

ESTABLISHMENT of CROWN VETCH and BIRDSFOOT TREFOIL on HIGHWAY SLOPES with VARIOUS COMPANION GRASSES and RATES of SEEDING

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● THE necessity for roadside cover has become very apparent with the advent of modern highway construction. Increased numbers of cut-and-fill slopes have emphasized the importance of a permanent vegetative cover. Mixtures of grasses and legumes are the least expensive and usually provide the most effective ground cover in the shortest time, in comparison with woody species which were favored previously. However, these "shot-gun" mixtures of grasses and legumes leave a lot to be desired in the way of a permanent protective cover, both from the practical and the aesthetic viewpoint.

The Pennsylvania Agricultural Experiment Station, in cooperation with the Pennsylvania Department of Highways, has conducted studies in an effort to evaluate various herbaceous materials for use on highway cut-and-fill slopes.

The first series, begun in 1947, was designed to compare the adaptability and rate of cover establishment by selected grasses and legumes. Certain of these grasses resulted in adequate cover but later showed evidence of thinning out. The crown vetch established full cover but required two full growing seasons, the apparent difficulty being the slow rate of seedling development, during which time erosion becomes a serious problem. It was necessary, therefore, to find a quick-growing companion grass that would provide adequate erosion protection until the crown vetch became established.

The second series, begun in 1950, was concerned, primarily, with the effects of the grasses best adapted for slope control on the rate of establishment of crown vetch seeded as a companion crop with them. The results of this series of experiments were promising; however, the differences were not wide enough nor sufficiently consistent to justify definite conclusions on the relative merits of the various companion grasses with the crown vetch. The results of the first two series have been reported in the Pennsylvania Agricultural Experiment Station Bulletin 576, May, 1954.

In 1952, a third series was established to study grass-crown vetch associations. The object of this study was to determine the effect of various seeding rates of crown vetch, birdsfoot trefoil, and grass species on the establishment of the legumes. This paper presents the results of these studies over the two-year period, 1953 to 1954.

MATERIALS AND METHODS

The field plots were located on a cut section of Morrison loamy sand subsoil on Pennsylvania Highway Route .047, 7 miles from State College.

The slope had a northwest exposure, a $1\frac{1}{2}$:1 elevation, and was graded to a rough finish. The pH was 4.9 to 5.2, and sufficient lime was added to adjust the reaction to approximately 6.5. The lime was worked in during the grading process. A 5-10-5 fertilizer was applied as uniformly as possible to the entire experimental area at a rate of 1,200 lb. to the acre. The individual plots were 5 feet wide by 20 feet on the slope and were separated from each other by steel guardrail plates.

The test included creeping red fescue, Kentucky 31 fescue, and domestic

ryegrass individually seeded with Empire birdsfoot trefoil or Penngift crown vetch. Seeding rates of grasses were 25, 40, and 60 lb. to the acre, with 15 and 25 lb. of birdsfoot trefoil and 20 and 30 lb. of crown vetch. Each plot contained one grass and one legume seeded in all possible combinations of the above rates with the exception of the 25-lb. rate of domestic rye with 15 and 25 lb. of birdsfoot trefoil. These combinations were omitted for lack of sufficient space. The plots were replicated three times in a randomized block design.

All seedings were made by hand, with seed mixed with soil containing inoculum for the legumes, on August 26 and 27, 1952. The entire area was then mulched with immature orchard grass at 2 tons to the acre. The mulch was applied with a mechanical mulching machine.

The first evaluation was made on October 17, 1952. Three random counts of the number of plants per square foot were made on all the plots to determine legume population. The grass cover on each plot was estimated independently by three investigators.

RESULTS AND DISCUSSION

The average establishment rate for crown vetch and the various species of grasses is shown in Table 1. The table also shows the persistence of the various

TABLE 1
EFFECT OF VARIOUS SEEDING RATES OF GRASSES AND CROWN VETCH ON THE
DEVELOPMENT OF A CROWN VETCH COVER OVER A TWO-YEAR PERIOD

Pounds per acre		Plants per Square Foot and Percent Cover					
		June, 1953		June, 1954		October, 1954	
Red Fes.	Crown Vetch	C.V. Plants Per Sq. Ft.	Grass % Cover	C.V. Plants Per Sq. Ft.	Grass % Cover	Cr. Vetch % Cover	Grass % Cover
25	20	7.0	50	4.7	67	75	23
25	30	5.3	60	5.0	72	64	26
40	20	3.0	55	1.8	77	33	60
40	30	7.0	63	2.3	83	47	38
60	20	6.3	65	4.7	73	70	30
60	30	12.0	73	4.7	63	65	33
Ave.	—	6.8	62	3.8	72	59	35
<u>Ky. 31</u>							
25	20	6.6	57	5.0	42	82	8
25	30	16.6	70	5.7	42	95	1
40	20	14.0	72	3.3	48	72	18
40	30	7.3	62	4.3	42	75	16
60	20	5.0	72	5.0	52	68	25
60	30	9.6	70	5.3	48	75	15
Ave.	—	9.9	67	4.8	44	77	14
<u>Ryegrass</u>							
25	20	8.3	77	6.0	2	96	0
25	30	7.3	68	4.7	0	82	0
40	20	4.6	83	2.7	0	87	0
40	30	9.3	80	6.0	2	92	1

TABLE 1 - Continued

Pounds per acre		June, 1953		June, 1954		October, 1954	
Ryegrass	Crown Vetch	C.V. Plants Per Sq. Ft.	Grass % Cover	C.V. Plants Per Sq. Ft.	Grass % Cover	Cr. Vetch % Cover	Grass % Cover
60	20	6.3	80	6.3	2	90	0
60	30	6.3	83	4.7	1	87	1
Ave.	—	7.0	78	5.1	1	89	0
LSD 0.05							
Grasses		2.6				10.4	
Crown vetch rates		2.1					

species over a two-year period. The grasses were able to provide a quick protective cover while the crown vetch, although established, was very slow to develop until the second growing season. This is demonstrated by the fact that individual crown vetch plants could still be counted in June, 1954.

The table shows that in June, 1953, the spring after seeding, a significantly greater stand of crown vetch was obtained with Kentucky 31 fescue. Ryegrass produced the best ground cover, with an average total cover of 78 percent, and red fescue was the lowest with 62 percent. The higher rate of seeding of crown vetch showed significantly better plant survival at this period. The various seeding rates of the grasses did not have an appreciable effect on crown vetch establishment.

It will be noted that by June, 1954, the number of crown vetch plants per square foot decreased on all plots. This can be attributed to seedling mortality and companion-grass competition. The smallest decrease was noted with ryegrass and the greatest decrease with Kentucky 31 fescue. Grass cover, at the same period, showed an average increase for red fescue from 62 to 73 percent, while Kentucky 31 fescue decreased from 67 to 44 percent. Ryegrass did not reseed itself successfully and subsequently decreased from 78 to 1 percent. However, the ryegrass provided an adequate protective mulch cover from dead vegetative material and did not give further competition to the crown vetch.

The growth situation was completely reversed in the second growing season, as shown in the table for October, 1954. At this time the crown vetch was contributing most of the ground cover. During the same period the grasses deteriorated because of legume competition and inability to persist under the conditions. A protective mulch and no growing competition from ryegrass resulted in an 89 percent average crown vetch cover. Red fescue offered the most competition but still resulted in an average of 59 percent crown vetch cover, with the grass cover being reduced from 73 to 35 percent. The Kentucky 31 fescue as a companion grass provided the second best crown vetch stand with an average cover of 78 percent, with the grass cover being reduced from 44 to 14 percent during the same period.

Seeding rates for grasses and crown vetch showed no significant differences for the final stand. The only significant difference found at this time was among the three grasses used in this experiment. It has been demonstrated that the minimum seeding rates used are as effective as the higher rates in the establishment and persistence of the final stand.

The establishment rate and persistence of birdsfoot trefoil and the grass species are shown in Table 2. The average of the two birdsfoot seeding rates is

TABLE 2

EFFECT OF VARIOUS SEEDING RATES OF GRASSES AND BIRDSFOOT TREFOIL ON THE DEVELOPMENT OF A BIRDSFOOT TREFOIL COVER OVER A TWO-YEAR PERIOD

Plants per Square Foot and Percent Cover

Pounds per acre		June, 1953		June, 1954		October, 1954	
		BTF plants Per Sq. Ft.	Grass % Cover	BTF plants Per Sq. Ft.	Grass % Cover	BTF % Cover	Grass % Cover
Red Fes.	BTF plants						
25	20	2.3	39	0.5	64	0	58
40	20	9.0	61	4.6	62	16	10
60	20	8.0	64	1.2	83	2	77
Ave.	—	6.4	55	2.1	70	6	58
<u>Ky. 31</u>							
25	20	5.5	58	0.9	54	3	14
40	20	6.7	65	0.6	56	1	41
60	20	6.2	69	1.5	61	7	49
Ave.	—	6.1	64	1.0	57	4	45
<u>Ryegrass</u>							
40	20	6.8	81	1.9	1	9	0
60	20	7.0	83	1.8	0	18	0
—	—	—	—	—	—	—	—
Ave.	—	6.9	83	1.8	1	13	0

given, because of lack of significant differences. A successful seedling stand was obtained as is shown for June, 1953. However, the subsequent stand was almost completely depleted with the exception of a few scattered plots. The final percent cover after two growing seasons, as shown for October, 1954, demonstrates that birdsfoot trefoil has little value as a roadside vegetative cover on raw droughty subsoils.

Since birdsfoot offered very little competition, the grass cover in these combinations is indicative of results obtained by seeding the grasses alone. Table 2 shows red fescue (58 percent) providing a better final cover than Kentucky 31 fescue (45 percent) with both species thinning out from their maximum stand in June, 1954. The ryegrass duplicated its performance as when seeded with crown vetch.

CONCLUSIONS

1. Penngift crown vetch with red fescue, Kentucky 31 fescue, and domestic ryegrass will provide excellent cover, with crown vetch taking over as the permanent cover after the second growing season.
2. Under the conditions of the experiment, the domestic ryegrass and crown vetch combination showed the best indication of a permanent crown vetch cover.
3. The value of crown vetch as a permanent cover is demonstrated by its ability to produce a dense cover and a deep root system on poor and droughty raw highway slopes and similar areas.

This is further substantiated by over 100 successful plantings made by the Pennsylvania Department of Highways in the spring of 1948. They are still satisfactory after a six-year period with no additional management since establishment.

4. No evidence was found which indicated that more than the minimum rate of grasses (25 lb.) and crown vetch (20 lb.) are needed for successful stands.

5. It is apparent that birdsfoot trefoil cannot be relied on as a permanent protective cover and has little value for this use on unfertile droughty subsoils.