THESIS

Reclamation of Sand blown Area
by White Pine planting

R. P. NORMAN. H. I. LOWE

1914

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# RECLAMATION OF SAND BLOWN AREA

BY

# WHITE PINE PLANTING.

R.P.Norman. H.J.Lowe.

1914.

Through the cooperation of the Forestry Department and Mr. E. K. Warren of Sawyer, Mich., the writers were delegated to superintend the planting of fifty thousand white pine trees (6 years old), which work was carried on from April 4th. to April 20th.,1914.

LOCATION and SITE.

The planting operations were carried on two miles south west of Sawyer, Berrien County,on the estate of E. K. Warren under the direction of Paul C. Warren and Curtis Richardson,representing the owner.

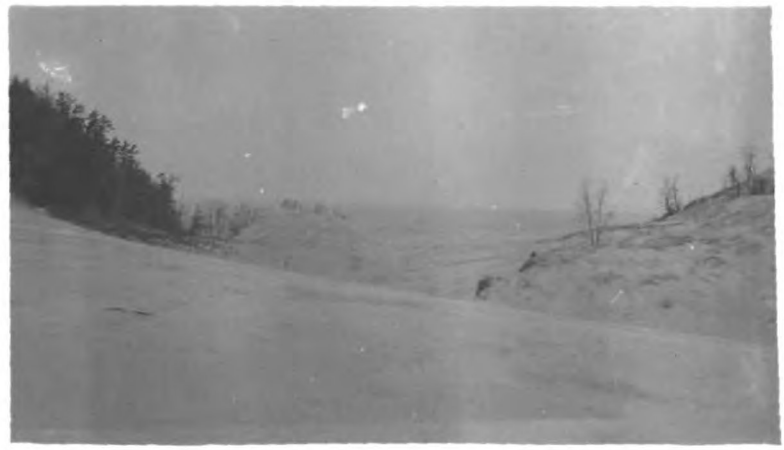
The thirty seven acres planted were situated in a large 'wind blow' which extended back from the shores of Lake Michigan for one-third of a mile,in a strip about three hundred to six hundred feet wide,and along the shore for twenty five hundred feet,and inside of the first row of dunes about two hundred feet from the lake.

( See Plate 1 for picture of planting site. )

The soil on the planting site was the typical wind blown sand,dry on top but always moist below two inches under the surface. By a former analysis by the Soils Department of the Mich. Ag'r. College, this soil was found to contain less than one-tenth per cent nitrogen,the bulk of it being silica.

Throughout the main 'blow' there was an entire absence of any ground cover whatever,and only on the south and southwestern slopes,was there any vegetation on the ground. Here there was the typical snake grass,sand cherry,and bunch grass in small amounts. Otherwise the monotony of stretches of sand was broken only by a little dead and down drift wood

Plate No. I.



THE PLANTING SITE.

Picture taken from rear of 'blow' and showing lake in back ground.

at the foot of the slopes.

Subsoil conditions were lacking, except in a very small part of the area lying on the southern rise of hills, which joined a straggling growth of native pine and hemlock. Here there was a little leaf mold and humus present due to the nearby vegetation.

There was a general rise from the lake shore to the crest at the back end of the planting area of one hundred feet in the third of a mile stretch. On the northwestern border of the area was 'Old Tom' which was one hundred and sixty eight feet above the lake, only part of which was planted as an experiment. Here the slope was even too steep for climbing, and only six hundred trees were set out. In two day's time, but a few of the original trees were visible, the others being blown under by the wind. Here and there on the wings of the main area were scattered kopjes of varying heights, rising above the general surface of the 'blow'.

( See Plate 2 for pictures of ' Old Tom' )

For the general topography, the topographic map in the Chart enclosed, will show the relative elevations of the planting area.

The area planted was the direct result of the action of the wind from the lake. The general direction of these winds was either from the north west or south west from the lake and the north east towards the lake.

It was only the wind from the lake that was creating the damage, and the lack of any ground cover, showed the terrific sweep of the wind. The sand particles blown by the wind were

Plate No. 2.

'OLD TOM'

Showing size and steepness of slope.

not the only menace,as the drying action of the wind also contributed to the lack of vegetation,plant life being unable to withstand the rapid evaporation.

OBJECT of the PLANTING.

The object of the planting was threefold,namely:-

1. To prevent blowing of sand.
2. For aesthetic reasons.
3. For timber production.

The rise from the farm land,immediately back of the blow,to its crest was eighty five feet at an angle of forty degrees. At the base of the slope,in a willow bottom, a small creek ran. During the summer,this stream was negligible,but in the spring it assumed alarming proportions.

The orchards and farms of various kinds,extended to within a few hundred feet of the base of the blow,the intervening distance being bottom land filled with willows,grasses, and thorny plants of various kinds. Some cedars and a few white pines were also found.

The territory,either directly or indirectly,affected by the blow was roughly estimated at about half a mile wide and a mile deep. This area stretched back from the crest in a fan shaped direction,with the point at the crest of the blow . Only a small portion of this area was controlled by the Warren interests.

The wind carried the sand both to and from the lake, but it was only the latter that did any damage. It had a clean sweep along the blow for one third of a mile,and by the time it reached the crest at the rear,the air was literally a solid

mass of flying,biting sand particles. Under such conditions, the sand transported in a year reached alarming proportions.

The crest forming the rear of the blow has moved in an easterly direction on an average of fifteen to twenty feet each year. This,of course moved the stream bed accordingly. During the last ten years,the whole back of the blow has moved inland nearly two hundred feet.

The actual moving inland of the crest itself,was of minor importance. The greatest damage was done by the deposition of sand over the large orchard in the farm area. The picture in Plate 3 will give an idea of the movement of the sand across one of the orchards during a wind of a forty five mile velocity. This blowing was sufficient in a year to bury such plants as strawberries and at the same time,make much of the surface soil of too sandy a nature for the successful growing of various small vegetables. At the same time,the blowing sand made life almost unbearable to the farmers and resorters in the immediate vicinity of the area.

The Warrens are trying to sell these lands and are making them suitable for resort purposes. The planting will not only make them more saleable but will add to their beauty and attractiveness.

It was not the intention to plant with the idea of the production of timber. However it is hoped that eventually the lumber produced will make the original planting of a profitable nature.

STOCK.

The stock used for the planting was white pine,

Plate No. 3.

THE BLOWING SAND.

Picture shows movement of sand in orchard below 'blow' during forty-five mile gale.

grown two years in the seed bed,and four years in rows as transplants.

The general run of the trees was twelve to eighteen inches,with about sixteen inches as an average height above ground. The root system was a little shorter,averaging about twelve inches long with a fine mass of rootlets and root hairs.

The trees were purchased from the Mich. Ag'r. College at $ 10. per thousand. The trees,growing in nursery rows were plowed up and packed in bundles of twenty five each and loaded into the car in tiers,the roots being piled inside and covered with straw at the top of the tier. They were shipped in two carloads,one car containing forty thousand, and the following car,the remaining nine thousand.

Although the first car came through to its destination in three days,it was an additional three days before the car was all unloaded,a Sunday and misunderstanding of the destination preventing. However the trees showed up in very good shape,and the majority,thirty two thousand, were 'heeled in' after the haul,on the lake shore adjacent to the planting area. The remaining trees were 'heeled in ' in an orchard about one half a mile from the 'blow' and were later hauled to the planting site. Those on the lake shore were within two hundred and fifty feet of the water's edge,in rows parallel to the lake. The second car of nine thousand was delayed in transit,so that the trees were in the car for seven days. They were heated somewhat and a few bunches were discarded as the roots were dry as tinder. They were 'heeled

in' at right angles to the lake and within twenty five feet of the water's edge.

HAULING OPERATIONS and COSTS.

From the car to the place where the trees were heeled in was a distance of two and a quarter miles. A three mule team was employed with a wagon box and hay rack, and about two hundred bundles (five thousand trees ) were hauled at one time.

The first one and three quarter miles were along the highway, but the last half mile was a stiff haul through sand up to the hubs, over the hills to the lake shore where the planting operations were carried on.

( See Plate 4 for pictures of hauling methods.)

Each day, enough trees for the day's planting were hauled back from the beach on a stone boat drawn by one mule. These were 'heeled in' at spots advantageous to the planting operations. This usually took about an hour or so each day and the rest of the time for the driver was spent in planting.

Two hours were spent on the seventh and ninth of the month by the entire crew in passing trees up from the creek bed to the crest at the back of the 'blow'. The hill was too steep for a man or mule to climb with a load and this method was devised as shown in Plate 5.

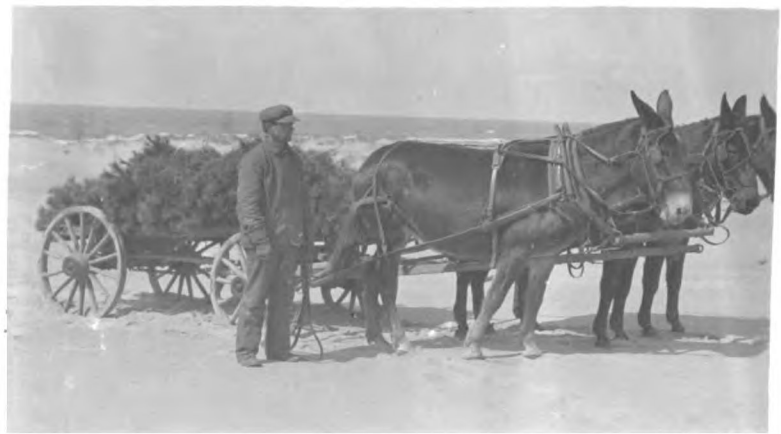
The following tabulation will show the total costs and costs per thousand for hauling.

Hauling from car to lake side ( April 6-7-9-17.)

1 man and team -----36 hours @ $.40--------- $14.40

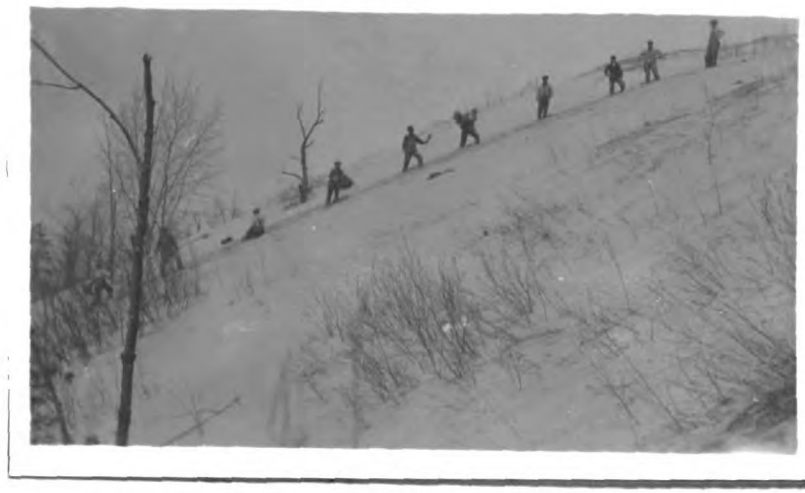
2 helpers --------- 36 " @ ..20--------- 14.40

Plate No. 4.



MANNER OF HAULING.

Plate No. 5.



MOVING TREES UP HILLSIDE.

Method used on steep slopes.

Lowe and Norman ----10 hours @ $.38--------- $ 7.60

Hauling to planting areas ( April 7-20.)

1 man and mule ---- 17 hours @ .30 -------- 5.10

Total cost of Hauling ---------- 41.50

Cost per Thousand ------------------------- $ 0.85

TOOLS USED and COSTS.

The following is a list of the tools used,

2 stone boats for hauling water and trees

2 barrels for water

| | | |
|---|---|---|
| 4 - #1 spades | @ $ 1.00---------- | $ 4.00 |
| 2 - #2 shovels | @ 1.00---------- | 2.00 |
| 6 - 12 quart pails | .50---------- | 3.00 |
| 4 - 12 " " | .20 ---------- | .80 |
| Total cost of Tools ---------- | | 9.80 |
| Cost per Thousand ---------- | | $ 0.20 |

HAULING WATER and COSTS.

Water was drawn from the lake in barrels on a stone boat to convenient places near the day's work, and from these the men got the water supply. The average haul from the lake was from five hundred to fifteen hundred feet at the back of the 'blow'. This took, on the average, one and a half hours a day to fill each barrel and place it. Time for watering the trees 'heeled in' on the beach, is also figured in the following expense. From four to six barrels were needed to keep the trees from getting dry.

Hauling water on boat.

1 man and mule ---- 35 hours @ $ .30 ------- $10.50

Cost per Thousand ---------- $ 0.21

## SPACING of TREES in ROWS.

In planting, the rows were six feet apart, the guide lines being run every six feet at right angles to the prevailing winds from the south west and north west, and the trees were so alternated or 'staggered' in the rows, that the whole planting presented a solid front to the winds from the lake, leaving no alley way for a sweep of the wind.

This system of planting six feet by six feet, by theoretical figures, will show twelve hundred and ten trees to the acre, but after carefully counting a few measured acres, we found an average of thirteen hundred per acre.

One man was delegated to mark these lines by means of dragging a stick in the sand in the general direction, and six feet from the line already marked. At times , these lines would be obliterated by the blowing sand, but this method gave the best result in making the rows uniformly six feet apart, as there was no show for a horse marker, on account of the steepness of the grade and the poor footing. Also the diggers could not be relied upon to keep in line without some guide. This man who was marking, also did part of the digging as well after having marked out a portion of the day's work.

## DIGGING OPERATIONS and COSTS.

On account of the character of the area and the easy digging, it was found advisable to divide the men into two crews, one crew to dig the holes, and the other to plant. This method, in contrast to that of two men working in pairs, was adopted to overcome the unequal division of labor, due to the easy digging. Thus both diggers and planters were kept

busy continually. By this method a crew of four to five men could keep enough holes ahead for twelve to fifteen planters.

The holes were dug about a foot deep and the dirt thrown out near the hole to aid in easy refilling. Care was taken not to let the digging get too far in advance of the planting as the holes would be filled with the blown sand and also dry out too much. The digging required from three to five shovels full for each hole and on the dry slopes it often took twelve to fifteen to get a hole dug.

See Plate 6 for pictures of the digging crew.

The following is the cost data for the digging.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| April | 7 | - | 4 men | -- | 10 hours | @ $ .20 | ------ | $ 8.00 |
| " | 9 | - | 3 " | -- | 5 " | " " | ------ | 3.00 |
| " | 10 | - | 3 " | -- | 8 " | " " | ------ | 4.80 |
| " | 11 | - | 5 " | -- | 10 " | " " | ------ | 10.00 |
| " | 13 | - | 4 " | -- | 10 " | " " | ------ | 8.00 |
| " | 14 | - | 6 " | -- | 10 " | " " | ------ | 12.00 |
| " | 15 | - | 5 " | -- | 10 " | " " | ------ | 10.00 |
| " | 16 | - | 3 " | -- | 5 " | " " | ------ | 3.00 |
| " | 17 | - | 1 " | -- | 3 " | " " | ------ | .60 |
| " | 18 | - | 5 " | -- | 3 " | " " | ------ | 3.00 |
| " | 20 | - | 4 " | -- | 10 " | " " | ------ | 8.00 |

Total cost of Digging ----- 70.40

Cost per thousand(49,000) ---------- $ 1.44

SETTING OPERATIONS and COSTS.

At first the men were started out separately, each one with a pail of trees,, and each planted separately. After a time it was found a little more rapid to have one man take

Plate No. 6.

DIGGING OPERATIONS.

Note the guide lines.

care of the trees in the pails and drop out six or eight at a time and have a couple of men planting behind him. In this way the best men were doing the actual planting while the poorer ones dropped the trees in the holes.

The detailed method would be as follows:-
The planter would get a bundle of trees from where they were 'heeled in' near by and would put them in a pail of water, making sure that all the roots were wetted. The trees were then dropped into the holes prepared for them and the planters would rapidly set them in place.

In setting the trees in the holes care was taken to have the roots laid in naturally and not doubled up, but in their origional position. At first the trees were set in about one half to three quarters of an inch above the nursery mark and the sand tamped down about the roots with the heel. Later developements, when the wind began to blow off the lake, showed many of the trees blown out by the roots. From then on the trees were set in a little deeper or nearly up to the first row of branches. This stopped their blowing out. The first two days plantings were gone over by a couple of men who reset those blown out, taking two days to complete the work.

In filling the sand into the holes, the moist sand was put in first around the roots and the drier sand on top. The men used a little stick about three inches wide and eight inches long for this purpose. This did away with the use of an extra shovel or using the hands and better results were accomplished.

Especial care was used to keep the roots covered up

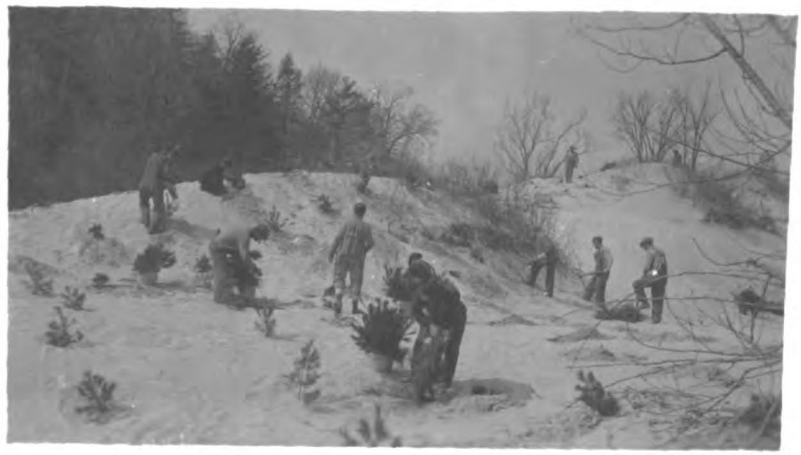
and in planting, the roots were not exposed over a minute or two to the drying effect of the wind. All bundles were immediately 'heeled in' as drawn from the lake shore and separately put into pails of water as the planting progressed.

( See Plate 7 for pictures of planting.)

The following is a daily program of costs etc.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| April | 7 | - | 7 | men | -- 6½ | hours | @ $ .20 ------ | $ 9.10 |
| " | 9 | - | 6 | " | -- 5 | " | " " ------ | 6.00 |
| " | 10 | - | 7 | " | -- 8 | " | " " ------ | 11.20 |
| | | | 9 | " | -- 4 | " | " " ------ | 7.20 |
| " | 11 | - | 7 | " | --10 | " | " " ------ | 14.00 |
| | | | 6 | " | -- 6½ | " | " " ------ | 10.20 |
| " | 13 | - | 4 | " | --10 | " | " " ------ | 8.00 |
| | | | 9 | " | -- 8 | " | " " ------ | 14.40 |
| " | 14 | - | 2 | " | --10 | " | " " ------ | 4.00 |
| | | | 7 | " | -- 8½ | " | " " ------ | 11.90 |
| " | 15 | - | 5 | " | --10 | " | " " ------ | 10.00 |
| | | | 6 | " | -- 8½ | " | " " ------ | 10.20 |
| " | 16 | - | 8 | " | -- 5 | " | " " ------ | 8.00 |
| " | 17 | - | 3 | " | -- 3 | " | " " ------ | 1.80 |
| " | 18 | - | 3 | " | -- 3 | " | " " ------ | 1.80 |
| | | | 7 | " | -- 1½ | " | " " ------ | 2.10 |
| " | 20 | - | 7 | " | --10 | " | " " ------ | 14.00 |
| | | | | | Total cost of Setting ---- | | | 143.90 |
| | | | | | Cost per Thousand ---------- | | | $ 2.93 |

Plate No. 7.



PLANTING OPERATIONS.

TOTAL COST of PLANTING (Digging and Setting)

April 7 - 4 men digging ----- $ 8.00

7 " setting ----- 9.10

Total daily cost -- 17.10

Cost per Thousand ----------$ 3.69

Number of trees planted ---------- 4,625

Average per day per man ---------- 541

" 9 - 3 men digging ----- 3.00

6 " setting ----- 6.00

Total daily cost -- 9.00

Cost per Thousand ---------- 3.91

Number of trees planted ---------- 2,300

Average per day per man ---------- 511

" 10 - 3 men digging ----- 4.80

16 " setting ----- 18.40

Total daily cost -- 23.20

Cost per Thousand ---------- 4.75

Number of trees planted ---------- 4,875

Average per day per man ---------- 420

" 11 - 5 men digging ----- 10.00

13 " setting ----- 24.20

Total daily cost -- 34.20

Cost per Thousand ---------- 4.25

Number of trees planted ---------- 8,000

Average per day per man ---------- 470

" 13 - 4 men digging ----- 8.00

13 " setting ----- 22.40

Total daily cost -- 30.40

Cost per Thousand ---------- 4.58

Number of trees planted ---------- 6,625

Average per day per man ---------- 436

April 14 - 6 men digging ----- 12.00

9 " setting ----- 15.90

Total daily cost -- 27.90

Cost per Thousand ----------4.15

Number of trees planted ---------- 6,700

Average per day per man ---------- 480

" 15 - 5 men digging ----- 10.00

11 " setting ----- 20.20

Total daily cost -- 30.20

Cost per Thousand ---------- 5.22

Number of trees planted ---------- 5,775

Average per day per man ---------- 382

" 16 - 3 men digging ----- 3.00

8 " setting ----- 8.00

Total daily cost -- 11.00

Cost per Thousand ---------- 5.50

Number of trees planted ----------2,000

Average per day per man ---------- 363

" 17 - 1 man digging ----- .60

3 " setting ----- 1.80

Total daily cost -- 2.40

Cost per Thousand ---------- 3.84

Number of trees planted ---------- 625

Average per day per man ---------- 520

April 18 - 5 men digging ----- 3.00

10 " setting ----- 3.90

Total daily cost -- 6.90

Cost per Thousand ---------- 2.58

Number of trees planted ---------- 2,675

Average per day per man ---------- 775

" 20 - 4 men digging ----- 8.00

7 " setting ----- 14.00

Total daily cost -- 22.00

Cost per Thousand ---------- 3.86

Number of trees planted ---------- 5,700

Average per day per man ---------- 518

(Note) The comparatively lower costs and higher daily average on the 17 th. and 18 th., was due probably to the very easy going and the nearness of the trees to the planting site. Also the men only worked three hours on the last day mentioned and were doing their best for a short time. This was the day that the wind blew so hard and everyone had to quit work.

The average costs are given below.

Average per Thousand ---------- $ 4.41

" " Acre ---------- 5.23

" Number of Trees per Day per Man ---- 483.

WEATHER CONDITIONS.

The weather conditions were very varied. On the night of the second day, there was a hard frost and the ground was frozen to a depth of two inches, so that it was impossible to continue the planting until the afternoon of the second

day following.

Then there were two days when the wind from the lake blew the sand in such quantities that it was impossible to withstand its attack. One of these days, the 10 th., we worked until 4 P.M. when the blowing sand became unbearable. On the 18 th., there was a forty eight mile wind off the lake, which was endured until 10 A.M. when it became folly to suffer the blinding sand storm which lasted throughout the day.

There was but slight rainfall during the two weeks but in the previous week, there had been a great quantity. Towards the end of the work, it was very hot on the planting site and the trees were in need of rain after being dried out by the strong winds of these weeks.

SUMMARY of TOTAL COSTS.

STOCK.

| | | |
|---|---|---|
| Total Cost of Trees (49,000) -----$ 490.00 | | |
| Cost per Thousand ---------- | | $ 10.00 |

FREIGHT.

| | | |
|---|---|---|
| Charges on car of 40,000 --------- | 37.00 | |
| " " " " 9,000 --------- | 21.60 | |
| Total Cost of Freight ---------- | 58.60 | |
| Cost per Thousand ---------- | | 1.19 |

SUPERVISION.

| | | |
|---|---|---|
| 14 day's time and expenses ------ | 100.00 | |
| Cost per Thousand ---------- | | 2.04 |

HAULING.

| | | |
|---|---|---|
| Total Hauling Costs ---------- | 41.60 | |
| Cost per Thousand ---------- | | .85 |

HAULING WATER.

| | | |
|---|---|---|
| Total Cost of Hauling Water ------- | 10.50 | |
| Cost per Thousand ---------- | | $ 0.21 |

TOOLS.

| | | |
|---|---|---|
| Total cost of Tools ---------- | 9.80 | |
| Cost per Thousand ---------- | | $ 0.20 |

PLANTING.

| | | |
|---|---|---|
| Total Cost of Planting, labor ------ | 214.30 | |
| Cost per Thousand ---------- | | $ 4.41 |

TOTAL COST of TREES LAID IN.

| | | |
|---|---|---|
| Total cost of trees in ground ----- | 924.80 | |
| " " per Thousand ---------- | | $18.90 |
| " " " Acre (37.7 A. ) ---------- | | $24.53 |

RECOMMENDATIONS.

The weather conditions for this locality were about the most favorable for such planting operations. Any time before the first of April, the weather is too unsettled, and later than the last of the month would be too hot and sultry.

This is also the best time to get labor, as a little after the middle of the month, there is great demand for help on the farms and orchards around Sawyer.

LATER OBSERVATIONS.

On May 12 th., Mr. Tyler , field agent, looked this planting over with the owner and reported ninty per cent of the trees alive and doing well. He counted several rows and found one hundred and twenty eight out of one hundred and thirty five that had buds forming and roots starting to grow.