

Home Course In Modern Agriculture

II.—How Plants Eat and Grow

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EVERY growing plant is a little factory. The green coloring matter of the leaves, or chlorophyll, is the engine. The sunlight is the power that makes the engine go, and the air, water and some of the substances in the soil are the raw materials.

Under the stimulating influence of sunlight the chlorophyll takes the carbon dioxide gas of the air and the water, nitrogen and minerals which the roots send up in the form of crude sap and tears them to pieces. Then it puts them together again in hundreds of different ways. It makes them into the starch of the potato or the sugar of the sugar beet. It puts them together in another way and makes the hard, horny gluten of a kernel of popcorn or the tough fiber of a cornstalk. By

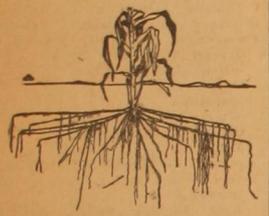


FIG. III.—THE GROWTH OF CORN ROOTS.

building them up in still different ways it makes the hard wood of the oak or the delicate petals of a rose. Man, with all his skill and machinery, has never been able to make any products half so wonderful as are being made every day in every field on your farm.

If plants are to grow rapidly and produce large yields, they must be well fed. About half the dry weight of a mature plant is made up of carbon. Practically all of this comes from the carbon dioxide of the air. Every acre of wheat will use a ton of this gas and all that is in a layer of air three miles deep over the acre. The constant mixing of the air by the wind is always bringing fresh supplies within reach of the plant.

The farmer does not need to concern himself with the supply of carbon dioxide, for every time he builds a fire or even breathes he is adding to the store of this material in the air.

The smooth upper surface of a leaf is both air and water tight. On the underside, however, are many small openings, which are really the mouths of the plant. It is through these tiny holes that carbon dioxide is taken into the leaf to be used by the chlorophyll. In making starch and other products out of carbon dioxide and water some oxygen is given off. This passes out through the openings in the leaves. Thus you see that plants breathe in much the same way as animals do, only they give off oxygen, the product which is used by animals, and take up carbon dioxide, the gas which is breathed out by animals. In this way plants make animal life possible. Animals give off carbon dioxide and manure as waste products. Plants tear these waste products to pieces and by rebuilding them make them once more into food for the animals.

Next to carbon hydrogen and oxygen are the foods that the plant uses in largest quantities. Since water is composed of these elements, the supply will be plentiful as long as there is plenty of water in the soil.

There is one element, nitrogen, which forms a considerable part of the plant, that is harder to get. While three-fourths of the air is nitrogen, the plant does not seem to be able to use it in this form. The only kind of plants that can use the nitrogen in the air at all are the legumes, such as clover and alfalfa. Certain bacteria that live on the roots of these legumes have the power of changing the atmospheric nitrogen into forms in which the plant can use it. We shall study more about this process later.

Nitrogen is one of the most important plant foods, and it is one that is very often lacking. If the plant cannot get a sufficient supply of nitrogen it will be stunted, will stop growing early, and the yield will be very much reduced. Since all the crops, with the exception of the legumes, must get their nitrogen from the soil, the farmer must see to it that there is a plentiful supply there if he wishes to obtain a large yield.

If you will drop a little rich black soil on a hot shovel some of it will go up in smoke. The part that burns is humus and is made up of vegetable and animal matter which is partly decayed. This humus contains large amounts of nitrogen, and from this source the greater share of this element used by the plant must come. If your soil is black, spongy and well supplied with humus there is little danger that the plant will go hungry for nitrogen. One of the best ways to keep a field in this condition is to apply liberal quantities of barnyard manure. Another way is to plow under green crops, especially clover. Sometimes it is necessary to buy nitrogen for the plant in the form of commercial fertilizers, but this is a very expensive way of obtaining it.

Even when the plant is given all the nitrogen it can use it sometimes fails

to do well. This is because it cannot get as much of the mineral elements as it needs.

Too much nitrogen in proportion to the amount of mineral elements causes the plant to "go all to vines." There will be an excessive growth of leaves but the yield of grain will be small. Take an ear of corn or a bunch of hay and burn it. The ashes that are left are the mineral parts of the plant. These cannot be obtained from air or water, but must come from the soil. Some of the most important of these are iron, which is the substance that helps to build up chlorophyll, and sulphur, which is found in the nitrogenous parts of the plant. There are a number of others also, all of which are present in the soil in such large amounts that there will probably always be all that the crops can use.

Two of these minerals, however, potassium and phosphorus, are not so plentiful. When the plant cannot get enough potassium the grain will not be filled out well. If there is too little phosphorus, especially in the case of fruit trees, the development of fruit is checked. Adding barnyard manure to the soil helps to keep up the supply of these two materials. On farms where little stock is kept or where grain has been raised continually for years and little attention paid to the soil it is sometimes necessary to apply phosphorus and potassium in the form of commercial fertilizers.

In the eastern part of this country there are many farms that have become so badly run down that crops will not grow at all unless they are fed with commercial fertilizers. These are very expensive, and it often takes nearly all a farmer makes to pay his fertilizer bills. These farms would never have become so worn out if they had been properly cared for. Leaving plowed ground, especially on hillsides, exposed for several months during the fall and winter allows much plant food to wash away. Growing the same crop year after year wears out the land rapidly. Different crops require different kinds of food. By changing crops from year to year no one food material is used to excess and the others wasted. By keeping as much stock on the farm as possible, saving the manure carefully and spreading it on the fields before it rots or leaches away and by using leguminous plants to gather nitrogen the soil can be kept well supplied with plant food.

It is much more profitable to feed the crops in this way than to buy plant food on the market at excessive prices. Usually, however, the plant is hungry for the mineral elements not because they are not in the soil, but because they are in a form in which it cannot get at them. The roots of the plant spread all through the soil in search of food. If you will look at a little root through a magnifying glass you will see that it is covered with root hairs. It is through these root hairs that the plant takes up food from the soil. There are no openings directly into them, but the walls are so thin that the water can soak through to the inside. Solid substances, of course, cannot get in, so that the plant food must be dissolved in water before it can get into the roots and so up to the chlorophyll, which is waiting to build it into seeds or leaves.

If the soil has been worked until it is fine and loose each little particle

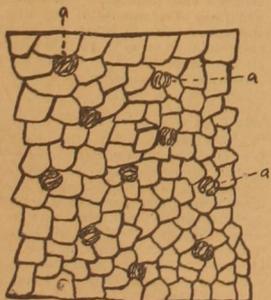


FIG. IV.—MAGNIFIED SECTION OF UNDERSIDE OF LEAF SHOWING BREATHING PORES—A, A, A.

will be surrounded by water, which will readily dissolve the plant food from it. If, on the other hand, the soil is in the form of chunks and clods very little of the plant food can be dissolved. The plant food that is on the inside of a clod might as well be out in the road or over on one of the neighbors' farms.

Some of the potassium and phosphorus will not dissolve even when brought in contact with water. It takes a long contact with the air to cause chemical actions which will change it into a soluble form. Continual stirring of the soil hastens this change. Thorough stirring also loosens up the ground so that air can get down to the roots. Without aid they will stop growing and the entire work of the plant will stop. The yellow appearance of a patch of corn in a low place where the ground is water soaked is due to lack of air about the roots.

WINNING A WELCOME

By BLANCHE HARPER.

"Well, what have you there?" exclaimed Mrs. Morton as Marjory, all out of breath, entered the room.

"Wait and see," mysteriously answered her daughter as she undid the wrapping paper.

"A canary!" cried Mrs. Morton. "What will you bring home next? Where and how did you get this bird?"

"Dorothy sent for me this morning and said that although she was all ready to go to Atlantic City she couldn't leave until she knew that her bird would be cared for during the summer. Her relatives absolutely refused to take the poor thing, and she declared that if I was any kind of a friend this was my opportunity to prove it. So what could I do?"

"But, my dear, we never owned a bird. We don't understand anything about their food, drink, bath or habits. And every one says a bird is a dreadful care—they're always catching cold or molting or something."

"I know. I told Dorothy all that and so she gave me written instructions, cautioning me to follow them implicitly."

"Listen!" said Marjory, unfolding a slip of paper. "Bath Mondays and Thursdays. Cage to be covered at 8:30 each evening. Small lettuce leaf Mondays and Wednesdays. Sliced apple on Tuesdays. Fresh seed and water daily. Cage cleaned daily. And 1,000 other directions."

"It's an imposition!" declared Mrs. Morton. "It's not necessary for Dorothy to promenade the boardwalk at Atlantic City while we sit at home and worry over her pet."

After Morton had worked an hour that evening adjusting a bracket for the cage he said peevishly: "One does impose on one's friends abominably. Here we have a rank outsider simply thrust upon us through no fault of our own. Some people have—well, what you might call nerve."

At eight o'clock the next morning Marjory's brother Bert came to breakfast with a scowling face.

"Where did that blooming bird hall from?" he demanded. "He has kept me awake since five o'clock with his everlasting singing."

Marjory's married sister soon ran in with her pet kitten, as was her cus-



"What Have You There?"

tom. She was greeted with a scream from Marjory. "Mildred, don't you dare to step into this house with that cat! Can't you see Dorothy's bird? Please, please go home—quick!"

"Very well," answered Mildred in icy tones. "If you care more for Dorothy's silly bird than for me and my darling Mopsy we shall not trouble you any more with our unwelcome presence." Then the irate sister marched out of the room.

"I wish I had never seen that horrid bird or Dorothy, either!" lamented Marjory.

After two months' absence Dorothy returned and claimed her canary. The first evening after the bird's departure Marjory noticed that both her father and her mother kept gazing at the empty bracket where the bird had swung and sung.

Presently Bert exclaimed: "It beats all how empty this house seems without that bird!"

Marjory wiped away a tear. "I've had the blues all day," she said. "I've missed Dickie so. If Dorothy had been the least bit appreciative she would have let me keep him a few weeks longer, anyhow."

The next morning Morton on his way to his office stopped at a bird store and purchased a canary. Mrs. Morton, before keeping her appointment at the dressmaker's, went to a bird dealer's and purchased a canary.

Bert, recollecting the empty bracket, on his return from business dropped in at a department store and purchased a canary.

Marjory, by this time firmly believing that no family is complete without a bird, took her savings and purchased a canary.

That evening each member of the family entered the dining room carrying a bird cage. Then they all beheld a canary in a cage that was hanging on the bracket. There was a card attached to the hook. On it Dorothy had written: "I hope this bird will partly take the place of the one you so lovingly cared for."

"Let's keep them all!" exclaimed Marjory.

"All but one," amended Mrs. Morton. "Mildred condescended to this morning that she has given Mopsy away, as she thinks she would rather have a bird than a kitten for a pet."—Chicago Daily News.

ograph of the oil pusher, as it hung framed in the colonel's office, with the huge spout of oil playing over the countryside. What he saw was a tiny oozing dribble, and an armed man pacing beside it, rifle in hand.

"Looks good, don't it?" sneered the man. "Read these."

The most cursory survey of the papers and letters flung down on the table showed Ormsby that his suspicions were more than justified. A lengthy perusal convinced him that the man's charges were entirely true. A letter signed with Ware's name, and in his inimitable writing, disclosed the fact that the whole scheme was a trick on a confiding public, to rake in thousands. And when Ormsby put down the papers and stared haggardly at the fellow he knew that his castle in the air lay ruined upon the ground.

Ten minutes later he had begun the most impassioned article that he had ever written. He denounced Alpacca oil as a fraud, he showed up Colonel Ware as an unmitigated scoundrel. Each word might have been written with his heart's blood, for each seemed to place a mile between Mildred and himself. When he had ended they might have been separated by illimitable space.

He finished the editorial, sent a proof by the boy to Manton, instructing his subordinate to have the article set as soon as Manton's formal acknowledgment came over the wire, and hastened home. He fell asleep after hours of agonized wakefulness.

When he awoke he sat up in bed, wondering why his head ached and all his life seemed hopeless. Then he began to remember. The news must have become general property long ago. Doubtless a panic reigned on the Street. He pictured chaos in a hundred homes, the colonel's fury, Mildred's tears. Then, putting on his dressing gown, he telephoned his office.

"Hello, Blake," he called to his assistant. "What price is Alpacca oil this morning?"

"It's being quoted at 119," answered Blake without hesitation.

"What!" shouted Ormsby. "What about that editorial in the paper?"

"There's nothing about Alpacca oil on our editorial page," said Blake.

"Then those scoundrels have omitted to print it," shouted Ormsby, beside himself.

"Just a minute, please," said the man at the other end. "Here's Mr. Manton. He wants to talk to you."

A moment later the owner's voice came over the wires.

"Hello, Ormsby," he said. "Say, what in thunder did you mean by that piece about Alpacca oil? I caught it just as I was going to bed and stopped it just in time. Why, that's the biggest proposition that's listed today. I'll touch 150 before the week is out."

"You must be mistaken, Mr. Manton," said Ormsby. "I have positive information that—but wait! I'll be down in an hour. Can you wait for me?"

"Come up to my house," said Manton curtly, and hung up the receiver.

Ormsby, smarting and indignant, dressed himself hurriedly and snatched a few mouthfuls of breakfast; then he took a street car up to Manton's house at Carrington Park, a fashionable residential district. He arrived fuming with indignation. He was shown into Manton's study—to find not only Manton but Colonel Ware and Mildred. The colonel was looking sour and Mildred despondent.

"Ah, Mr. Ormsby," said Manton, "you nearly got us into a fine scrape. The 'Observer' has never made so bad a break as you seemed bent upon making for us last night. Lord, if I hadn't caught that editorial of yours in time! I placed such trust in you, Ormsby, that I've passed everything you've written automatically for weeks. But I happen to be interested in Alpacca oil and—"

"Then I'll write you my resignation, sir," said Ormsby.

"Well, it isn't as bad as that," grumbled the owner. "But—"

Colonel Ware took two or three strides up and down the room. He looked at Mildred, whose lips were trembling; then all at once he stopped and thumped his fist down on the table.

"Manton," he said, "I'm pretty tough, but I can't stand for this. I'm the culprit. I meant to tell you, but I didn't know how you'd take it. That boy isn't to blame."

"What do you mean, Colonel?" inquired Manton stiffly.

"You remember George—shabby little fellow with a limp who used to spy on the Knack properties? Well, Manton, it may not have been quite straight, but I meant to let you fellows in on it. I tried to work Mr. Ormsby to give us a fair write-up. When he wouldn't I sent George to him with some fake papers and photographs in hopes he'd write just such an article as he did. If that had got into the paper our stock would have been down to 40—and I'd sold half my holdings to buy it in. Next week, when it was found that Alpacca oil was absolutely sound, it would have jumped to 100 again and I'd have cleared \$75,000. And as it is I've skinned out about \$20,000 to the bad. And you can thank your stars, Manton, that Alpacca oil is sound, or that article would have blown us all sky-high."

"Then the mine is good?" gasped Ormsby.

"None better in Texas, sir," said the colonel shortly. "And since you've skinned me out of \$20,000 with your confounded honesty I guess you'd better take care of Mildred for me. I don't think I'm a fit father for her, somehow."

Our Query and Reply Department

What is the oldest newspaper in the world?

The Peking King-Pan, founded in the ninth century and published continuously to the present time.

Did Ireland ever have a parliament of its own?

An Irish parliament, so called, existed long before the Tudors, but it had no representative character. Henry VIII. was the first to summon chiefs of the native Irish to a parliament in Dublin, but it was not until the reign of George III. that the Irish parliament exercised any authority of its own. Ireland's opportunity came in the course of the American war of independence. In 1782 Grattan succeeded, with the aid of Flood and Malone, in securing the independence of the Irish parliament. At first no Irish Catholic could sit as a member or even vote for one. The right to vote was at last conceded, but a bill entitling Catholics to become members was vetoed by the king, who also refused to sanction the removal of many other disabilities. Irish discontent led to the rebellion of 1798. When this had been suppressed Pitt induced the Irish parliament to pass the act of union which came in force 1801.

Is it proper to sit and contemplate the food on your plate until your hostess is served?

Not every one does it, but it is a good rule and does no harm to observe.

What is a "hookah"?

A large tobacco pipe much used in Turkey, Persia and other eastern countries. It consists of two bowls, one placed over the other. The upper bowl contains the tobacco and is connected by a tube with the lower, which is partially filled with water. The connecting tube passes down into the water. The stem, which is a long, flexible tube, is connected with the air space above the water, and thus the smoke must pass through the water before reaching the smoker. In passing through it is cooled and deprived of most of its harmful constituents.

When was the Brooklyn bridge opened?

May 24, 1883.

Please tell me the attendance at the three largest colleges in the world.

University of Berlin, 10,000; Columbia, 9,500; Munich, 7,500.

What allowances, if any, do the officers of the army receive in addition to their pay?

The chief is the longevity allowance. Officers below the rank of brigadier general receive 10 per cent on the yearly pay of the grade for each term of five years, not to exceed 40 per cent in all; the colonels, lieutenant colonels and majors receive longevity allowances only until the sum of the pay and "fogey," as the army slang designates this item, reaches \$5,000, \$4,500 and \$4,000 respectively, the maximum fixed by law. Any officer below the grade of major, required to be mounted, shall receive \$150 additional per annum if he provides one suitable mount at his own expense, and \$200 if he provides two mounts. Quarters are provided at army posts, and under conditions where quarters are not procurable a commutation is allowed. When travel is performed under orders upon public service mileage is allowed. Food and other household supplies are procurable from the commissary department at rates appreciably below the prices charged in retail shops.

What was Joaquin Miller's real name?

There is some disagreement about this seemingly easily established fact. Most reviewers refer to him as Cincinnati Heine Miller, but since his death old friends claim that his middle name was Hiner and not Heine.

Who is the chief justice of the United States supreme court?

Edward D. White of Louisiana.

Does a life sentence to prison bar a man from receiving a pension or inheritance?

The fact that a person is in prison for life does not affect his right to draw a pension or to inherit property except that, if convicted of murdering a relative, he cannot inherit from the murdered person. He can give his money and property to any one he desires.

What are the points of the compass as related to a person standing at the north pole?

The question is hardly a clear one. To a person standing at the north pole every direction would be south.

What was the height and weight of George Washington?

Washington was six feet two inches in height and powerfully built. His uniforms, of which several specimens are preserved at the National museum, have been found to be uncomfortably snug upon a man of equal height and weight of 250 pounds.

What is the present strength of the Japanese navy?

The Japanese fleet at the end of 1912 consisted of the following vessels: Dreadnoughts, 1; pre-Dreadnoughts, 16; armored cruisers, 13; protected cruisers, 17; torpedo gunboats, scouts, etc., 6; destroyers, 61; torpedo boats, 50; submarines, 12.

PLANS WENT WRONG

Trick of a Spectacular Speculator Foiled by an Honest Man.

By H. M. EGBERT.

"The Alpacca Oil company, sir, is the biggest thing in Texas today," said "Colonel" Ware, looking up at Ormsby from his plate of asparagus. "And what is more, our friends believe in us and are doing all they can to help us—most of them."

There was no mistaking the challenge in the colonel's words. Ormsby looked across the table at Mildred and then fell into a brown study.

Ormsby was assistant editor of "The Financial Observer," a staid, accurate, old-fashioned financial paper, with fifty years of undiminished reputation behind it. That was why it was trusted as few financial papers were. No body had ever doubted the honesty of the "Observer" or imagined that it was representative of any special interest. During the editor's absence on a prolonged sick leave Ormsby had been in full control. He was only twenty-six, but he had won the editor's and the owner's confidence as being proof against all influence.

But other influences than money may be at work in a man's mind. Mildred Ware and Ormsby were acknowledged lovers. And "Colonel" Ware was a speculator—a spectacular one. He had won and lost half a dozen fortunes. Just now his whole fortune was placed in Alpacca oil. He was not a dishonest man, but it was known that he was not above turning a sharp trick or two. And Ormsby had not yet been able to ascertain whether Alpacca oil was a genuine investment or a colossal fraud. And he had challenged Ormsby to further his interests with the stock.

The "Observer" had delayed offering its opinion upon this stock, and in that it had exceeded its customary caution, for Alpacca oil was the sensa-



"Then Look at That."

tion of the week. The rush for shares had been phenomenal; it had forced up the stock from 55 to 108 since Monday. People were demanding the "Observer's" opinion. And while Ormsby was pondering it Ware had flung out his ultimatum. The few quietly spoken words meant, in effect, "Boom my stock or relinquish Mildred."

Ormsby knew that Mildred understood the situation. He knew, too, that while she would wait for him for any number of years she would not leave her father to marry without his sanction. And they were anxious to be married. They had loved each other for two whole years.

Ormsby kissed her good-bye and went down to his office with a heavy heart. That editorial must be written soon.

"There's a man waiting to see you, sir," said the office boy as he entered.

"Show him in," said Ormsby, and a moment later he was looking into the face of his visitor. The man was of a type that Ormsby knew well and instinctively distrusted; the shady, shabby adventurer, who hangs round newspaper offices, offering surprising information for a small sum. Ormsby was not surprised at the man's opening words.

"The 'Observer' hasn't touched on Alpacca oil yet, I notice," he said.

"Well, sir?"

"It's a swindle, isn't it?"

"If it were a swindle the 'Observer' would say so."

"Would it be worth a hundred to me if I prove to you that it's a swindle?" sneered the man.

"No, sir," said Ormsby. "The 'Observer' does not pay for information from outside. I wish you good-evening."

The fellow leered at him and sat down at the table. He pulled a shabby pocketbook from his coat.

"What would you say, young man, if I was to prove that for nothing?" he asked. "Old Ware did me a bad turn once and I'd be glad enough to get even with him."

"I should say that your facts were probably malicious and inaccurate," said Ormsby.

"Then look at that," said the man, handing Ormsby a photograph. "Taken three days ago by me, at the risk of my life. They've put armed guards round the oil-hole since the flow dwindled down."

Ormsby started. He knew the pho-