dry hay yields per acre add 12 to 15 percent to the above weights.

ESTABLISHING A PASTURE

SOURCES OF SEED.—Any reputable seed house or seed dealer can supply grass seed of these mixtures. Bargains in grass seed like "bargains" in other seeds are usually expensive when the live-seed content is considered. "Bargains" in grass seed frequently have a large percentage of weed seed some of which may be noxious. The tag giving the State Seed Laboratory report should be closely examined on every purchase of seed.

PREPARATION OF LAND.—A firm, smooth seedbed is essential to success in establishing a pasture. Grass seeds are very small and do not possess sufficient energy to push thru a very great depth of soil. An inch is considered the best depth in most Colorado soils to plant grasses. It is difficult to prevent covering seed too deep with harrow or drill on a soft, loose seedbed. A beet field, potato field or cornfield can usually be put in condition for seeding grasses by harrowing or light disking and floating. Fields that have not grown cultivated crops the previous year should be fall plowed in order to secure a firm, mellow condition of the soil. It is better to drill grass seed in a small-grain stubble than to plow and plant on a loose soil. Early

spring plowing may be irrigated by furrows or flooding before seeding in order to settle down the seedbed and supply moisture for immediate germination.



Flood irrigation of spring-plowed land just before seeding grasses insures a firm, moist seedbed.

Grass seeds require moisture very near the surface of the soil for germination, then a liberal supply in the top layers of soil until the little seedlings become established. It is better to irrigate the field just before seeding to supply needed moisture for germination than to irrigate after seeding because of the danger of crust.

TIME OF SEEDING.—Since grasses are generally considered to be a cool-weather crop, the pasture mixture should be seeded in the early spring. Under irrigated conditions, it is perhaps best to delay planting until a continuous supply of irrigation water is available so that the seeding may be saved in case of dry weather after the seeds have sprouted. In the non-irrigated intermountain areas, an attempt should be made to seed grasses before or during the shower season if previous experience or rainfall records indicate that such seasons occur with reasonable certainty.

METHOD OF SEEDING.—A grain drill with grass-seeder attachment is the best equipment for seeding grasses. The light, chaffy grass seed as brome, orchard, meadow fescue and slender wheat should be mixed together and put in the drill box. The heavier seeds as sweet clover, red clover, alsike and timothy should be seeded thru the grass seeder. Some difficulty will be experienced in making the chaffy

grass seed feed down in the drill. Therefore, careful attention will be needed to secure a uniform rate of seeding.

Some farmers mix a little cracked wheat or corn chop with the light seed in the drill box to make the grass feed down. Others use barley or heavy oats in small amounts. In either case, an occasional stirring will be necessary and the drill openings should be watched to make sure that grass seed is being dropped. The drill set as if to seed 2 to 2.5 bushels of oats per acre and the grass seeder set to seed 4 quarts will release 30 to 35 pounds of the mixture per acre. A better distribution of the seed can be obtained by drilling half the seed one way then cross drilling the remainder of the seed. There is less danger of the drill operator exhausting his seed before the field is planted if cross drilling is practiced.

BROADCASTING by hand is wasteful of seed tho in the absence of a drill and on small acreages, it may give good results if the field is lightly harrowed and rolled with a corrugated roller immediately after seeding. This method of seeding has been used successfully in securing a stand of grasses when a small-grain nurse crop has already been established. A light harrowing or rotary hoe checks weed growth and covers the seed just ahead of the first irrigation. Immediate growth of the small grain furnishes shade for the grass seedlings, which is very desirable on some soils.

FURROW IRRIGATION is considered best as flooding will cause most soils to crust. Furrowing should be done immediately after seeding. On sloping land furrows gently sloping or on contours around the hill may prevent excessive erosion. A beet cultivator with ditchers is useful in furrowing, or small posts tied underneath a harrow 2 to 3 feet apart may be used to line out a field.

NURSE CROP.—If a nurse crop is to be used, Colless barley seeded at about half the usual rate (40-50 lbs.) is the best of the small grains. Field peas seeded at the rate of 60 lbs. per acre and cut for hay are also considered to be a good nurse crop for grasses, clovers or alfalfa. In case either of these nurse crops is used it should be drilled before the grass is sown. By stopping every other hole in the drill the growing nurse crop will allow sunlight to reach the small grass seedlings and more rapid growth will result. Frequent irrigations may be necessary, especially during early growth, to save the grasses during drouthy periods. Such irrigations may be damaging to the nurse crop and if Trebi barley, oats or wheat are used, lodging is apt to occur, causing smothering of the young grass in spots. It is important to remember that the *grass crop should be given first consideration*. This may mean that if irrigation water is short, the nurse crop must be harvested for hay in order to save the grass stand.



Grasses drilled without a nurse crop on a firm seedbed is the surest method of securing an early sod.

ESTABLISHING A PASTURE IN NON-IRRIGATED MOUNTAIN AREAS

Lack of continuous moisture supply after germination and until the grass seedlings are established is the greatest hazard in establishing a tame-grass pasture in non-irrigated regions. Rainfall records by months, together with the experiences of those who have lived in the community for many years, should be used as a guide to determine the best time to plant grasses in mountain areas. Some farmers have successfully seeded grasses late in the fall so that the seed will not germinate until the following spring. Snow covering provides sufficient moisture to establish the grass stand before the drouth period. Other farmers have successfully established stands of grasses or sweet clover by scattering the seed on the snow in winter.

A FIRM SEEDBED is even more important in securing grass stands under non-irrigated conditions than under irrigation. A field that has grown potatoes, vegetables or any cultivated crops the previous year is most desirable for establishing a pasture. A small-grain stubble field can readily be seeded to grasses by using a disk drill. Such a field does not need disking or any previous preparation unless a thick stand of weeds has started which cannot be destroyed in drilling.

Some farmers use a nurse crop of a thin seeding of oats or barley which is cut for hay. Seeding without a nurse crop allows for the

greatest possible growth of the grasses the first year, provided the weeds are checked by mowing.

Grass yields without irrigation at the Fort Lewis Experiment Station, altitude 7600 feet, near Durango, Colorado, are given in the accompanying table as a guide in selecting grass varieties for mountain areas.

Yields of Air-Dry Hay in Pounds Per Acre at Fort Lewis Experiment Station. Grasses Cut With Mower and Raked with Hay Rake.*

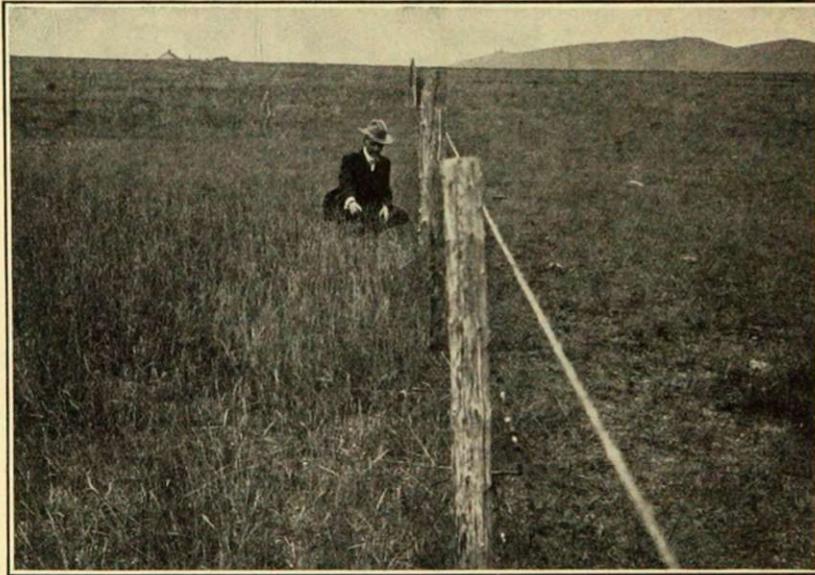
	1926	1927	1928	1929	1930	1931	Total	6-Year Average
Brome	75	90	18	28	8	344	563	94
Orchard	29	66	12	60	0	168	335	56
Meadow Fescue	61	85	11	32	2	96	287	48
Slender Wheat	90	36	9	8	0	72	215	36
Morton's Mixture (50)	175	134	65	68	4	424	870	145
Morton's Mixture (30)	254	105	60	13	23	427	882	147
Yellow Sweetclover	201	124	78	140	0	220	763	127
Rainfall, March to July, inclusive (inches)	9.27	7.34	5.30	6.97	6.46	8.58		7.32

*These areas were subjected to grazing each year until June 1 except in 1931.

PASTURE MANAGEMENT

LIVESTOCK SHOULD NOT be allowed to graze the pasture during the year of seeding. Grazing while the grass seedlings are establishing themselves is apt to cause excessive winter killing and a delay in establishing a sod. If a thin stand is secured, it is advisable to allow the pasture grasses to produce seed the following year, pasturing late in the season or during winter. Such practice allows maximum growth and spread of the grass roots as well as the production and scattering of more grass seed for reseeding. Some farmers cut 2 crops of hay instead of pasturing the second year's growth of grasses. Others cut one crop of hay then allow stock to graze during the remainder of the season.

A pasture should be fenced so as to divide it into two or three areas. When one division is being grazed the other sections may be irrigated and allowed to make considerable regrowth. When the leaves of grasses are closely and continuously grazed, sufficient food material cannot be assembled and the plants gradually starve or vigorous growth and high carrying capacity are impossible.



The pasture should be divided. Half the field can be grazed while the other half is being irrigated for quick recovery and rapid growth.

FERTILIZATION

Pastures respond favorably to a top dressing with barnyard manure. Manure applied in February or March with reasonable moisture stimulates rapid early growth of the pasture and as a result 2 weeks more grazing in the early spring is usually possible. After several years in pasture, soils are apt to become trampled and packed as well as root bound so that disking or renovation with an alfalfa renovator following an application of manure is a means of aerating the soil and stimulating new growth.

In some pastures, commercial fertilizers may be applied to advantage. Before making an application of commercial fertilizer, a representative soil sample taken to a depth of 7 inches at several places in the pasture should be sent to the Soils Laboratory at the Colorado Agricultural College for analysis to determine what fertilizer is needed.

TEMPORARY PASTURES

SWEET CLOVER alone is considered by most stockmen or farmers to be an excellent pasture crop. Sweet clover pasture is an excellent crop to grow in a rotation with other crops because of its beneficial

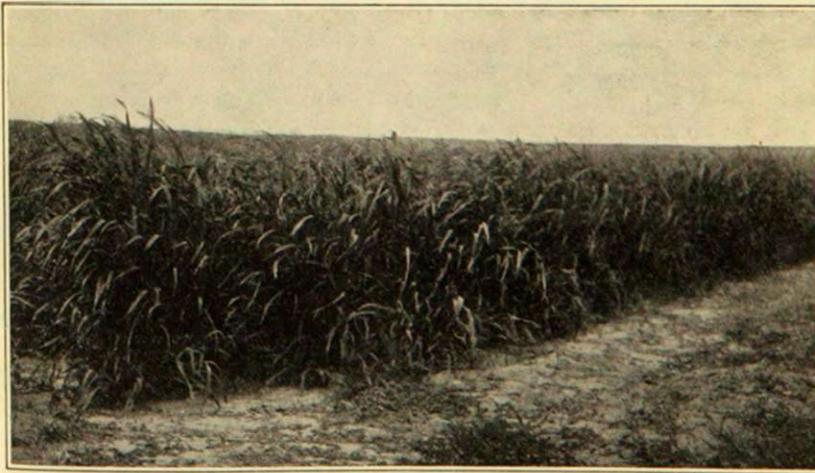
effect on the soil. When planted in April or May at the rate of 10 to 12 pounds per acre without a nurse crop, sweet clover will provide some pasture in August, September and October. Close grazing of this spring-seeded clover will cause a reduced growth in the early spring of the second year.

Sweet-clover plants will live only 2 years. Therefore, should a longer pasture period be desired it should be allowed to produce seed for reseeding or additional seed should be drilled in the early spring of the second year.

Bloat difficulties may be reduced by drilling a light seeding of oats or barley in the clover field as growth starts in the spring of the second year. Livestock relish straw or some dry feed when being pastured on sweet clover. Access to a straw pile or straw fed to cattle and sheep while grazing on clover will reduce the danger of bloat.

WINTER RYE AND SUDAN GRASS can be grown to supply pasture during the entire year except in midwinter. Winter rye can be seeded as early as August 1 in the lower altitudes to supply pasture during the fall and early spring months. July seeding can be practiced at the higher altitudes. An additional seeding of winter rye in April will supply pasture until the old rye field which has been grazed during the fall and early spring months can be prepared and seeded to sudan grass.

Sudan grass is a hot-weather crop, therefore should not be planted until late May or in June. When drilled at the rate of 20 to 25 pounds



Sudan is an excellent pasture or hay crop. If cut for hay as the first heads appear, it contains 9 to 11 percent protein.

of seed per acre, excellent pasture will be provided for stock until frost. Sudan is very sensitive to frost, therefore is not so well adapted in altitudes above 7000 feet.

It is dangerous to graze cattle or sheep on stunted or frosted sudan grass because of prussic acid poisoning. Spring grains or winter wheat may be substituted for sudan grass to provide summer pasture.

SPRING GRAINS may be used to supply pasture in order to give the native-grass sod time to reach maturity and produce a seed crop. Oats and barley are more leafy than wheat, therefore are preferred as pasture crops. Winter rye or winter wheat seeded in the spring after heavy freezes occur, will produce only a few heads and furnish pasture thruout the summer.

FEED CROPS

ALFALFA HAY is the standard winter roughage in most irrigated or inter-mountain districts. At the Colorado Experiment Station at Fort Collins the variegated alfalfas (many colored blossoms), as Grimm, Baltic and Cossack, have outyielded other varieties. Seed from northern-grown common alfalfa has outyielded crops produced from southern seed.

A firm seedbed is essential in securing a good stand of alfalfa. It is believed better to drill alfalfa seed in a stubble field without previous preparation than to prepare the field by spring plowing which may cause a loose seedbed. Flood irrigation is desirable on spring-plowed land to insure a firm seedbed and plenty of moisture before seeding alfalfa. Alfalfa is grown successfully at altitudes of 8300 feet in Teller county. With dependable snow covering during the winter, it is probable that hardy alfalfa can be successfully grown at altitudes up to 9000 feet.

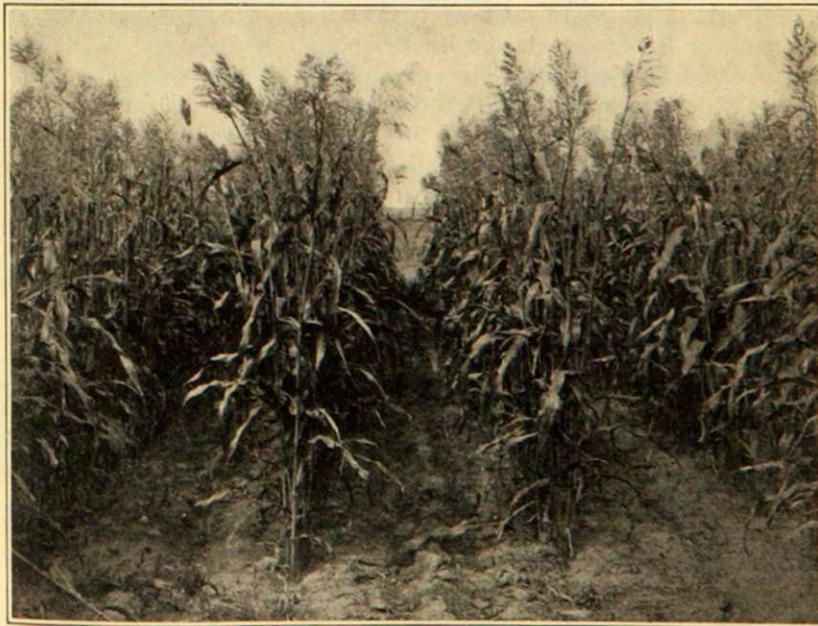
CORN will produce more digestible nutrients per acre for livestock than any other crop when grown at altitudes and conditions favorable to this crop. Seed corn grown at lower altitudes will not mature a grain crop when planted at higher altitudes, tho a heavy forage yield may be secured. By selection of mature seed corn in the field before frost, or purchase of adapted seed, corn can be readily adapted to most Colorado conditions below 6000 feet altitude. At the Fort Collins Experiment Station, May 1 to 10 plantings have averaged 2 bushels more per acre with more U. S. No. 1 corn than later planting. On good soil, Colorado 13, Minnesota 13 or medium-type dent corn will yield best when planted 4 stalks per hill in check-rowed hills 36 inches by 36 inches, or when dropped in the row, single stalks 9 inches apart. Ten pounds of good-quality seed are consid-

ered to be sufficient to plant an acre. Reids Yellow Dent, Iowa Silvermine or local large dents are best adapted to lower altitudes.

The corn crop can be entirely converted into a succulent feed by storing the crop in a silo. The *trench silo* is the most economical means of storing silage. A trench silo is simply a hole in the ground 6 or 8 feet deep, 8 feet wide at bottom and 12 feet in width at the top. It can be dug with tractor or team, plow and scraper. One end of the silo is sloped to allow for dragging out the loaded scraper. The ensilage harvester which cuts corn stalks into silage lengths in the field as it moves along the row is an efficient machine to eliminate heavy hand labor. This harvester delivers the cut silage into a truck or wagon moving with the machine.

Corn cut as the shucks turn brown but while the leaves are still green may be cured out in large shocks. When shredded or fed whole with proper supplements, excellent results are reported by cattlemen, sheepmen and experiment stations. In a 3-year test at the Fort Collins Experiment Station an average of 5.5 tons of corn fodder for shredding has been secured.

SORGHUM drilled broadcast at the rate of 40 pounds per acre has yielded an average of 6.78 tons of moisture-free forage per acre at



Sorghums in 36-inch rows have averaged 6.42 tons per acre of moisture-free forage under irrigation at the Fort Collins Experiment Station.

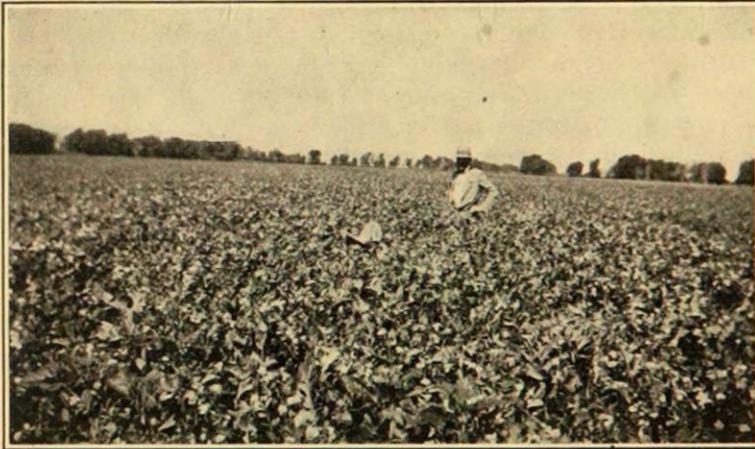
the Fort Collins Experiment Station. Planted in rows 36 inches apart with a corn planter using 5 pounds of seed per acre, an average of 6.42 tons of moisture-free feed have been secured the same years of test.

It is probable that a maximum tonnage of forage sorghums can be secured under irrigation by planting in narrower rows and cultivating 2 or 3 times to destroy weeds. Sweet or forage sorghums, as red and black amber, sumac and orange cane, are best adapted to medium growing seasons. At the lower altitudes in regions of longer growing seasons, Atlas sorgho, Sumac or Kansas Orange will produce highest yields. Grain sorghums such as Kafir, Feterita, Hegari and locally adapted milo may produce satisfactory yields.

PEAS AND OATS drilled at the rate of 50 pounds of peas and 50 pounds of oats, may be grown under most irrigated conditions in Colorado with good results. Oat-pea mixtures have averaged 5121 pounds of moisture-free hay per acre in tests conducted at the Fort Collins Experiment Station. Oats and peas can be drilled in April with maturity expected during the last of July or first of August. At the medium altitudes, Colorado 37 oats, Victory or side oats will ripen approximately at the same time as peas when grown in mixtures. Improved varieties of peas are Clamart, Agnes and French Gray. At higher altitudes early maturing oats, as Nebraska 21, Kherson or Brunner, mixed with Perfection or Yellow Admiral canning peas, when drilled in May or June, will mature together. Oat-pea mixtures may be harvested with a binder as the oats begin to ripen. Bundles of this forage are easily handled in stacking and feeding. The pea vines are high in protein, being approximately equal to alfalfa hay in feed value. Some growers cut the oat-pea mixture with a mower, raking into large shocks as soon as the hay is wilted. These large shocks are allowed to remain in the field and this forage is pastured off during the winter. In regions of heavy snowfall it would be best to stack the hay and hand feed. Peas that shatter during harvest will readily be picked up by hogs or sheep when the land is free of snow.

Peas grown in mixture with Colseess barley are finding favor among sheepmen in some districts. Thousands of acres of peas alone are annually grown in the San Luis Valley to be hogged or sheeped off during the fall and winter months. Peas alone seeded at the rate of 60 to 90 pounds, or a mixture of peas and Colseess barley, is proving to be a better nurse crop for alfalfa or clovers than small grain alone, at the Colorado Experiment Stations.

SUDAN GRASS is a hot-climate crop, therefore is best adapted to regions favorable to production of corn. Sudan grass drilled at the



Peas alone or in mixture with oats or barley make excellent forage and are satisfactory as a nurse crop for clovers or alfalfa.

rate of 25 pounds per acre, has yielded an average of 5672 pounds of moisture-free hay during the 5 years that it has been grown at the Fort Collins Experiment Station. Sudan is an annual that has the ability to produce a fair crop with limited amounts of moisture. It is an important forage crop in the non-irrigated plains of Eastern Colorado. Under favorable conditions, two cuttings of hay can be harvested. Sudan hay contains 9 to 11 percent protein when cut as the first heads appear. Prussic acid in sudan stubble or new growth may poison livestock if grazing is being done at the time killing frosts occur.

OATS ALONE make an excellent hay crop if cut as the heads begin to ripen. The normal rate of seeding is 80 to 90 pounds. In a 3-year test at the Fort Collins Experiment Station, oats alone have averaged 3917 pounds of oven-dry forage. Oats are used in some districts to increase tonnage of hay from a thin stand of alfalfa or sweet clover. Oats may be drilled in the alfalfa field after it has been renovated or disked, with increased tonnage of hay from the second cutting. Oats drilled in a sweet-clover field may reduce bloat in cattle or sheep when this crop is grazed. If the sweet-clover crop is intended for hay, the oats may increase the tonnage the same as in alfalfa.

THE BEST VARIETIES OF SOYBEANS in tests at the Fort Collins Experiment Station have averaged 3614 pounds of moisture-free hay. Soysota, a brown-seeded bean, has averaged 28.6 bushels of grain in a 3-year test under irrigation. Yellow-seeded varieties proving best at

the Fort Collins station are Minsoy, Wea and Saskatoon. Dark-seeded varieties proving best under the same conditions are Soysota and Black Eyebrow. Soybean seed contains 36 percent protein. Soybeans can be planted in rows as a crop of pinto beans, using 20 to 40 pounds of seed per acre or drilled with a grain drill, planting 80 to 120 pounds. A beet drill, planting soybeans in rows 20 inches apart, is best, then the crop can be kept free of weeds by using a beet cultivator. If cut for hay, the crop should be harvested before the leaves turn yellow and begin to drop off. May 1, or corn planting time, has proved to be the best time for planting soybeans at the experiment station.

In planting soybeans and corn in the same field for hogging or lambing off, higher yields of both corn and beans will be secured if separate rows for each crop are planted instead of planting together in the same row or hills. A group of 4 to 6 rows of soybeans to 20 rows of corn seems to be about the best proportion.

Roots.—The feed value of mangels and Swedes or rutabaga turnips is being overlooked on most Colorado farms. Roots are relished by most classes of livestock, especially during the winter and early spring. A small acreage of root crops will supply a very desirable succulent feed at most altitudes in Colorado.

Roots can be easily stored in a shallow pit or cellar. A root slicer can be secured at low cost or the roots may be cut with a spade in feeding.

SUNFLOWERS for silage at the higher altitudes should not be overlooked. Fifteen to 25 tons of sunflower silage is not an unusual yield under irrigation. Russian sunflowers planted at the rate of 15 pounds of seed per acre in rows 20 to 28 inches apart will produce a good tonnage of succulent feed which can easily be stored in a trench silo.

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