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THE TIME TO SEED WHEAT IN KANSAS.

MANHATTAN, KANSAS.

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## SUMMARY.

1. The time of seeding wheat varies with the degree of infestation by Hessian fly, the amount of winterkilling, and the rainfall.

2. In central and eastern Kansas wheat may be sowed late enough to avoid most of the injury from Hessian fly and yet early enough on well prepared ground to secure a good growth before winter. The best date of seeding in northeastern Kansas varies from about September 25 to October 3; in south central Kansas from about September 25 to October 7; and in north central Kansas from about September 20 to October 1.

3. The time for seeding in western Kansas depends on the rainfall. It is usually not advisable to seed in dry ground. The land should be prepared early and seeded when in proper condition to insure germination and good growth.

4. Wheat may be sowed later in rich soil and well prepared ground than in soil that is poor or poorly prepared. Early and thorough preparation not only destroys many of the flies in the stubble but enables the wheat to make a more rapid and vigorous growth. Strong wheat plants are damaged less by Hessian fly and stand more severe winters than plants which are small and weak.

5. Wheat should be sowed somewhat thicker when planted late. Late planted wheat often germinates less, and usually tilers less, than wheat sowed earlier.

## THE TIME TO SEED WHEAT IN KANSAS.

By L. E. CALL, S. C. SALMON, and C. C. CUNNINGHAM.

The time of seeding is one of the most important factors in growing wheat in Kansas. Wheat that is sowed late usually winterkills much; the roots do not penetrate the ground as deeply as when it is sowed early, and hence it is more subject to injury from drouth and hot winds. Late sowed wheat tillers vary little and hence usually gives a thin stand. It ripens late, and in the eastern part of the state is more likely to be injured by rust than wheat that is sowed somewhat earlier. The quality is usually poor as compared with wheat planted early.

On the other hand, wheat sowed too early is practically certain to be injured by Hessian fly if these insects are present in the neighborhood. In dry seasons very early seeding is often detrimental because the heavy growth uses all the moisture stored in the soil and leaves the crop entirely dependent on seasonal rains. This happens frequently in western Kansas.

The best time to seed varies with different sections of the state, with different seasons, and with different conditions. For these reasons no definite date for planting can be given. The proper time for seeding must be settled according to the locality, and local and seasonal conditions.

### The Influence of the Hessian Fly on Time of Seeding.

The best time to seed wheat in central and eastern Kansas is determined largely by the Hessian fly. The damage by this insect has been estimated at sixteen million dollars for 1915 and fifteen million dollars for 1916. Most of this damage could have been prevented. The map (Fig. 1) indicates that Hessian fly was present this past season in all counties in the central part of the state and was fairly well distributed over the eastern counties. This does not mean that fly always causes damage in this area, but that it has been found there this past season and is, therefore, a source of danger to future crops. The Hessian fly can readily be detected by examining the wheat stubble. If they are present in large numbers, they will certainly injure the next crop unless they are controlled.

HESSIAN FLY INFESTATION 1915 - 1916.

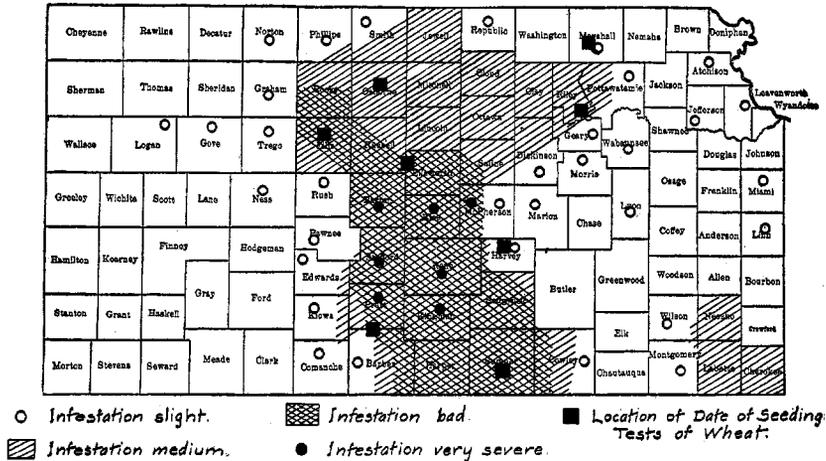


FIG. 1.

How to Control Hessian Fly.

There are two effective and practical ways to control Hessian fly. One is to kill all the fly in the stubble and in volunteer wheat before they can hatch and lay their eggs in the grain. The other is to destroy the volunteer wheat and delay seeding so that most of the flies will have ceased laying eggs by the time the wheat is up.

The best way to kill the Hessian fly in infested stubble, where it exists in the pupa stage, is to plow early and at least four or five inches deep. If the ground is then worked down with a disk, the fly will be buried so deep and the ground above packed so firmly that very few of them will be able to get to the surface.

Burning the stubble also kills the few Hessian flies above ground, but probably does not kill the majority, which are below the surface. Since burning destroys the organic matter in the stubble, which is badly needed in most Kansas soils, and does not destroy a very large percent of the Hessian flies, it cannot be recommended as a general practice. Early deep plowing, to be fully effective, must be practiced by the entire neighborhood, and must include all infested fields since the flies sometimes migrate considerable distances. As it is usually impractical to plow all fields in a neighborhood early and deep, the only way to insure safety from the fly is to avoid early seeding. It is also necessary to destroy the volunteer wheat which starts before the fly-free date, since it may become infested, carry the flies through the winter, and infest the fields in the spring.

### **Experiments to Determine the Best Time to Seed Wheat.**

In 1911 the Kansas Experiment Station began experiments at six different places in Kansas to study the effect of the time of planting wheat upon the yield and the injury by Hessian fly. These tests were located in Marshall, Marion, Sumner, Osborne, Ellsworth, and Pratt counties—that is, in representative counties in the main wheat—producing area of the state where the Hessian fly is likely to cause serious loss. Each test consisted of seeding a series of plots at weekly intervals for six or seven weeks, beginning the second week in September. Similar but more extensive tests were also conducted at the Experiment Station, at Manhattan, in Riley county.

The Marshall county test was conducted by H. J. Bornhorst, two miles southwest of Marysville, on fertile river bottom land. The ground was well prepared each season, and because of the good preparation and fertile soil the late sowed wheat undoubtedly produced better than would have been the case on less fertile upland soil in that community.

The tests at the Experiment Station in Riley county were conducted on well-prepared upland silt loam. The tests in Marion and Harvey counties were conducted in 1911 by Firebaugh Bros., Marion; in 1913 and 1914 by W. A. Bailey, Peabody, and in 1915 and 1916 by F. B. Lawton, Newton. These tests were located on upland silty clay loam soil of average fertility, excepting the test of 1911 which was located on river bottom land. Chinch bugs in 1912 destroyed the wheat and in 1912-'13 rains interfered in planting on the last date, while in 1913-'14 the ground was too dry to seed when the first seeding should have been made. In 1914-'15 Hessian fly practically destroyed the early sowed wheat in the fall, and the spring brood of flies greatly damaged the late seeding.

In Sumner county the tests were conducted by E. Laney, Wellington, on upland silt loam soil of average fertility. In 1912 the early seeded wheat failed to grow because of dry soil, and in 1914 the first date of seeding was omitted because seed was not available at the time the wheat should have been planted.

The Smith and Osborne county tests were conducted in 1912 by H. H. Smith, Smith Center, and from 1913 to 1915, inclusive, by John H. Nonamaker, Osborne. On the Smith farm the plant-

ings were made on well-prepared silty clay loam upland soil, and on the Nonamaker farm on silt loam second river bottom soil.

L. G. Brown, Wilson, conducted the Ellsworth county tests. The soil was upland sandy loam of medium fertility. The seedbed was well prepared each season.

In Pratt and Barber counties the tests were conducted for the season of 1912 and 1913 by C. F. Hertline, Pratt, on upland sandy loam soil, and in 1914 and 1915 by Miss Mary Best, Medicine Lodge, on sandy loam river bottom soil. The ground was in excellent condition each season.

**The Time to Seed in Northeastern Kansas.**

Experiments conducted for three years in Marshall county (Table I) and for seven years in Riley county (Table 11) show that the best yields of wheat are obtained when the grain is sown from about September 25 to October 3.

TABLE I.—Yields in date of seeding test in Marshall county, 1912-1915.

YEAR.	Yield—Bushels per acre.						
	Seeding period.						
	Sept. 8-11.	Sept. 15-18.	Sept. 22-25.	Sept. 29 to Oct. 1.	Oct. 6-8.	Oct. 13-16.	Oct. 20-23.
1912.....	*.....	*.....	*.....	26.6	†25.0	*.....	*.....
1913.....	.....	42.2	45.2	41.5	39.3	27.8	25.6
1914.....	22.5	26.4	32.7	39.1	38.4	33.9	36.1
1915.....	.....	.....	29.2	35.0	34.2	29.4	33.1
<i>Percent of plants infested with Hessian fly in the fall.</i>							
1912.....	7.5	5.6	0.3	.....	.....	.....	.....
1913.....	18.1	12.8	1.8	0.9	.....	.....	.....
1914.....	48.7	53.0	42.4	18.0	.....	.....	.....
1915.....	.....	12.0	10.0	.....	.....	.....	.....

\* Winterkilled.  
 † Seeding delayed until October 12 because of wet weather. The degree of infestation with Hessian fly was determined by the Department of Entomology of the experiment station.

TABLE II.—Yields in date of seeding tests in Riley county.

YEAR.	Yield—Bushels per acre.						
	Seeding period.						
	Sept. 7-12.	Sept. 14-21.	Sept. 21-27.	Sept. 28 to Oct. 3.	Oct. 5-10.	Oct. 12-17.	Oct. 19-25.
1906.....	39.9	52.6	54.0	.....	53.2	45.2	43.0
1908.....	22.5	28.5	31.3	.....	34.4	32.1	30.0
1911.....	44.8	50.0	53.8	52.8	51.2	45.7	45.0
1912.....	15.0	26.8	25.4	27.0	14.5	6.8	8.5
1913.....	.....	41.3	44.1	47.5	40.3	25.1	20.0
1914.....	46.2	44.5	46.5	46.8	44.5	36.8	22.8
1915.....*	*.....*	.....	17.3	21.3	26.0	28.7	22.7
<i>Percent of plants infested with Hessian fly in the fall.</i>							
1915.....	19.2	15.4	7.7	2.4	1.0	.....	.....

\*Wheat badly damaged by fly and plowed up in the early spring to prevent the spring brood of fly from injuring the wheat on the plots seeded later.

In Marshall county the best yield in one year was obtained from seeding September 22 to 25, and in two years from seeding September 29 to October 1. In Riley county the best yield was secured in two seasons from seeding September 21 to 27, in three seasons from seeding September 28 to October 3, and in one season each from seeding October 5 to 10 and October 12 to 17. The experiments show a very clear and definite decrease in the infestation of Hessian fly with late seeding. In one season (1914) in Marshall county about fifty percent of the wheat sowed before September 20 was infested, while none sowed after the first week in October had any flies. A few flies were found in wheat sown in the Riley county tests as late as October 5 to 10, but not enough to cause any serious loss.

In Marshall county in 1912 and in Riley county in 1906, 1908, 1911, 1912, 1913 and 1914 there was practically no damage from Hessian fly. In all these seasons the best yields were obtained from seeding either the fourth week in September or the first week in October. This shows that where no fly is present there is usually no advantage from very early seeding, and this is especially true if the ground is well prepared.

It is seldom advisable to seed in northeastern Kansas earlier than September 25. In the extreme northern part of the state it may be advisable on infertile ground or on a poorly prepared seedbed, where there are no Hessian flies, to begin seeding a little

early, or unfavorable weather may delay planting until too late to obtain the best yields. If Hessian fly is present in large numbers, however, it is always advisable in this section to delay seeding until at least September 25 in the extreme northern part, and until September 28 or October 1 in Riley county and the counties east of Riley. It should be understood that seeding at these dates will not absolutely prevent damage from Hessian fly. For that reason if the flies are extremely numerous and the area to be seeded is limited better average results will be secured if the grain is not planted before October 3 or 4.

**The Time to Seed Wheat in South-Central Kansas.**

Twelve tests have been conducted in south-central Kansas to determine the relation of time of seeding to Hessian fly damage and yield. These tests include three years' work in Marion county, one year in Harvey county, two years in Pratt county, two years in Barber county, and four years in Sumner county. Tables III, IV, and V give the results of these tests:

TABLE III.—Yields in date of seeding tests in Marion and Harvey counties.

YEAR.	Bushels per acre.						
	Seeding period.						
	Sept. 9-14.	Sept. 15-21.	Sept. 22-26.	Sept. 27 to Oct. 5.	Oct. 5-12.	Oct. 13-18.	Oct. 19-24.
1911.....	20.3	20.3	*18.9	20.8	20.2	16.6	14.5
1912.....	†						
1913.....	13.7	14.0	12.2	16.9	9.0	7.0	
1914.....	†	24.1	24.4	28.3	14.3	12.7	11.9
1915.....		1.1	1.0	1.8	6.0	8.75	11.1
<i>Percent of plants infested with Hessian fly in the fall.</i>							
1914.....		40.5	19.3	12.8			
1915.....		54.0	66.0	31.0	16.0	3.0	

\* Seeded September 29.  
 † Wheat destroyed by drouth and chinch bugs.  
 ‡ Not seeded because of dry weather.

*The Time to Seed Wheat in Kansas.*

TABLE IV.—Yields in date of seeding tests in Sumner county.

YEAR.	Bushels per acre.						
	Seeding period.						
	Sept. 8-11.	Sept. 15-18.	Sept. 22-25.	Sept. 29 to Oct. 2.	Oct. 6-9.	Oct. 18-17.	Oct. 20-23.
1913.....		8.4	8.6	6.8	2.4	1.3	0.2
1914.....	80.4	81.8	80.8	80.7	30.3	22.5	13.1
1915.....		0.7	1.4	2.7	3.7	4.8	3.1
<i>Percent of plants infested with Hessian fly in the fall.</i>							
1914.....	1.7	1.2	0.2				
1915.....	100.0	95.0	35.0	15.0	0.5		

TABLE V.—Yields in date of seeding tests in Pratt and Barber counties.

YEAR.	Bushels per acre.						
	Seeding period.						
	Sept. 9-11.	Sept. 13-19.	Sept. 21-25.	Sept. 27 to Oct. 2.	Oct. 4-9.	Oct. 11-16.	Oct. 18-23.
1912.....	23.3	21.6	23.3	*23.3	25.0	14.4	18.0
1913.....	18.6	25.6	17.8	18.1	20.3	14.8	12.6
1914.....			31.7	28.6	28.5	27.8	26.5
1915.....			19.1	21.7	18.7	18.9	19.0

\* Seeded October 5, delay due to rain.

In the tests in Marion and Harvey counties the best yields have been obtained with seeding between September 27 and October 5, in all years but one, when the best date was October 19 to 24. In that year (1915) the wheat sowed early was practically a total loss because of the fly.

The test in Sumner county seems to favor rather early seeding, *i. e.*, September 15 to 25, as shown by the results in 1913 and 1914. Hessian fly caused practically no damage, however, in these two seasons. In 1915 all plots sowed before October 1 were practically destroyed by the fly, and the late sowed wheat produced very small yields because the fly which infested the early plots flew over into the late plots the next spring and then deposited their eggs in almost as large numbers as in the early planted wheat. If the early seeded plots of wheat had been plowed up in the fall or early spring the flies in them would have been destroyed and the later wheat saved, providing there were no other badly infested early sowed fields in the neighborhood.

This instance shows very clearly that late seeding in itself is not insurance against fly damage from the spring brood unless all farmers cooperate in late sowing, kill all volunteer wheat, and plow, in the fall or early spring, all stubble in which the fly may winter.

The tests in Pratt and Barber counties are somewhat contradictory. This is explained by the fact that the best time to seed in this area depends more on the fall rains than is the case in eastern Kansas; also because Hessian fly did no damage during the four years in which the test was conducted.

In 1912 the highest yield was obtained from seeding the second week in October, in 1913 from seeding the third week in September, in 1914 from seeding the fourth week in September, and in 1915 from seeding the first week in October. It will be seen, therefore, that where no flies are present, as was the case in this experiment, seeding earlier than the middle of September gives no better yields than somewhat later seeding. When flies are present, later seeding, up to October 1 on poor soil or until October 6-7 on fertile soil and a well-prepared seedbed, will give better results than early seeding.

**The Time to Seed in North-Central Kansas.**

Somewhat earlier seeding is desirable for north-central Kansas than for points east or south. This is because the elevation and latitude shorten the season and grain must be sowed earlier to get the same start before winter. Also the Hessian fly disappears earlier in the fall so there is not so much danger from this source with early seeding.

Tests to determine the best date were conducted for four years in Smith and Osborne counties and Ellsworth county. The Hessian fly did no material damage during these tests. The results are shown in tables VI and VII.

TABLE VI.—Yields obtained in date of seeding tests in Smith and Osborne counties.

YEAR.	Bushels per acre.						
	Seeding period.						
	Sept. 8-11.	Sept. 14-18.	Sept. 21-25.	Sept. 28 to Oct. 6.	Oct. 5-9.	Oct. 12-16.	Oct. 17-23.
1912 .....	28.8	28.8	32.2	31.8	30.0	*18.8	11.1
1913 .....	44.2	35.0	33.2	32.1	29.8	27.5	24.9
1914 .....	21.9	21.5	23.7	19.0	17.8	14.1	10.6
1915 .....		30.6	36.7	39.9	36.8	31.8	36.3

\* Seeded October 19; delay due to wet ground.

TABLE VII.—Yields obtained in date of seeding tests in Ellsworth county.

YEAR.	Bushels per acre.						
	Seeding period.						
	Sept. 8-11.	Sept. 14-19.	Sept. 21-25.	Sept. 28 to Oct. 2.	Oct. 5-9.	Oct. 12-16.	Oct. 19-23.
1912.....	20.1	24.9	26.0	25.7	19.8	8.4	10.3
1913.....	17.8	13.4	11.7	10.2	11.8	11.6	8.7
1914.....	16.5	18.0	20.0	21.9	24.4	22.2	20.5
1915.....		31.9	28.6	30.0	26.1	18.5	22.2

The experiments show that the best yields have been secured from September seedings, the average favoring late September. Probably the best date for this section on the average is about September 20 to 25, but this will vary with local conditions. As in other sections of the state, if a large acreage is to be seeded and it is known that there are few Hessian flies it is advisable to begin seeding reasonably early since unfavorable weather may delay seeding until too late for good results. If, on the other hand, a small acreage only is to be sown and flies are present in abundance, the seeding should be delayed until near the end of September or even until October 1.

**The Time to Seed in Western Kansas.**

Western Kansas differs markedly from the rest of the state with respect to the best time to seed. In the first place, flies are seldom found west of the eastern border of Norton, Graham, Trego, Ness, Hodgeman, Ford, and Clark counties—hence, the question of damage from fly need not be considered in the average season. In the second place, the farmer has less choice with respect to time of seeding because of dry falls. It is usually not advisable to seed in dry ground and to expect a rain later to germinate the wheat. There may be just enough moisture in the ground to germinate the wheat, but not enough to keep it growing. The result is that the wheat starts to grow and then dies for lack of moisture. There may be enough moisture to allow fungi in the soil to grow on the wheat kernels and destroy them and yet not enough to cause germination. In either case the seed is lost.

On the other hand, there is less danger of winterkilling in western Kansas due to late seeding than in the eastern part of the state. It quite frequently happens that the seed sowed as late as

November makes a fair yield. While it is not ordinarily advisable to seed so late, such late seeding with favorable conditions is usually better than early seeding with poor conditions and better than seeding spring wheat.

The best thing to do in this area is to have the ground prepared early, the seed cleaned and treated for smut if this is necessary, and be ready to seed when conditions are most favorable. The common practice of delaying the preparation of the ground until sufficient rain comes to germinate the seed should be discouraged. By the time the ground is prepared the moisture may all have evaporated, and the grain must be sowed in dry ground or seeding delayed until another rain comes.

Probably the best date for seeding in western Kansas, when all conditions are favorable, is about the middle of September. Extremely early seeding should be avoided, especially under conditions favorable for germination and early development of the wheat, since the heavy growth that will result takes all the moisture from the ground, leaving the wheat entirely dependent on seasonal rains to complete its growth. Early sowed wheat also sometimes makes so thick a growth in the spring that it is easily injured by hot winds and drouth.

#### **Preparation of the Ground and its Relation to Time of Seeding.**

It has been noted that early deep plowing is very effective in controlling Hessian fly. It is also very effective in promoting a rapid growth of the wheat in the fall. For this reason wheat may be sowed considerably later on ground that has been plowed early and deep than if it has been carelessly prepared. When ground is plowed early, plant food is developed very rapidly and water is usually stored in the soil for the growth of the plant. As a result, growth is rapid, the plants tiller abundantly, and strong roots are developed before winter. Rather late seeding on a well-prepared seedbed will give much better yields than early seeding on poorly prepared ground even when no Hessian flies are present. Also, wheat that has made a good growth is better able to resist attacks of the fly since it tillers more and there are more stalks to take the place of those destroyed.

**The Rate to Seed Wheat.**

The rate to seed wheat bears a very definite relation to the time of seeding. Wheat that is planted early tillers abundantly and produces many heads from a single grain. On the other hand, late sowed wheat often germinates poorly and produces but one or two heads per plant. This is indicated in Table VIII, which gives the average number of tillers produced by a single plant when sowed at different dates from September 8 to October 17.

TABLE VIII.—*The effect of the time of seeding on the tillering of wheat.*

	Number of tillers per plant.				
	1912.	1913.	1914.	1915.	Average 4 years.
September 8 to 11, inclusive.....	5.8	4.8	4.8	3.6	4.7
September 13 to 19, inclusive.....	6.0	4.1	4.2	4.9	4.8
September 21 to 25, inclusive.....	4.8	3.1	3.8	4.1	3.8
September 27 to October 2, inclusive.	2.7	3.0	3.7	3.7	3.3
October 4 to 9, inclusive.....	1.8	2.1	3.2	2.8	2.5
October 11 to 17, inclusive.....	1.4	1.1	1.9	2.4	1.7

On the average, the early sowed wheat produces nearly three times as many tillers per plant as that sowed in the middle of October or later. A part of this difference can be made up by increasing the rate of seeding.

Experiments to determine the best rate to seed with different times of seeding have been conducted at the experiment station at Manhattan for four years.

Table IX shows the results. The rate of seeding made very little difference in the yield when the grain was sowed before September 28. When sowed after this date the higher rates of seeding gave the best yield. This result agrees with the general farm practice of sowing more grain when seeding late than when seeding early.

TABLE IX.—Yield in date and rate of seeding tests at the Manhattan Experiment Station.

DATE OF SEEDING.	Rate.	Bushels per acre.				
		1913.	1914.	1915.	1916.	Average.
September 8.....	2	.....	45.38	*.....	*.....	15.11
	4	.....	46.38	.....	.....	15.44
	6	.....	46.16	.....	.....	15.89
	8	.....	46.16	.....	.....	15.89
September 15 to 17.....	2	41.47	47.83	*.....	*.....	22.58
	4	41.28	46.50	.....	.....	21.95
	6	45.40	44.50	.....	.....	22.48
	8	41.76	45.33	.....	.....	21.77
September 21 to 23.....	2	38.88	45.33	†22.66	*.....	26.72
	4	40.33	46.00	23.32	.....	27.41
	6	44.07	46.50	17.32	.....	26.97
	8	43.78	46.83	†12.66	.....	25.82
September 28 to 30.....	2	37.15	41.33	15.00	14.27	27.03
	4	36.00	46.66	20.66	13.00	29.08
	6	47.54	46.83	21.32	13.70	32.85
	8	51.85	48.16	22.00	16.90	34.73
October 4 to 7.....	2	33.98	34.83	24.32	16.00	27.28
	4	33.30	43.83	23.32	13.50	30.99
	6	40.33	44.50	26.00	24.10	33.73
	8	33.30	44.60	27.00	24.70	33.65
October 11 to 14.....	2	20.74	26.00	20.32	13.60	20.17
	4	23.33	34.00	25.00	13.70	24.01
	6	25.05	36.83	28.66	15.30	26.46
	8	26.20	41.16	24.32	24.50	29.05
October 19 to 20.....	2	14.11	13.50	17.32	10.10	13.74
	4	15.84	20.66	24.00	14.80	18.83
	6	20.01	22.83	22.66	16.70	20.55
	8	19.44	25.50	25.32	21.10	22.84
October 26 to 28.....	2	.....	16.00	10.32	14.10	13.47
	4	.....	22.83	14.66	15.30	17.60
	6	.....	29.50	15.32	16.30	20.37
	8	.....	33.33	20.00	18.00	23.78
November 2 to 5.....	2	.....	.....	6.66	6.80	6.70
	4	.....	.....	10.00	9.90	10.00
	6	.....	.....	10.00	11.60	10.80
	8	.....	.....	15.66	12.50	14.10

\* Destroyed by Hessian fly. † Washed badly.

