the soil.

Discussion

Boron deficiency was found to be rather general through the sugar beet growing sections of the Puget Sound district, but most serious on higher lands and lighter soils of low water-holding capacity. Data indicate that soil moisture deficiency and overliming enhance crown rot and that the overliming in effect results in soil moisture deficiency.

The disease may be controlled by irrigation, at least in most fields of this district, and by the proper application of borax. The amount of borax to be used depends on the water-holding capacity of the soil, rainfall, extent of liming, previous applications of borax and the time of year it is applied. Under most conditions serious boron injury can be expected if borax is drilled with the seed at rates of over 10 pounds per acre, and this amount cannot be expected to prevent the disease on soils seriously deficient in boron. It is apparently safe to broadcast boron at rates of 50 or 60 pounds per acre before planting and to expect to prevent disease manifestations except during seasons of drought on land that has been over limed and that is by nature of poor water-holding capacity. Perhaps the most effective way to add borax is as a side dressing at the rate of from 20 to 40 pounds per acre, depending on requirements, a month or so after thinning, providing rain can be expected soon or there is sufficient moisture in the soil to dissolve the borax.

SOIL AND SEED TREATMENT EXPERIMENTS WITH SUGAR BEETS FOR CONTROL OF SEEDLING DISEASES[1]

M. M. Afanasiev
Montana Agricultural Experiment Station
Bozeman, Montana

The study of seedling diseases and phosphate deficiency in manured and non-manured rotations at the Huntley Field Station, Huntley, Montana after four years of study shows that the occurrence of these diseases is closely associated with the productive power and physical conditions of the soil, and with the other crops in the rotations. Weather and many other factors also have their effect on these diseases.

To determine the relationship between the occurrence of seedling diseases of sugar beets and the above mentioned factors, and also to develop measures for the control of these diseases, soil and seed treatment experiments were conducted during the past two years at the Huntley Field Station. The results of 1939 only are presented as they show the same trend as those secured in 1938.

For seed treatments, four ounces of ceresan and one ounce of new improved ceresan per twenty pounds of sugar beets were used.

For soil treatments nitrogen (N), phosphates (P), manure (M) and $Ca(OH)_2$ were used in the following combinations:

---

[1]Contribution from Montana State College, Agricultural Experiment Station, Paper No. 134 Journal Series. Abstract of paper presented at the meeting of the American Society of Sugar Beet Technologists, Denver, Jan. 4-6, 1940.

1. NPM
2. $\frac{N}{2}$ PM. In this treatment half of the nitrogen was applied at the time of planting and the other half as a side dressing immediately after thinning.
3. NP
4. $\frac{N}{2}$ P Nitrogen was applied in the same way as in 2.
5. $\frac{N}{3}$ P In this treatment one-third of the nitrogen was applied at the time of planting, one-third as a side dressing immediately after thinning, and the remaining third about a month later.
6. MP
7. N
8. P
9. M
10. $Ca(OH)_2$
11. NPM + $Ca(OH)_2$
12. NP + $Ca(OH)_2$
13. N + $Ca(OH)_2$
14. P + $Ca(OH)_2$
15. M + $Ca(OH)_2$
16. Check

All these soil treatments were used in three randomized replications, so that altogether there were 48 individual plots. Each plot consisted of three randomized rows of beets, 125 feet long. One row was planted with seeds treated with ceresan, another with seeds treated with new improved ceresan and the third with untreated seeds.

One hundred or more seedlings (in the four leaf stage) were collected from each row and examined in detail for disease. At the time of harvest each row of beets was dug separately, tops and roots were weighed and disease readings were taken.

The graph (Fig. 1) shows the amount of seedling diseases, yield and stand for each individual soil and seed treatment. The numbers represent the averages of three replications.

The results presented in this graph show:

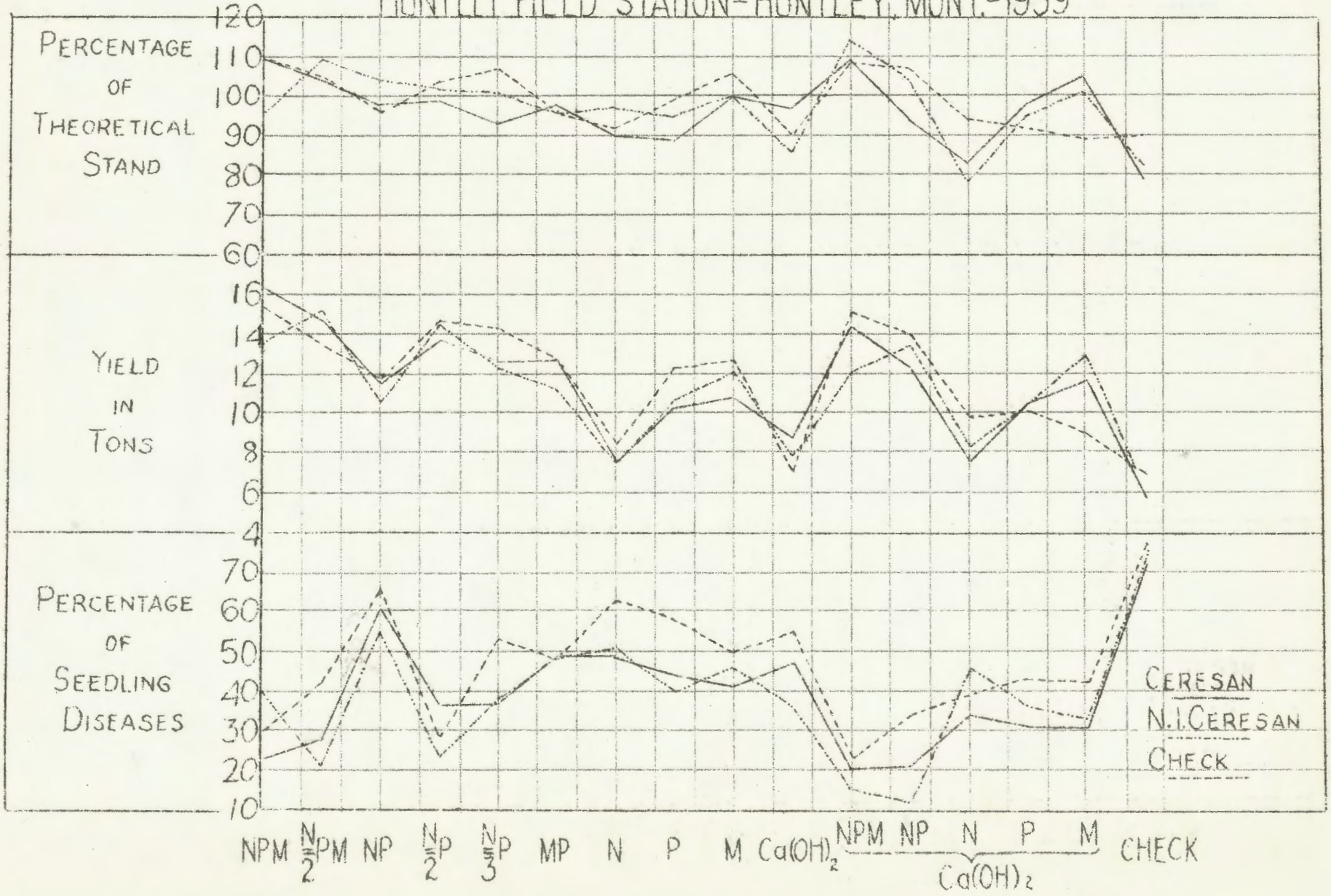
I. Seed treatments alone were found to be only slightly beneficial in controlling seedling diseases of sugar beets.

II. Soil treatments, regardless of seed treatments were found to be of great importance in the control of seedling diseases of sugar beets.

1. Plots with the most complete soil treatments, namely NPM, $\frac{N}{2}$ PM, $\frac{N}{2}$ P, NPM + $Ca(OH)_2$ and NP + $Ca(OH)_2$ had the smallest amounts of seedling diseases, highest yields and stands.

2. Although plots treated with NP, $\frac{N}{3}$ P, and MP had fairly good yields, they had considerable amounts of seedling diseases, yet it is difficult to explain why, when all nitrogen is applied at once (NP) or divided in three

SOIL AND SEED TREATMENT EXPERIMENT WITH SUGAR BEETS
HUNTLEY FIELD STATION - HUNTLEY, MONT. - 1939



applications ($\frac{N}{3}$ P) sugar beets have much more seedling diseases than when it is divided in two amounts ($\frac{N}{2}$ P), in which case one half of the nitrogen is applied at the time of seeding and the remainder soon after thinning.

3. The plots with unbalanced soil treatments (N, P or M) all had high amounts of seedling diseases; the yields and stands were also poor except for plots with manure.

4. Check plots had the highest amount of seedling diseases, poorest yields and stands.

5. The application of $Ca(OH)_2$ undoubtedly had a beneficial effect in controlling seedling diseases of beets. A comparison of duplicate soil treatments with and without $Ca(OH)_2$ show that all plots with $Ca(OH)_2$ have much less seedling diseases than those without it. It is possible that $Ca(OH)_2$ could have a beneficial effect on the physical, chemical and biological conditions of the heavy clay-loan soil of this region and makes it more suitable for normal development of sugar beets.

In conclusion it may be said that seedling diseases of sugar beets can be efficiently controlled and good stands and high yields of sugar beets obtained by creating conditions in the soil which will promote a rapid and healthful development of young sugar beets through:—

1. Use of complete and balanced fertilization.
2. Improvement of the physical conditions of the soil, and
3. To a limited extent through the seed treatments.

SEEDLING DISEASES, PHOSPHATE DEFICIENCY AND FURARIUM YELLOWS OF SUGAR BEETS IN THE ROTATIONS AT THE HUNTLEY FIELD STATION IN MONTANA[1]

M. M. Afanasiev
Montana Agricultural Experiment Station
Bozeman, Montana

Seedling diseases of sugar beets which are commonly called "Black root" manifest themselves in the rot of young beet roots. They limit the profitable production of sugar beets in some sugar-beet-growing sections of Montana. Phosphate deficiency is also an improtant physiological disease of sugar beets, especially on heavy alkali soils poor in available phosphates. Fusarium wilt or yellows of sugar beets is important only where sugar beets are planted continuously on the same ground.

During the past four years these diseases of sugar beets were studied in the sugar beet rotations at the Huntley Field Station, which is located at the Yellowstone Valley of Montana in the vicinity of Billings. The results of

---

[1]Contribution from Montana State College, Agricultural Experiment Station Paper No. 133 Journal Series. Abstract of paper presented at the meeting of the American Society of Sugar Beet Technologists, Denver, Jan. 4-6, 1940