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Seed Treatment of Forage Grasses and Small-Seeded Legumes in Idaho

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Conclusions from the study

BASED on the data presented in this bulletin, it appears that a general improvement in stand cannot be expected when the seed of Manchar smooth brome, Alta fescue, Ranger alfalfa, Kenland red clover, and Ladino clover seed, of either high or low germination levels, is treated with Spergon, Arasan, or New Improved Ceresan at either 8 ounces of material per bushel or per hundredweight of seed.

The data show that treating seed of low germinating ability is no more beneficial than treating seed of high germinating ability.

In some districts of the state, growers are experiencing difficulty in reestablishing stands of legumes. The fact that treating seed, as indicated by the data presented, did not increase stands would indicate that such a practice is not the answer in overcoming this dilemma of the growers.

In a few isolated cases, phenomenal increases in stand, on a percentage basis, were secured. However, such cases were not significant under the conditions of the tests.

The data secured at Moscow indicate that the conditions governing the germination of the seed at this station are different than those at other stations, in that there was evidence that treating the seed was somewhat beneficial. The seed at Moscow was planted in the Plant Pathology plots. These plots have been used for a number of years in studying plant disease problems. It is, therefore, conceivable that the soil flora of the plots is more concentrated and complex than that in the soils of the other stations.

Unusually low stands were secured at Sandpoint with the legumes, with both treated and untreated seed.

Applying New Improved Ceresan at the rate of 8 ounces per bushel of seed to either Manchar smooth brome or Alta fescue was injurious, in that stands from treated seed of these two species were consistently lower than stands from untreated seed of the same species. The seed of Ranger alfalfa, Kenland red clover, or Ladino clover was not injured by the same material applied at the same rate.

Seed Treatment of Forage Grasses and Small-Seeded Legumes in Idaho

J. M. RAEDER*

MANY inquiries have been received from growers throughout the state concerning the effect of seed treatment on subsequent stands and yields of forage grasses and small-seeded legumes. Articles in farm journals, based on the experience of growers and research workers in other states, have focused the interest of Idaho growers on this problem. The advertisements of manufacturers have likewise stimulated this interest. Realizing the inadvisability of making recommendations to Idaho growers on the experiences of others, particularly when their soil and climatic conditions are far different from the environmental factors in Idaho, a project was set up to study this problem in Idaho. The results herein reported are based on a two years' study.

LITERATURE

The response obtained by various workers in treating forage crop seeds, both grass and legume, with various fungicides has been varied. In some cases significant increases in stand have been obtained. In other cases no beneficial effects have been noted. Consistency seemed to be lacking in all cases. Chilton and Garber (2) in 1941, using 17 species of forage legumes seeded in flats of unsterilized field soil and treated with 5 different fungicides, obtained inconsistent results. Depending upon species and fungicides used, Kreitlow (6) showed increases of stand with some species of legumes and no beneficial results with others. Allison and Torrie (1) reported that when grown in compost contained in flats in the greenhouse, significant increases in stand were obtained with alfalfa, sweet clover, red clover, alsike clover, strawberry clover, and ladino clover seed treated with New Improved Ceresan, Spergon, and Arasan. On the other hand, no significant results were obtained when seed of the same species, treated with the same materials was planted in woods humus contained in flats, in the greenhouse, nor when grown under field conditions.

Vlitos and Preston (9) state that alfalfa seed treated with Phygon at dosages of 1.00, 0.50 and 0.25 per cent by weight of seed gave highly significant increases in germination as compared with germination of untreated seed of the same species. Kreitlow, *et al,* (7) treated alfalfa, red clover, and Sudan grass seed with New Improved Ceresan, Semesan, Spergon, Arasan, and Yellow Cuprocide for the control of damping-off. In the greenhouse, all fungicides protected the seedlings in *Pythium* infested soil. Under field conditions, seed of Sudan grass treated with Spergon, Arasan, or Semesan, and seeded in either Pennsylvania, New York, Rhode

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Island, or New Jersey during a 3-year period, yielded the highest average stands. It was not stated whether the increases were significant. Results with both alfalfa and red clover were not consistent. Gerdemann (3) reported on the effect on stand of seed of alfalfa, red clover, and sweet clover, treated with three rates of Arasan, Ceresan M and Phygon in both wet and dry soils. Here again, no consistent results were obtained. Alfalfa and red clover were neither benefited nor injured by most treatments. One percent Ceresan M caused injury to seedlings in wet and dry soil in greenhouse, and one per cent Phygon reduced emergence in the field under drought conditions. Sweet clover emergence was increased by treatment with Arasan and lower rates of Ceresan M, in the greenhouse, but another seed lot was not benefited by any seed treatment. Kernkamp (5) studied the effect of treating the seed of alfalfa, red clover, and sweet clover with Spergon, Spergon W, Arasan, Arasan SF, Phygon, Phygon XL, Phygon Paste, Tersan, Parzate, Fermate, and Dow 9B. Spergon and Arasan were best. The remaining materials were unsatisfactory. He states that the response of the seeds of these legumes to treatments is a function of environmental factors and seed quality. In environments unfavorable for germination or with seed of poor quality, there was great response to seed treatment, whereas with excellent seed and unfavorable environments there was no response. Averages of all treated lots of alfalfa and red clover were significantly better than average of controls. Results with sweet clover were erratic.

In greenhouse trials, Weber (10) in an attempt to control damping-off of alfalfa in flats caused by *Colletotrichum trifolii* and *Rhizoctonia solani*, found that treating the seed of Buffalo alfalfa with either Arasan, Dow 9B, Phygon XL, or Spergon, applied at two rates, were all ineffective against post-emergence damping-off. Pre-emergence damping-off caused by one strain of *Rhizoctonia* was not prevented by any seed treatment, but when the soil was infested with a mixture of two strains of *Rhizoctonia* and *Rhizoctonia solani*, all seed treatments significantly increased total emergence and stand. Hansen (4) produced no significant increases in stand under field conditions when he treated seed of alfalfa, red clover, and sweet clover, and seeded it in Almena silt loam, Miami silt loam, Omega loamy sand, or Plainfield sand in Wisconsin. Significant increases in stands were secured, however, when the seed of the same species were treated with the same materials and planted in Carlisle muck. Tyler, *et al.* (8) in New York secured no significant increases in stand nor yields with seed of alfalfa, red clover, birds-foot trefoil, smooth brome grass, orchard grass, Sudan grass, and timothy, treated with Arasan or Phygon.

MATERIALS AND METHODS

Idaho has a wide variety of ecologic conditions. Farming is conducted on glaciated, alluvial, and wind deposited soils which have developed under coniferious forests, prairie grasses, or sage-

brush-grass combinations, and at elevations varying from 750 feet to over 6,000 feet with annual precipitation varying from less than 10 inches to approximately 30 inches. Irrigation is resorted to in areas of low precipitation.

Agricultural Branch Experiment Stations are located throughout the state to accommodate the above mentioned conditions. In this study, plots were established in 1952 and 1953 at five of these stations, strategically located throughout the state. The stations involved, together with the soil and climatic conditions of each respective station, are listed in Table 1.

Table 1. List of Branch Agricultural Stations at which plots were located in 1952 and 1953, showing ecologic data pertaining to each station.

Station	Elevation	Average annual precipitation	Soil type and history
Sandpoint	2100	29.83	Mission silt loam; glacier deposited, developed under coniferous forest.
Moscow	2564	21.91	Palouse silt loam; wind deposited; developed under prairie grasses.
Parma	2224	-9.00	Greenleaf silt loam; alluvial deposited, developed under dry sagebrush-grass, irrigated.
Aberdeen	4400	8.56	Declo silt loam; alluvial deposited, developed under dry sagebrush-grass, but slightly more effective climate for soil development and plant growth than Parma, irrigated.
Tetonia	6200	12.96	Tetonia silt loam; wind deposited, developed under sagebrush-grass, but much more effective climate for soil development and plant growth than Aberdeen.

Five species of forage crops were used in the tests: Manchar smooth brome, Alta fescue, Ranger alfalfa, Kenland red clover, and Ladino clover. Seed of each species, with two levels of germination for each years' plantings, were secured from the State Seed Laboratory, where the levels of germination had been determined. In Table 2 can be found the germination percentages of the respective forages used.

Spergon (tetra chloro-para-benzoquinone), Arasan (tetra methylthiuram disulfide) and New Improved Ceresan (ethyl mercury phosphate) were applied at the rate of 8 ounces per bushel of seed in 1952. This was an error as it was intended to apply the material at the rate of 8 ounces per 100 pounds of seed. The data secured indicates this amount of Ceresan had a depressing effect on the germination of seed of both brome and fescue. Eight ounces of each fungicide per 100 pounds of seed was applied in 1953.

A planting sample consisted of approximately 200 seeds and was secured in the following manner: A 200-seed sample of each species of the untreated and treated seed was first counted out. The planting samples were then secured by counter-balancing against the counted samples. Subsequent sample counts, to test

the accuracy of the method, showed the planting sample to be composed of 200 seeds ±2.

At Sandpoint, Moscow, and Tetonia, the plots were planted in a randomized split plot, Latin square pattern, wherein the species were arranged in a Latin square and the sub plots or treatments randomized within the species plot. The amount of soil moisture, for germination and growth, depended upon natural precipitation at these stations. At Parma and Aberdeen, where irrigation was practiced, the main plots were aligned in a row to facilitate irrigation. Five replications were planted at each station. Each replication for each species at all stations consisted of the following treatments:

1. Check—high germination
2. Spergon—high germination
3. Spergon—low germination
4. Check—low germination
5. Arasan—high germination
6. Arasan—low germination
7. N. I. Ceresan—high germination
8. N. I. Ceresan—low germination

Table 2. Germination percentages of forages used in tests in 1952 and 1953, to study effect of seed treatments upon subsequent stand.

Species	Year	Level of germinaiton	Germination response			
			% Germination	% Hard Seed	% Abnormal	% Dead
Mancher Smooth Brome	1952	High	94.00			
		Low	63.25			
	1953	High	93.50		2.25	4.25
		Low	69.50		3.25	27.25
Alta Fescue	1952	High	96.50			
		Low	71.75			
	1953	High	97.00		1.25	1.75
		Low	63.75		.75	35.50
Ranger Alfalfa	1952	High	58.50	35.75	4.00	1.75
		Low	52.25	11.15	15.00	21.00
	1953	High	63.75	30.25	4.25	1.75
		Low	53.00	16.50	16.00	14.50
Kenland Red Clover	1952	High	77.50	15.25	6.00	1.25
		Low	58.50	3.50	35.25	2.75
	1953	High	61.25	36.50	1.75	.50
		Low	52.50	11.00	19.50	17.00
Ladino Clover	1952	High	69.75	20.50		
		Low	63.25	9.75	24.25	2.75
	1953	High	63.00	34.75	2.25	0.00
		Low	61.75	20.00	12.00	6.25

Each 200-seed sample was seeded in an 8-foot row, either by hand or with the aid of an endless belt seeder. The plants were dug, counts were made, and total number of plants for each treat-

ment recorded. The counts were transposed to logarithms, and the logarithms were analyzed by the analysis of variance.

RESULTS

The data indicate that New Improved Ceresan applied at the rate of 8 ounces per bushel of seed was detrimental to germination of brome and fescue as reflected in the germination of the seed of the two grasses in 1952. This marked reduction in stand in 1952 undoubtedly accounts for the highly significant F values of the data pertaining to these two forages. It should be noted that the stand of the seed of the two grasses treated in 1952 with New Improved Ceresan was very low. This deleterious effect was not apparent in 1953, when the rate of application was at the rate of 8 ounces per hundred pounds of seed. The data in Tables 5, 6, and 7 show that applying New Improved Ceresan at the rate of 8 ounces per bushel of seed of the three legumes did not reduce germination with these forages as it did with the two grasses.

Table 3 contains data pertaining to Manchar smooth brome grass seed, treated with Spergon, Arasan, and New Improved Ceresan in 1952 and 1953 and grown at Sandpoint, Moscow, Parma,

Table 3. Combined average stands of Manchar smooth brome grass seed, of high and low germination levels, treated with Spergon, Arasan and New Improved Ceresan, in 1952 and 1953 at five stations in Idaho.

Station	Treatment	Average stands (1) High germ 52 & 53	Low germ 52 & 53	High & low 1952	High & low 1953	F values Log basis	Count basis
Sandpoint	Check	102.6	61.0	64.6	99.0		
	Spergon	95.3	60.5	65.4	90.4		
	Arasan	96.2	60.9	60.6	96.5	107.96xxx	21.59xxx
	N. I. Ceresan	63.5xxx	38.1xxx	3.4xxx	98.2		
19:1	L.S.D.	15.77	12.00	12.71	15.19		
Moscow	Check	119.3	70.5	74.7	115.1		
	Spergon	119.6	82.8xxx	87.2xxx	115.2		
	Arasan	121.4	86.5xxx	82.3	125.6xxx	65.00xxx	37.73xxx
	N. I. Ceresan	79.1xxx	57.0xxx	22.1xxx	114.0		
19:1	L.S.D.	9.03	12.24	11.71	9.69		
Parma	Check	71.8(2)	44.0(2)		57.9		
	Spergon	83.4(2)	49.6(2)		66.5		
	Arasan	87.2(2)	54.4(2)		70.8	.89	
	N. I. Ceresan	77.0(2)	46.4(2)		61.7		
19:1	L.S.D.	18.67	19.28		13.25		
Aberdeen	Check	73.9	42.6	36.9	79.6		
	Spergon	64.2	43.9	36.8	71.3		
	Arasan	61.9	45.1	28.6	78.4	15.41xxx	3.45xxx
	N. I. Ceresan	54.1xxx	31.4	5.7xxx	80.1		
19:1	L.S.D.	11.80	15.08	11.09	15.61		
Tetonia	Check	119.0	82.3	94.9	106.4		
	Spergon	118.3	80.7	98.8	100.2		
	Arasan	122.5	91.9	101.8	112.6	177.17xxx	102.94xxx
	N. I. Ceresan	56.3xxx	41.7xxx	8.1xxx	89.9xxx		
19:1	L.S.D.	12.55	10.01	10.69	12.41		

(1) Average of five replications each year at each station.
(2) 1953 Stands only.

xxx Highly Significant.
xx Significant at 5%.

Aberdeen, and Tetonia. An examination of these data will disclose the fact that in only four cases was there a significant increase in stand of the treated seed over the untreated check based on L.S.D. values. All of these occurred at Moscow: two cases pertained to seed of low germination treated with either Spergon or Arasan for 1952 and 1953; one with high and low germinating seed treated with Spergon in 1952; and the fourth case concerned seed of high and low germination treated with Arasan in 1953. On a percentage basis, some outstanding increases in stand were secured. An increase of 23.6 percent over the check was secured in the case of the combined averages of low germinating seed treated with Arasan for 1952 and 1953 at Parma. If such gains were consistent throughout, one might be inclined to look with favor upon the matter of seed treatment, in spite of the fact that such increases were not significant under the conditions of the test.

The data in Table 4 concern Alta fescue grass seed of high and low germination levels treated with Spergon, Arasan, and New Improved Ceresan, and grown at Sandpoint, Moscow, Parma, Aberdeen, and Tetonia in 1952 and 1953. Here again, applying New Improved Ceresan at the rate of 8 ounces of the material per bushel of seed reduced the stand of the treated seed. F and L.S.D. values show these reductions to be highly significant. An inspection of

Table 4. Combined average stands of Alta fescue grass seed, of high and low germination levels, treated with Spergon, Arasan and New Improved Ceresan, in 1952 and 1953, at five stations in Idaho.

Station	Treatment	Average stands (1)				F values	
		High germ 52 & 53	Low germ 52 & 53	High & low 1952	High & low 1953	Log basis	Count basis
Sandpoint	Check	103.6	66.6	64.6	105.6	97.61xxx	16.89xxx
	Spergon	114.7	56.1	63.5	107.3		
	Arasan	103.3	61.1	57.2	107.2		
	N. I. Ceresan	65.9xxx	48.1xxx	3.9xxx	110.1		
19:1	L.S.D.	16.87	12.48	14.41	15.25		
Moscow	Check	128.2	64.0	93.7	98.5	117.88xxx	55.24xxx
	Spergon	127.9	71.7	93.8	105.8		
	Arasan	122.3	67.8	89.0	101.1		
	N. I. Ceresan	73.6xxx	45.6xxx	22.6xxx	96.6		
19:1	L.S.D.	11.27	8.14	9.56	10.09		
Parma	Check	127.4	74.0	111.4	90.0	14.01xxx	23.87xxx
	Spergon	120.7	68.4	89.2xxx	99.9		
	Arasan	118.8	73.6	105.7	86.7		
	N. I. Ceresan	80.0xxx	50.5xxx	44.5xxx	86.0		
19:1	L.S.D.	16.65	12.72	16.01	12.04		
Aberdeen	Check	60.0	36.4	29.0	67.4	43.67xxx	8.05xxx
	Spergon	76.6xxx	38.0	29.3	85.3		
	Arasan	72.8	40.2	28.8	84.2		
	N. I. Ceresan	48.6xxx	26.8	3.8xxx	71.6		
19:1	L.S.D.	144.62	13.63	8.66	18.02		
Tetonia	Check	145.5	74.8	114.6	105.7	157.21xxx	158.79xxx
	Spergon	142.1	76.3	112.0	106.4		
	Arasan	139.2	77.1	107.0	109.3		
	N. I. Ceresan	65.3xxx	33.8xxx	12.1xxx	86.5xxx		
19:1	L.S.D.	11.01	9.15	9.58	10.64		

(1) Average of five replications each year at each station.
xxx Highly significant.

the data in Table 4 discloses the fact that there are no cases where increases in stand occurred, due to treatment, where such increases were significant. In one case a 26.5 percent increase was obtained; still this increase was not significant. This occurred in the case of seed of high and low germination treated with Spergon at Aberdeen in 1953. This was but a single isolated case.

In Table 5 can be found the data pertaining to Ranger alfalfa seed. Out of a possible 60 cases in which significant increases in stand might have been expected, due to treatment, significant increases did occur in 15 of these based on L.S.D. values. Seven of the cases occurred at Moscow, one at Sandpoint, three at Parma, and two each at Aberdeen and Tetonia. Only at Moscow did F values show highly significant increases in stand, due to treatment.

An examination of the data will show that in a few cases rather high increases in stand on a percentage basis were secured. For example, a 48.7 percent increase was obtained at Aberdeen with high and low germinating seed treated with Arasan in 1952 and a 37.5 percent increase with high and low germinating seed treated with New Improved Ceresan at Sandpoint in 1953. In neither of these cases were the increases significant when based on F or L.S.D. values.

Table 5. Combined average stands of Ranger alfalfa seed, of high and log germination levels, treated with Spergon, Arasan and New Improved Ceresan, in 1952 and 1953, at five stations in Idaho.

Station	Treatment	Average stands (1)				F values	
		High germ 52 & 53	Low germ 52 & 53	High & low 1952	High & low 1953	Log basis	Count basis
	Check	33.9	8.6	11.6	30.9		
	Spergon	25.9	12.7	9.4	29.2		
Sandpoint	Arasan	34.7	9.5	8.3	35.9	1.01	.99
	N. I. Ceresan	36.4	15.1xxx	9.0	42.5		
19:1	L.S.D.	13.90	6.36	2.92	15.26		
	Check	90.7	46.0	83.0	53.7		
	Spergon	111.8xxx	64.0xxx	110.1xxx	65.7		
Moscow	Arasan	104.5	73.0xxx	110.5xxx	67.0	8.09xxx	9.94xxx
	N. I. Ceresan	88.4	66.3xxx	97.9xxx	57.3		
19:1	L.S.D.	15.65	10.49	12.54	14.07		
	Check	85.5	51.3	101.4	35.4		
	Spergon	88.0	60.6	106.5	42.1		
Parma	Arasan	100.2xxx	56.4	114.4	42.2	2.63	3.31xx
	N. I. Ceresan	101.2xxx	63.2	120.8xxx	43.6		
19:1	L.S.D.	14.1	13.32	16.91	11.33		
	Check	78.1	47.4	27.5	98.0		
	Spergon	93.9xxx	53.9	46.4xxx	101.4		
Aberdeen	Arasan	82.5	55.4	40.9	97.0	2.24	2.67
	N. I. Cereasn	77.7	42 8	30.0	90.3		
19:1	L.S.D.	15.43	14.51	17.67	10.99		
	Check	108.6	67.4	106.9	69.1		
	Spergon	124.8xxx	60.4	112.3	72.9		
Tetonia	Arasan	121.5xxx	65.1	114.0	72.6	1.86	1.46
	N. I. Ceresan	115.4	81.5	119.2	77.7		
19:1	L.S.D.	11.76	19.78	21.16	8.98		

(1) Average of five replications each year at each station.
xxx Highly significant.
xx Significant at 5%.

In only one case was a significant increase in stand secured by treating Kenland red clover seed based on L.S.D. values. This occurred with low germinating seed for 1952 and 1953 at Moscow when the seed was treated with New Improved Ceresan. The greatest increase in stand, on a percentage basis, occurred in the case of high and low germinating seed in 1953, treated with Arasan at Parma. The data shows that this increase amounted to 24.7 percent, but still the increase was not significant. It is interesting to compare the percentage increase in this particular case with the percentage increase in the only case, concerning red clover, where there was a significant increase in stand, namely the case enumerated above. In this instance the percentage increase was 18.8 percent. These data can be found in Table 6.

Table 6. Combined average stands of Kenland Red Clover seed, of high and low germination levels, treated with Spergon, Arasan and New Improved Ceresan, in 1952 and 1953, at five stations in Idaho.

Station	Treatment	Average stands (1)				F values	
		High germ 52 & 53	Low germ 52 & 53	High & low 1952	High & low 1953	Log basis	Count basis
	Check	33.7	19.2	13.2	39.7		
	Spergon	31.8	19.2	15.8	35.2		
Sandpoint	Arasan	42.7	21.0	14.7	49.0	.49	1.09
	N. I. Ceresan	40.3	14.9	14.2	41.0		
19:1	L.S.D.	12.70	7.32	5.18	13.72		
	Check	102.9	58.9	93.4	68.4		
	Spergon	96.1	58.6	88.0	66.7		
Moscow	Arasan	110.5	55.7	100.6	65.6	2.33	2.52
	N. I. Ceresan	110.1	70.0xxx	105.4	74.7		
19:1	L.S.D.	16.46	10.30	14.68	12.71		
	Check	100.0	57.0	102.4	54.6		
	Spergon	98.4	66.5	103.9	61.0		
Parma	Arasan	107.0	66.2	105.1	68.1	2.26	1.06
	N. I. Ceresan	98.7	63.3	107.1	54.9		
19:1	L.S.D.	19.26	10.11	16.53	14.14		
	Check	73.2	52.6	43.4	82.4		
	Spergon	69.9	50.0	37.4	82.5		
Aberdeen	Arasan	78.4	54.4	49.2	83.6	.22	.57
	N. I. Ceresan	83.5	47.5	48 8	82.2		
19:1	L.S.D.	15.88	12.32	16.72	13.12		
	Check	117.9	56.3	103.0	71.2		
	Spergon	113.6	64.4	103.3	74.7		
Tetonia	Arasan	118.5	65.6	107.9	76.2	.36	.22
	N. I. Ceresan	110.5	66.1	103.3	68.5		
19:1	L.S.D.	21.07	17.76	22.81	15.46		

(1) Average of five replications each year at each station.
xxx Highly significant.

In no case was there a significant increase in stand of treated Ladino clover seed as shown by L.S.D. values. F values indicated that there were some significant differences in stand at the 5 percent point at Moscow. An examination of Table 7 shows, however, that these differences were generally negative rather than positive. A rather phenomenal increase in stand was secured in one case at Tetonia, on a percentage basis. This occurred with high and low germinating seed treated with Spergon in 1952, resulting in a 71 percent increase in stand.

Table 7. Combined average stands of Ladino clover seed of high and low germination levels, treated with Spergon, Arasan, and New Improved Ceresan, in 1952 and 1953, at five stations in Idaho.

Station	Treatment	Average stands (1)				F values	
		High germ 52 & 53	Low germ 52 & 53	High & low 1952	High & low 1953	Log basis	Count basis
Sandpoint	Check	24.5	23.5	23.1	24.9	1.20	.64
	Spergon	27.1	24.6	30.2	21.5		
	Arasan	25.6	17.2	20.8	22.0		
	N. I. Ceresan	25.2	21.9	24.0	23.1		
19:1	L.S.D.	9.44	10.36	7.98	11.52		
Moscow	Check	52.3	43.7	53.4	42.6	2.86xx	3.03xx
	Spergon	44.6	38.4	45.8	37.2		
	Arasan	57.7	50.2	61.5	46.4		
	N. I. Ceresan	48.6	41.6	51.5	38.7		
19:1	L.S.D.	14.78	11.07	13.23	12.86		
Parma	Check	60.1	49.6	80.9	28.8	.77	1.34
	Spergon	44.5	47.6	62.3	29.8		
	Arasan	54.6	51.3	76.0	29.9		
	N. I. Ceresan	54.6	46.0	71.4	29.2		
19:1	L.S.D.	10.98	16.12	16.95	9.66		
Aberdeen	Check	31.8	25.3	11.5	45.6	.17	.98
	Spergon	27.7	34.2	12.0	49.9		
	Arasan	36.7	32.4	17.2	51.9		
	N. I. Ceresan	27.7	27.5	11.6	43.6		
19:1	L.S.D.	11.24	14.34	7.85	18.09		
Tetonia	Check	36.8	28.3	35.2	29.9	1.31	1.98
	Spergon	48.9	43.2	60.2	31.9		
	Arasan	29.8	22.8	22.4	30.2		
	N. I. Ceresan	35.2	41.6	44.4	32.4		
19:1	L.S.D.	24.69	27.63	34.41	13.75		

(1) Average of five replications each year at each station.
xx Significant at 5%.

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