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Seed and Forage Production in Four Clonal Lines of Alfalfa as Influenced by Lygus Infestation

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SEED AND FORAGE PRODUCTION IN FOUR CLONAL LINES OF ALFALFA AS INFLUENCED BY LYGUS INFESTATION

by

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INTRODUCTION

No other forage crop cultivated in the United States can be used in as many ways as alfalfa. The variety of its uses make it a most useful forage crop.

The distribution of alfalfa is world wide and it plays a leading role in the production of livestock and their products. For general feeding of farm animals, alfalfa is unsurpassed. Used for pasture, it has a high capacity, which leads to large gains in grazing animals. If properly rotated and cared for, it adds nitrogen to the soil in a form that is available to plants and thereby increases crop yields. In addition to these assets, alfalfa is a valuable source of essential nutrients and vitamins for livestock.

With cultivation and practices of intensified farming, insects and diseases have made great strides in establishing themselves in alfalfa, as in other crops. During the period preceeding 1928, Utah was one of the major alfalfa-seed producing states. Immediately following this period seed production declined rapidly. As a result, the Utah Agricultural Experiment Station in the summer of 1930 conducted a preliminary survey in Millard county and the Unitah Basin on various harmful insects inhabiting the alfalfa-seed fields. Lygus bugs were found the most numerous in these fields, with the single exception of thrips during the blossom period of the alfalfa.

Prof. C. J. Sorenson and Dr. J. W. Carlson, from 1930 to 1933, found lygus bug injury to be the essential limiting factor in the production of alfalfa seed. Their control, however, was not found practical until 1944 when DDT was first used experimentally. Its commercial use began in 1946, and seed production in the state began to show marked improvement.

During the three-year period 1943-45, inclusive, prior to the commercial use of DDT, the average per-acre yield of alfalfa seed in Utah was 81 pounds, in comparison with 154 pounds per acre for the three-year period 1946-48, inclusive, after it was used commercially. It is doubtful if more than one-half of the seed growers of the state used DDT for dusting their alfalfa fields during the latter period.

The alfalfa-seed crop ranked fourth in total value among farm crops produced in Utah during 1948 ($3,861,000). It has, therefore, played an important part in the economic welfare of the state. Utah alfalfa seed is also of superior quality. In 1948 Utah seed growers received 7 cents more per pound than the average price paid elsewhere in the United States. (2)

The purpose of the present study has been to determine the effects of lygus infestation on growth and development in four clonal lines of alfalfa differing in fertility levels and their potential capacity in seed and forage production. Data were taken on height of plants, number of racemes produced, development of racemes and buds, stage of flowering, and quality of seed. The significance of the results will be discussed in the order of these headings.

REVIEW OF LITERATURE

In general, a close agreement has been found between seed yields and size of alfalfa plants. Exceptions occur, however, owing largely to factors which affect the growth but little, while at the same time inhibit pollination and seed setting. (6)

Stitt (19) found differences between average growth of the plants in insect-free cages (26.3 inches) and infested cages (15.5 inches) to be a good indication that harmful insects may greatly reduce the growth of alfalfa during the summer months. Sorenson (15) confined lygus bugs on alfalfa plants, and measured the length of stems at various intervals. He found from 8 to 35 per cent reduction in length, as a result of injuries caused by these bugs. Similar cage studies conducted by Shull (14) indicated that if lygus occur in sufficient numbers on growing plants they will so limit the growth as to cause considerable reduction in hay yield. MacLeod and Jeppson (11) also showed that feeding lygus reduced alfalfa hay yields.

Damage to the seed crop caused by the feeding of the tarnished plant bug, Lygus pratensis (Linn) and the superb plant bug, Adelphocoris superbus (Uhler) was reported by Sorenson (16) in 1932. He found considerable flower-drop in alfalfa to result from damage caused by these bugs. In California and Arizona, Stitt (20) found a population of 5.01 to 9.50 lygus bugs per sweep resulted in a loss of 34.91 per cent of the flowers that normally might have formed pods, and 53.89 per cent with populations in excess of 9.50 bugs per stroke of the net. Sorenson (15) reported in 1939, that as the damage of the buds and flowers by lygus bugs was increased, alfalfa seed production was proportionately reduced.

Carlson (8) in 1928, found alfalfa racemes with flowers ranging in number from 17-27 set about 50 per cent more pods than did those having flowers ranging in number from 5 to 16. This is in agreement with the work conducted by Piper (13) et al. (1914). The results are significant in the light of present knowledge concerning the effects of lygus infestation in relation to alfalfa-seed production.

During seed quality studies in Minnesota in 1943, Hughes (10) found that mirid-bug, Adelphocoris lineolatus (Goeze), adults and nymphs feed on young alfalfa-seed pods, especially when there were few buds or blossoms. He observed that the injured pods shriveled, turned brown, and usually dropped to the ground within a few days following injury. Bolton and Peck (3) found a negative correlation coefficient ($r = -.58^{**}$) between seed quality and lygus numbers, which agrees with results reported by Carlson (6) and Sorenson (16).

Varieties of alfalfa differ widely in their ability to flower abundantly with moderate lygus infestation. Of a large number of varieties studied Grimm was found to be the most resistant in preliminary studies made cooperatively by Aamodt and Carlson (1).

METHOD OF STUDY

Description of Experimental Plots

Location. Three sites were selected for the study of seed and forage production in four clonal lines of alfalfa, namely:1/

1. The Forage-crops Farm, Utah Agricultural Experiment Station, south of Logan, Utah.

2. Alfalfa-seed experimental plots located two miles north of Newton, Utah.

3. Alfalfa-seed experimental plots located near Petersboro, Utah.

Flora. Red root, *Amaranthus* spp., and other native weeds were found growing along the ditch banks and waste places at the Forage-crops Farm. Immediately bordering the experimental plots on the east, south and north were irrigated fields of wheat and sugar beets. Irrigated fields of corn and alfalfa occurred on the west.

Teasel, *Dipsacus* spp., sunflowers, *Helianthus annuus*, and other native weeds were found along the ditch banks and waste places at Newton experimental plots. (See fig. 1 p. 10) Field adjacent to these experimental plots were planted to sugar beets that were irrigated periodically. Alfalfa in this vicinity was grown and cut for hay.

In the Petersboro area, gumweed, *Grindelia squarrosa*, ragweed, *Ambrosia elatior*, and other native weeds were found growing along the fence lines. (See fig. 2 p. 10) Some alfalfa grown in this vicinity had been left for seed production.

Fauna. The most injurious insects observed at the Forage-crops Farm were: lygus, *Lygus elisus* (Van Duzee) and *Lygus hesperus* (Knight); pea aphids, *Illinoia pisi*; thrips, *Frankliniella* spp. and *Thrips* spp.; alfalfa weevil *Hypera postica*; and several species of Lepidoptera.

1/ In the text of the paper these locations will be referred to as the Forage-crops Farm, Newton, and Petersboro.

Fig. 1. Experimental plots located two miles north of Newton, Utah. Looking north towards the Newton Reservior.

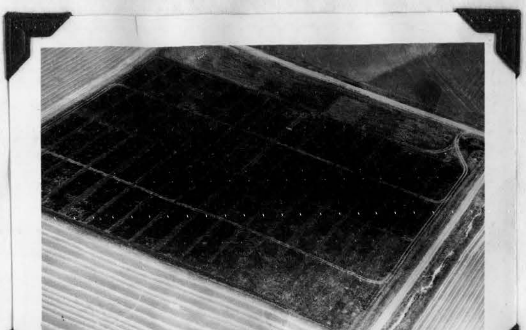

Fig. 2. An aerial photograph of the Petersboro experimental plots. Bordering the experimental plots were large fields of wheat.

Several colonies of honey bees had been placed at the Forage-crops Farm. Leaf-cutting bees, Megachile, and bumble bees, Bombus spp. were also present, but did not become conspicuous in the field until the middle of July. They were then relatively abundant until the middle of August.

Injurious insects observed at the Newton experimental plots were lygus, pea aphids, thrips, grasshoppers, Melanoplus spp., and several species of Coleoptera. These plots were also within the flight range of honey bees in nearby apiaries, consisting of approximately 178 colonies. Leaf-cutting bees and bumble bees were not conspicuous in the field until the middle of August. They remained abundant until the middle of September.

Injurious insects observed at the Petersboro experimental plots were lygus, black and gray blister beetles, Epicauta spp., grasshoppers, pea aphids, thrips, larvae of the alfalfa weevil, and several species of Coleoptera and Lepidoptera. Here, as at the Newton plots, were located apiaries consisting of approximately 285 colonies within flight range of the experimental plots. Bumble bees were relatively abundant from the middle of July to the middle of August, while leaf-cutting bees were not numerous at anytime during the summer.

Size of Plots. The area used for study at the Forage-crops Farm contained 16 plots 6' x 6' in size. The plots were separated by alleyways 6' wide with guard rows established from seed sown in rows 18" from the margins of the plots. Individual plants of each plot were spaced 18" apart. (See fig. 4 p. 12)

The area used at Newton consisted of two acres in a rectangular shape, with the length running north and south and the width east and west. (See fig. 4 p. 12) This was subdivided into 32 plots, each

Fig. 3. Alfalfa experimental plots near Logan, Utah. Cloth cages in the background were used for controlling the drift while dusting. Forage-crops Farm

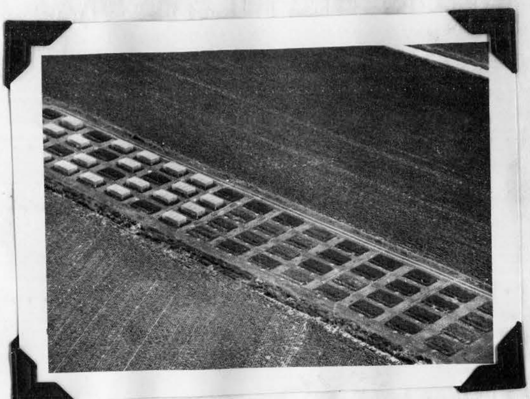

Fig. 4. Alfalfa experimental plots near Newton, Utah. Sugar beet fields border the alfalfa plots. Insect cages used for the control of bees in pollination are shown in the upper one-half of the experimental field.

15' x 20' in size. Four plots occupied the width and eight the length of the field. Each plot contained four clonal lines of alfalfa, randomized within the row and four rows of Ranger alfalfa, each containing 41 plants. These plants were bordered on all sides by two guard rows sown from seed.

The area at Petersboro consisted of ten acres in a rectangular shape, with the length running east and west and the width north and south. (See fig. 2 p. 10) There were 64 individual plots, each one consisting of approximately 1/8 acre. Sixteen plots comprised the width of the field and four the length. Each plot had been sown to Ranger alfalfa.

Replications. Treatments at the Forage-crops Farm were not replicated, while at Newton and Petersboro, they were replicated two times. Both the first and second crop plots were replicated twice at Petersboro.

Buffer Strips. At the Forage-crops Farm cloth cages were used instead of buffer strips to confine the dust on the treated plots. At Newton and Petersboro strips of brome grass were planted between the plots to restrict the movement of the insects as much as possible. These strips served especially well as barriers against the free movement of lygus nymphs.

Method of Planting

Genotypes. Clonal lines from four genotypes of alfalfa were obtained from cuttings made in the greenhouse. The fertility levels and seed production potentials of each are as follows:

G-1 Utah Grimm No. 12, poor seeder, owing to low cross and self-fertility.

G-2 Nebraska No. 1255, highly cross-fertile and a good seeder.

G-3 Utah Ranger No. 7, cross-fertile and a very good seeder.

G-4 Utah Grimm No. 14, highly self-fertile and a fair seeder.

The plants were later transplanted to the experimental plots for special studies of seed setting and production. Each plot at the Forage crops Farm was given 16 plants of each of the four genotypes. A subsidiary portion of each plot at Newton, also contained plants of the four genotypes.

Ranger. The main portion of each plot at Newton, however, included 164 seedling plants of Ranger alfalfa. These were set in four rows 18" apart, with plants 6" apart in the rows. Thus each plot consisted of 4 rows with 41 plants each. At Petersboro stands were limited to the regular seeding of Ranger alfalfa sown at the rate of 4 pounds to the acre.

Guard Rows. One guard row grown from seed was 18" from the margin of each plot at the Forage-crops Farm while two similar rows bordered the Ranger portion and the subsidiary portion of each plot at Newton.

Treatments

Stage of Infestation. Lygus infestation was effected and maintained artificially during approximately two weeks at four stages in the growth and development of the alfalfa, namely, (1) prebud; (2) bud; (3) early-bloom; and (4) late-bloom. Infestation in the prebud stage of development was maintained for two weeks prior to budding, after which the plants were protected by frequent dusting until maturity. Plants infested during the bud-stage of development, were previously exposed to the natural bug population of the area, and after infestation were dusted for protection from further damage until maturity. Plants dusted in the early-bloom stage of development were likewise exposed first to the natural bug population, and then, protected from further damage following two weeks of artificial infestation. A similar sequence of treatments was applied to plants infested in the late-bloom stage of development, except that protection by dusting was withheld until the final stages of growth.

SOURCE OF DATA

Bi-weekly sweepings with the insect net were made to determine the numbers of lygus occurring on various plots. The number of sweepings taken varied with the area of the plots. The data obtained are expressed as the average number of bugs per sweep of the net.

Height measurements were also taken at bi-weekly intervals. Random plants of each genotype were measured and the data are given in inches.

The total number of racemes found on each of the sample plants were counted at the different stages in growth and development. The racemes were classified as normal or damaged; and as "flowering" and "non-flowering".

The number of flowering racemes of the sample plants were recorded three times during the flowering period. Racemes were classified as "flowering racemes", when three-fourths of the potential florets had opened.

Each sample plant was divided into three regions with respect to the stage of flowering, as early, medium, and late. Early flowers comprised the lower one-third of the plant; medium flowers as the middle one-third of the plant; and the late flowers as the upper one-third of the plant. Sixteen pods were taken from each region of flowering and analyzed for seed quality based on normal, shriveled, and discolored seed.

The forage weights were recorded in grams per plant and later converted into tons per acre before calculating the analysis of variance.

Seed quality studies were based on the number of normal and shriveled seed per sample taken from each treatment. Pods from each plant were opened by hand and examined.

RESULTS

The design of the experiment afforded an opportunity for several different phases of study. Emphases, however, were placed on growth and reproductive development in the four clonal lines, as influenced by lygus infestation.

Height in Relation to the Total Number of Racemes per Plant

Significant differences in height and total number of racemes found per plant are shown for the genotypes in tables 1 and 3. The analysis of variance for height and total racemes is given in table 2. This type of analysis was used throughout the investigation. Utah Ranger No. 7 was found to be significantly superior to the others in height and total racemes per plant. This genotype is a high seed and forage producer, as well as highly responsive to insect pollination.

Covariance analyses were made of the total racemes per plant and height, as affected by different levels of infestation. The correlation coefficient (r) at the Newton plots was found to be .48 (127 df), which is statistically significant. A similar correlation coefficient (r) for the Forage-crops Farm was found to be .58 (63 df) which is also statistically significant. High production of flowers was thus found to be associated with the large size of the individual plants. The number of flowering racemes produced varied for the different genotypes as shown in tables 4 and 5. In other words, Utah Ranger No. 7 produced significantly more flowering racemes than the other plants.

Table 1. Average height and average number of racemes per plant of four clonal lines of alfalfa as influenced by intensity of lygus.

(Newton - 1948)

Genotypes	Replications A	B	C	D	Means
Utah Grimm No. 12					
(low fertility & a poor seeder)					
Average height in inches	33	33	33	31	32
Total racemes per plant	132	118	180	162	148
Nebraska No. 1255					
(highly cross fertile & a good seeder)					
Average height in inches	35	34	34	34	34
Total racemes per plant	238	202	184	118	185
Utah Ranger No. 7					
(cross fertile & a very good seeder)					
Average height in inches	37	35	38	37	37
Total racemes per plant	241	230	290	301	265
Utah Grimm No. 14					
(highly self fertile & a fair seeder)					
Average height in inches	35	31	31	33	33
Total racemes per plant	297	227	248	228	225

Least significant difference (L.S.D.)

Average height	
@ .05	2
@ .01	3
Total racemes per plant	
@ .05	15
@ .01	33

	A	B	C	D
Average number of bugs per stroke	.60	1.16	1.20	1.24

Table 2. Analysis of variance of the average height and average number of racemes per plant of four clonal lines of alfalfa as influenced by intensity of lygus.

(Newton - 1948)

Average Height

Source of variation	Degrees of freedom	Sum of squares	Mean square
Levels of infestation	3	31	10
Stages of infestation	3	31	10
Levels x stages	9	79	8.8
Replications	1	3	3
(Total error 1)	15	402	26.9
Genotypes	3	214	71**
Genotypes x levels	9	138	15**
Genotypes x stages	9	97	10.8**
Genotypes x levels x stages	27	773	28.6**
Remainder (Error 2)	48	71	1.5
Total	127	1839	

Racemes per Plant

Source of variation	Degrees of freedom	Sum of squares	Mean square
Levels of infestation	3	630	210
Stages of infestation	3	40841	13613
Levels x stages	9	135718	15079
Replications	1	20939	20939
(Total error 1)	15	833200	55546
Genotypes	3	319305	106435**
Genotypes x levels	9	21372	2375
Genotypes x stages	9	80531	8948**
Genotypes x levels x stages	27	816370	30240**
Remainder (Error 2)	48	117159	2441
Total	127	2386065	

Table 3. Average height and average number of racemes per plant of four clonal lines of alfalfa as influenced by intensity of lygus.

(Forage-crops Farm - 1948)

Genotypes	Replications A	B	C	D	Means
Utah Grimm No. 12					
(low fertility & a poor seeder)					
Average height in inches	25	22	26	28	25
Total racemes per plant	65	68	59	83	69
Nebraska No. 1255					
(highly cross fertile & a good seeder)					
Average height in inches	27	27	27	28	27
Total racemes per plant	98	102	125	92	104
Utah Ranger No. 7					
(cross fertile & a very good seeder)					
Average height in inches	33	32	33	32	32
Total racemes per plant	122	133	88	108	112
Utah Grimm No. 14					
(highly self fertile & a fair seeder)					
Average height in inches	23	20	21	24	22
Total racemes per plant	90	84	64	77	79

L.S.D.	
Average height	
@ .05	4
@ .01	5
Total racemes per plant	
@ .05	20
@ .01	26

	A	B	C	D
Average number of bugs per stroke	.60	.61	.99	1.00

Table 4. Number of flowering racemes per plant on four clonal lines of alfalfa as influenced by lygus infestation.

(Newton - 1948)

Genotypes	Replications A	B	C	D	Means
Utah Grimm No. 12 (low fertility & a poor seeder)					
Flowering racemes per plant	68	64	71	62	66
Nebraska No. 1255 (highly cross fertile & a good seeder)					
Flowering racemes per plant	106	121	99	108	109
Utah Ranger No. 7 (cross fertile & a very good seeder)					
Flowering racemes per plant	136	119	101	111	117
Utah Grimm No. 14 (highly self fertile & a fair seeder)					
Flowering racemes per plant	108	85	98	75	91
L.S.D. @ .05					19
@ .01					34
Average number of bugs per stroke	.60	1.16	1.20	1.24	

Table 5. Number of flowering racemes per plant on four clonal lines of alfalfa as influenced by lygus infestation.

(Forage-crops Farm - 1948)

Genotypes	Replications A	Replications B	Replications C	Replications D	Means
Utah Grimm No. 12					
(low fertility & a poor seeder)					
Flowering racemes per plant	56	59	40	69	56
Nebraska No. 1255					
(highly cross fertile & a good seeder)					
Flowering racemes per plant	68	86	99	67	80
Utah Ranger No. 7					
(cross fertile & a very good seeder)					
Flowering racemes per plant	102	141	87	103	108
Utah Grimm No. 14					
(highly self fertile & a fair seeder)					
Flowering racemes per plant	70	45	69	55	59
L.S.D. @ .05					24
@ .01					34
Average number of bugs per stroke	.60	.61	.99	1.00	

Relation of Forage to Seed Yield

Table 6 shows the amount of seed and forage per acre for each of four genotypes at the Forage-crops Farm. Utah Ranger No. 7 was found to be significantly superior to the others in this respect. The correlation coefficient (r) between random variations in seed and forage production is .92 (36 df), at the Forage-crops Farm and .93 (51 df) for Newton, both of which are significant. Thus a close agreement is shown between seed and forage production in alfalfa, provided the conditions necessary for seed production are favorable.

Quality of Alfalfa Seed as Influenced by Lygus Infestation

A study was made of the quality of alfalfa seed as affected by lygus infestation during different stages of growth and development. Data are given in tables 7 and 8. There appears to be a definite increase in seeds per pod with early protection. The reason is that plants which are protected from lygus infestation through the flowering stages of growth and development function normally, while those that are infested in the bud and bloom stage, produce various abnormal characters as well as a poor quality of seed. (See fig. 5 & 6 p. 26)

Plants that were protected immediately after the prebud stage of infestation to maturity produced significantly more normal seeds than did those which were not protected until a later stage in development. At the Forage-crops Farm there was about the same number of shriveled seeds produced with the various stages of infestation owing to the low level of lygus infestation and the small size of the plots, which made it difficult to control the drift. However, at Petersboro there was a consistent increase in the number of shriveled seeds as the length of the protection

Table 6. Seed and forage production in relation to four genotypes differing in fertility and seed production potentials.

(Forage-crops Farm - 1948)

Stage of Infestation	Replication	Seed in pounds per acre G-1	G-2	G-3	G-4	Forage in tons per acre G-1	G-2	G-3	G-4	Means Seed	Means Forage
Prebud											
	A	128	535	985	321	1.30	2.08	4.13	2.01	492	2.38
	B	171	706	771	450	1.65	2.76	3.00	2.55	524	2.49
	C	171	514	578	300	2.01	2.10	3.19	1.78	391	2.27
	D	192	706	557	621	1.93	2.82	2.10	3.12	519	2.49
		165	615	722	423	1.72	2.44	3.10	2.36	481	2.41
Bud stage											
	A	171	642	707	86	1.63	2.23	2.79	.92	401	1.89
	B	107	792	899	150	1.31	2.87	3.00	1.43	487	2.15
	C	192	749	557	278	1.78	3.38	2.40	1.95	444	2.38
	D	107	792	707	321	1.41	3.10	2.95	2.05	482	2.38
		144	744	717	209	1.53	2.89	2.78	1.59	453	2.20
Early bloom											
	A	214	578	528	478	2.03	2.27	2.23	1.90	474	2.11
	B	171	749	885	64	2.48	2.95	4.15	1.22	467	2.70
	C	86	428	771	236	2.10	4.34	3.74	2.40	380	3.14
	D	64	492	814	236	1.48	1.84	3.49	2.38	408	2.30
		134	562	749	281	2.02	2.85	3.40	1.98	432	2.56
Late bloom											
	A	214	749	1071	171	2.10	3.21	4.07	1.56	551	2.73
	B	107	599	749	64	1.46	3.60	3.12	.92	380	2.27
	C	86	856	685	214	1.37	3.96	3.32	1.52	460	2.54
	D	107	557	343	471	1.50	2.89	1.57	2.57	369	2.16
		128	690	712	230	1.61	3.40	3.02	1.64	440	2.42
General means		143	563	725	285	1.72	2.90	3.08	1.89	451	2.40
L.S.D. @ .05		125				.45				n.s.	n.s.
@ .01		166				.60					

Correlation coefficient for the error line in the analysis of variance:
Total between seed x forage r = .92

Table 7. Quality of alfalfa seed as influenced by lygus infestation in various stages of growth and development.1/

(Forage-crops Farm - 1948)

Stage of infestation*	Seeds per 50 pods: Normal	Discolored	Shriveled	Per cent Normal Seed
Prebud	237	1.8	3.7	97.7
Bud stage	195	3.4	5.9	95.4
Early bloom	204	4.8	8.0	94.1
Late bloom	197	5.4	6.4	93.9
Means	208	3.9	6.0	
L.S.D. @ .05	16	n.s.	n.s.	
@ .01	23			

1/ Each value is the mean of 48 determinations

* Plots were protected to maturity immediately after the stage of infestation

Table 8. Quality of alfalfa seed as influenced by lygus infestation in various stages of growth and development.1/

(Petersboro - 1948)

Stage of Infestation*	Seeds per gram: Normal	Seeds per gram: Shriveled	Per cent Normal Seed
Prebud	317	41	88.5
Bud stage	306	41	88.1
Early bloom	266	50	84.1
Late bloom	259	73	78.1
Means	287	51	
L.S.D. @ .05	22	11	
@ .01	30	15	

1/ Each value is the mean of 16 determinations

* Plots were protected to maturity immediately after the stage of infestation

Fig. 5. A plant of Utah Ranger No. 7 that was protected during the flowering stages of growth and development

Fig. 6. Plants of Utah Ranger No. 7 infested with lygus during the flowering stages of growth and development

period was shortened. These results at Petersboro are in accordance with previous findings by Carlson (7) and Sorenson (16).

Stage of Flowering and Seed Quality

The relation of stage of flowering to the quality of alfalfa seed is shown in table 9. Early-season flowers appear to be superior to those forming later in the production of normal seeds. The results show no difference, however, between the stage of flowering and the discolored and shriveled seed. Although late-season flowers may often produce a substantial quantity of seed, early frosts, as a rule, frequently destroy a major portion of the expected crop.

Cage studies made by Shull, Rice and Cline (19), showed that injury to alfalfa flowers by *Lygus hesperus* (Knight) prevented their normal development and subsequent setting of seed. Their results are thus confirmed in the present study.

Relation of Seed Quality to Different Genotypes of Alfalfa

The quality of seed was not influenced significantly by the dusting treatments imposed in this study, but variations occurred, owing to differences in the genotype of the plants, as shown in tables 10 and 11. Utah Ranger No. 7 is superior to the others in the production of high quality seed. This plant proved to be highly productive, with seed of good quality and color. In conducting this study, the writer has observed many characters that can be used to distinguish plants of one genotype from another. The color of the seed of Utah Grimm No. 12 and Utah Ranger No. 7 are especially distinctive. Utah Ranger No. 7 has a very small yellow seed as compared to Utah Grimm No. 12, which has a large dark green seed. (See fig. 7 p. 31)

Table 9. The quality of alfalfa seed as influenced by early, late and medium stages of flowering.1/

(Forage-crops Farm - 1948)

Stage of flowering	Seeds per 50 pods: Normal	Discolored	Shriveled	Per cent Normal Seed
Early-season flowers	219	4.5	6.3	95.3
Mid-season flowers	205	4.2	5.9	95.3
Late-season flowers	201	3.1	5.8	95.7
Means	208	3.9	6.0	
L.S.D. @ .05	11	n.s.	n.s.	
@ .01	14			

1/ Each value is the mean of 48 determinations

Table 10. Quality of seed in relation to four clonal lines of alfalfa.1/

(Newton - 1948)

Genotypes	Avg. number of seeds per pod: Normal	Avg. number of seeds per pod: Shriveled	Per cent Normal Seed
Utah Grimm No. 12 (low fertility & a poor seeder)	3.0	2.0	60.0
Nebraska No. 1255 (highly cross fertile & a good seeder)	4.5	4.5	50.0
Utah Ranger No. 7 (cross fertile & a very good seeder)	6.2	3.0	67.3
Utah Grimm No. 14 (highly self fertile & a fair seeder)	4.7	3.5	57.3
Means	4.6	3.2	
L.S.D. @ .05	n.s.	n.s.	
@ .01			

1/ All values are the means of 32 determinations

Table 11. Quality of seed in relation to four clonal lines of alfalfa.1/

(Forage-crops Farm - 1948)

Genotypes	Seeds per 50 pods: Normal	Seeds per 50 pods: Discolored	Seeds per 50 pods: Shriveled	Per cent Normal Seed
Utah Grimm No. 12 (low fertility & a poor seeder)	92	2.0	3.8	94.0
Nebraska No. 1255 (highly cross fertile & a good seeder)	278	3.1	6.1	96.9
Utah Ranger No. 7 (cross fertile & a very good seeder)	257	3.5	5.1	96.6
Utah Grimm No. 14 (highly self fertile & a fair seeder)	205	6.9	8.9	92.7
Means	208	3.9	6.0	
L.S.D. @ .05	29	n.s.	1.8	
@ .01	39		2.5	

1/ All values are the means of 48 determinations

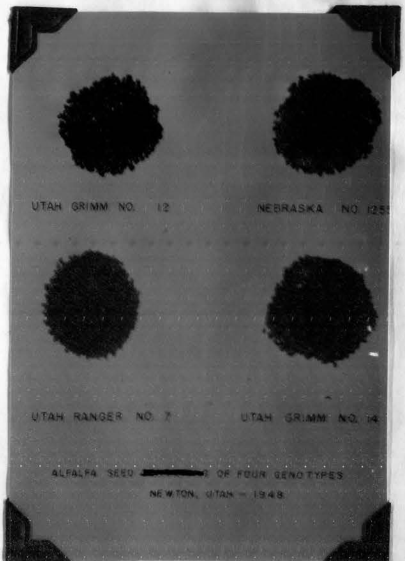

Fig. 7. Alfalfa seed of four genotypes

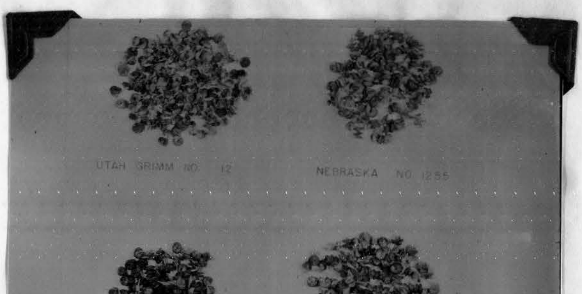

Fig. 8. Alfalfa pods of four genotypes

The following weights in grams per hundred seeds were obtained: Utah Grimm No. 12, .30 gram; Nebraska No. 1255, .22 gram; Utah Ranger No. 7, .15 gram and Utah Grimm No. 14, .20 gram. Crandall (9) found in his studies of clonal lines in Nebraska, the following weights in grams per hundred seeds: Nebraska No. 1255, .18 gram and Utah Ranger No. 7, .12 gram, thus indicating a consistent genetic difference between individual genotypes in relation to seed size.

Pods of different plants may also be used for identification. Those of Nebraska No. 1255 are lighter in color then those of the others studied. Pods of Utah Ranger No. 7 are very small and black; and, therefore, can be easily distinguished from those of other plants. (See fig. 8 p. 31)

CONCLUSION

Studies on the Forage-crops Farm and Newton plots, show that height in alfalfa, although affected adversely by lygus infestation, is influenced by the genetic composition of the plant. The results also show, that there is a tendency for height to be positively associated with the total number of racemes and vice versa.

The quality of alfalfa seed was found only slightly affected by lygus infestation during different stages of growth, although it was not found practical to maintain the desired levels which, no doubt, would have produced an effect.

In view of its seed size, germination, and other desirable characters possessed, it appears that Utah Ranger No. 7 is significantly superior to other clonal lines used in this investigation.

The data from this research are probably inadequate to show conclusively the importance of the genetic composition of alfalfa plants in relation to seed production. Further investigations should be made with reference to breeding for increased seed production.

SUMMARY

1. In an attempt to find the effects of lygus on vegetative growth and reproductive development of alfalfa, investigations were made at Petersboro, Forage-crops Farm, and Newton, Utah, during the 1948 season.

2. Results of these investigations indicate that height in alfalfa, although affected adversely by lygus infestation, is largely influenced by the genetic composition of the plant.

3. The tendency for more racemes to be associated with taller plants is shown by a significant correlation between these characters.

4. The number of flowering racemes produced was found to vary with the genotype.

5. There was a pronounced tendency for seed and forage productivity to be positively associated, as shown by correlations of 0.92 and 0.93 at two different locations between the characters.

6. The quality of alfalfa seed was only slightly affected by variations in lygus infestation during the different stages of growth, although the desired levels of infestation were not practical to maintain.

7. Early-season flowers appear to be superior to those forming later in the production of normal seeds. The results, however, show no difference between the stage of flowering and the discolored and shriveled seed.

8. In view of its seed size, germination, and other desirable characters possessed, it appears that Utah Ranger No. 7 is significantly superior to other clonal lines used in this investigation.

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