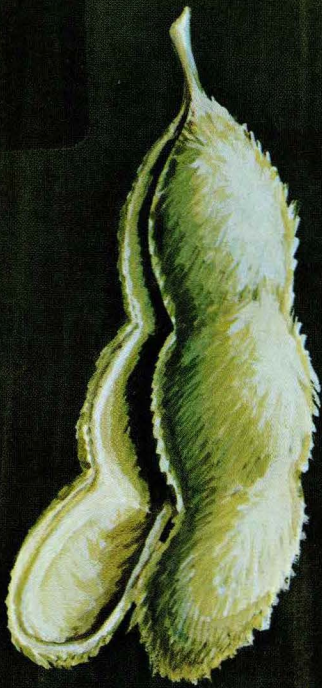


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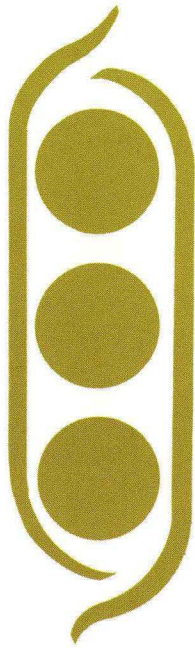
SOYBEAN PLANT



DEVELOPS

by **John J. Hanway**
and
Harvey E. Thompson

contents



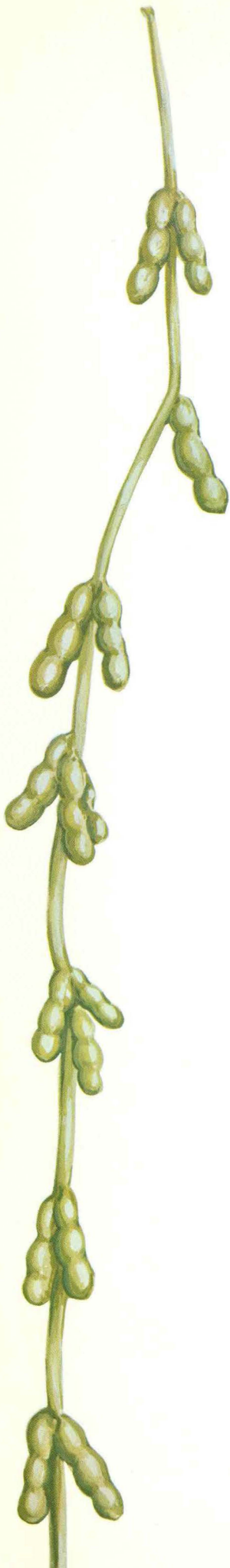
The Illustrations.....	2
Identifying Stages of Growth	2
Summary	15
How A Soybean Plant Grows	15
Nutrient Uptake	15
Fertilizer Application	17
Environment Versus Yield.....	17
Pointers for High Yields	17

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Compiled in this publication are years of research, study and observation of exactly how a soybean plant develops. Photographs and accompanying text record the findings for each major stage of development in the soybean plant's life.

Management guides interpret the research findings into practical application. Knowing the critical management factors at each stage of the plant's development can vitally influence a grower's profit from the soybean crop.

HOW A SOYBEAN PLANT DEVELOPS...



Potential soybean yield is about three times the current average production.

Some growers already harvest three times more than the average. Many farmers produce well below their capability.

New varieties, new concepts about fertilization and culture can turn potential yields into real yields for a greater number of growers.

Science and experimentation have given soybean producers many practices that improve total output from a field of soybeans. Generally, these practices are adaptable over a wide range of situations. They will work under different levels of management. The manager who follows the general recommendation can be confident of getting a profitable return. He can do that without understanding **why** there is improvement—without really knowing **what** effect he causes by using recommended practices.

As knowledge has been gathered, a much greater precision in practices has become possible. And output goes up with precision.

Crop management becomes more complicated as technology becomes more precise. The manager who knows **how** the soybean plant develops and functions can do a more precise job of controlling the forces that affect yield. An understanding of the plant is necessary to make precise decisions on:

- Selection of most suitable varieties
- Seedbed preparation
- Row spacing and plant population
- Fertilizer applications
- Timing of planting, weed control, irrigation and harvesting

This publication is designed for the person who is interested in soybean production precision. The content is both basic and applied. The basic information explains the botanical phenomenon of each major stage in the soybean plant's development. Management guides pinpoint the practices needed for optimum plant growth and production.

Turn the page and see precisely **HOW A SOYBEAN PLANT DEVELOPS.**

THE ILLUSTRATIONS

The pictures, charts and discussion in this publication represent an adapted midseason, indeterminate soybean variety grown in central Iowa.

Soybean varieties are adapted to long belts east and west but to relatively short distances north and south. The flowering mechanism in soybeans is triggered by day length. Each variety has a certain day length requirement to initiate floral development. Most "Corn Belt" soybean varieties will begin flowering in early July when planted at recommended dates.

An indeterminate soybean plant continues vegetative growth after flowering begins. Indeterminate varieties are commonly grown in the Corn Belt. Most soybean varieties grown in the southern part of the United States are a determinate type—vegetative growth stops when flowering begins.

All normal presently grown indeterminate soybean plants follow the same general pattern of development shown and described in this publication. But the specific times between stages, number of leaves developed and plant height may vary between different varieties, seasons, planting dates and locations. For example:

1. An early maturing variety may develop fewer leaves or progress through the different stages at a faster rate than indicated here, especially when planted late. A late maturing variety may develop more leaves or progress more slowly than indicated here.
2. The rate of plant development for any variety is directly related to temperature, so the length of time between the different stages will vary as the temperature varies both between and within the growing season.
3. Deficiencies of nutrients, moisture or other stress conditions may shorten the time between different stages, especially after pod set.
4. The number of seeds and the ultimate seed size for any variety appears to be genetically controlled. But stress factors—such as disease, low fertility and moisture—may reduce

the number of pods and size of seed produced in any one season.

The pictures show plants and plant parts at identifiable stages of morphological (form and structure) development. The plants were grown in the field but were photographed in the laboratory. Scientific names of the parts in a young soybean plant are shown in fig. 1.

IDENTIFYING STAGES OF GROWTH

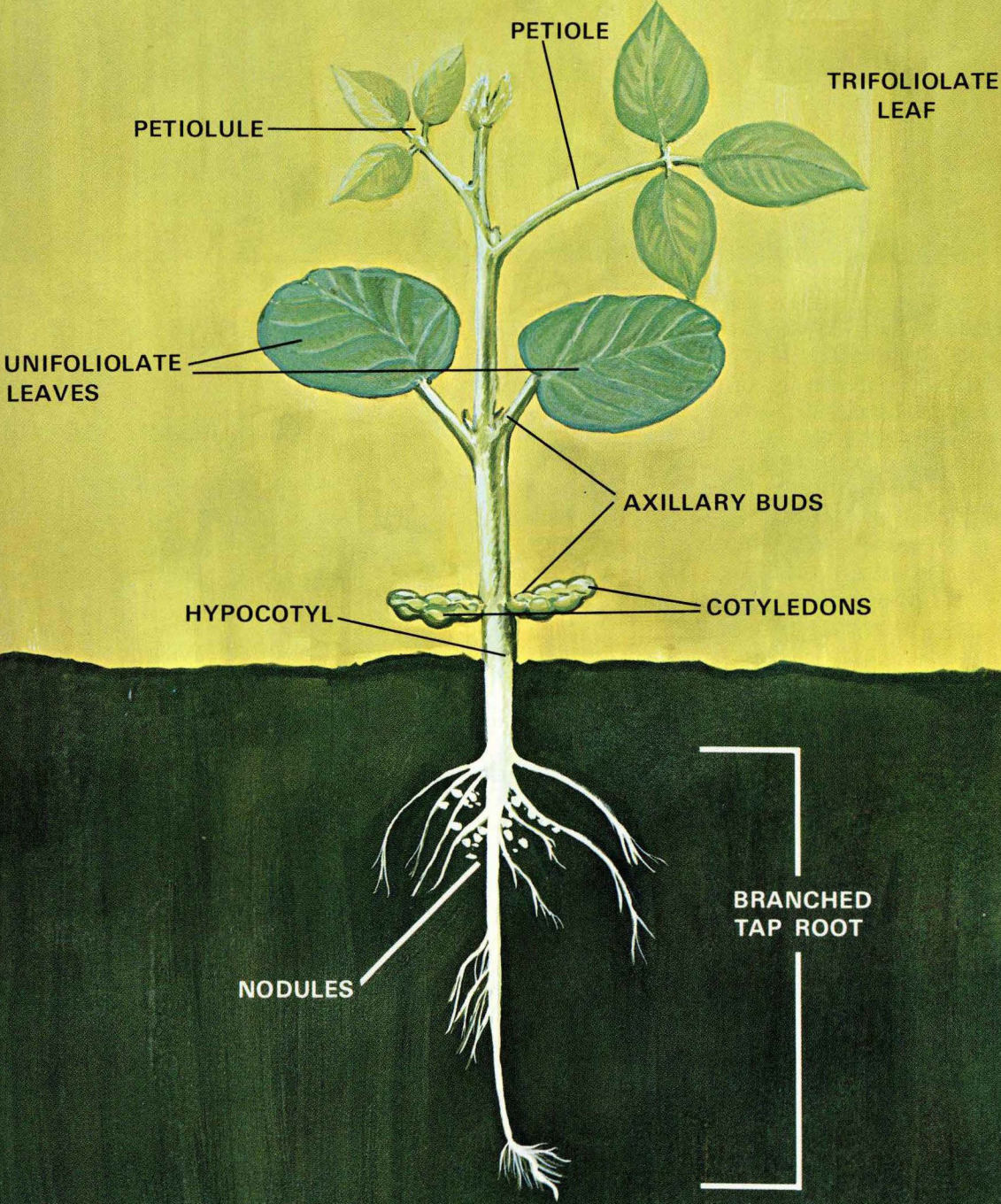
A numbering system is used to identify the different stages of plant development. This is the same numbering system that is used by the hail insurance industry in adjusting hail losses to soybeans. This basic numbering system is also used for corn and is being adopted on an international scale by FAO (Food and Agriculture Organization) for wheat. It is also being considered for rice and other crops.

The stage at which the plant emerges from the soil is stage 0, and the stage when the plant is physiologically mature (all the yield is made) is stage 10. Intermediate stages are assigned numbers between 0 and 10. For example, stage 5 refers to the period when soybeans are in full bloom (flowers found all the way to the top of the plant). A decimal is used to refer to a stage of development that comes between those identified by whole digits. For example, the stage halfway between stage 3 and stage 4 is identified as stage 3.5.

Stages of growth *before* flowering can be identified in the field by counting the number of trifoliolate leaves. These stages are always the same but may occur at different dates. From the beginning of flowering (stage 3) through full bloom (stage 5), stages are determined by leaf number and flowering. Stages 6 through 8 are identified by pod and bean development. Stages 9 and 10 are identified by pod and bean development, leaf color and percentage of fallen leaves.

On the following pages, major stages are described and illustrated with pictures of the plant at the stage being discussed.

FIG. 1. PARTS OF A YOUNG SOYBEAN PLANT.





GERMINATION AND EMERGENCE.

The seed is made up of two halves called cotyledons. Between the cotyledons and attached to them is the plumule (young leaves and stem) and radicle (root).

The seed absorbs moisture and the young plant begins to grow, usually emerging in 5 to 10 days after planting. The time from planting to emergence depends upon moisture and temperature conditions.

Upon germination, the radicle or primary root emerges from the seed and grows downward, where it becomes anchored in the soil. At the same time, the hypocotyl (portion of plant between the cotyledonary node and the primary root) grows toward the soil surface and pulls the cotyledons (seed leaves) through the soil, finally forcing them above the soil surface. Soon after the cotyledons emerge, the hypocotyl ceases to grow.

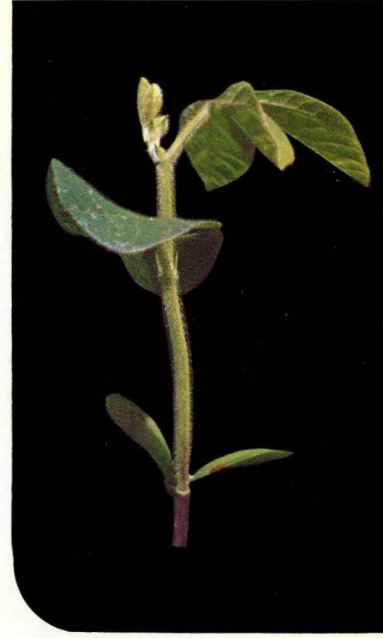
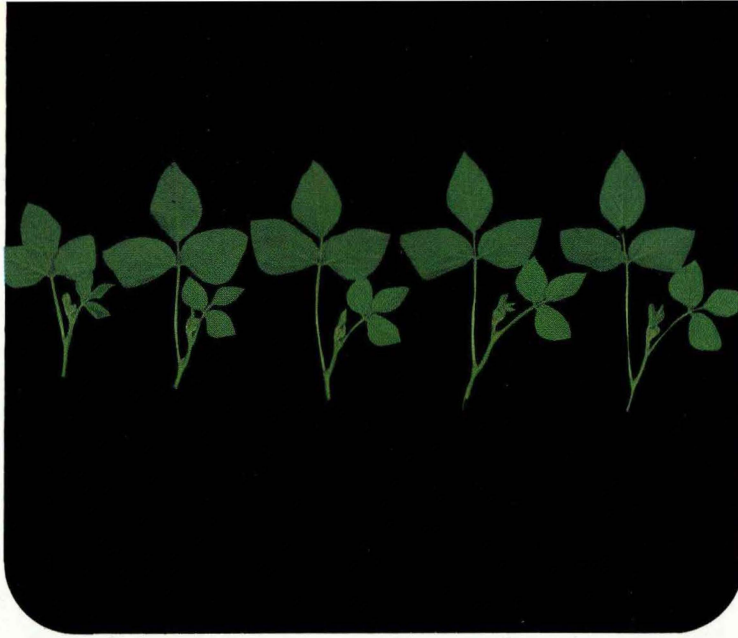
After emergence, the stem elongates from the meristem (growing point) between the cotyledons. This meristem is part of a structure called an epicotyl. The cotyledons nourish the seedling for approximately the first 2 weeks of its life (emergence plus 1 week). During this time, the cotyledons lose 70 percent of their dry weight. Loss of one cotyledon has little effect on the young plant's growth rate. Loss of *both* cotyledons at or soon after emergence will reduce yields 8 to 9 percent.

MANAGEMENT GUIDES

Depth of planting influences the length of time from planting to emergence. Seedlings from deep-planted seeds have a greater depth of soil to penetrate. In addition, temperatures are cooler at greater depths and growth is slower. Soybeans planted at greater depths have more difficulty breaking a crust than those planted closer to the soil surface.

Never plant soybeans deeper than 2 inches—1 to 1½ inches is better.

Weeds compete with soybeans for moisture and nutrients. A light cultivation prior to planting helps control weeds. Once the soybeans are up, the rotary hoe is an excellent tool for early weed control. Treat them rough—two good rotary hoeings should kill 10 percent of the beans as well as the weeds. Herbicides can also be useful tools in weed control. Select the chemical that will best control the complex of weeds in your field and apply it properly.



STAGE 0. UNIFOLIOLATE LEAVES EMERGED.

The first true leaves to appear above the cotyledons are the two unifoliolate (single) leaves. These leaves have a single blade per petiole and appear on nearly opposite sides of the same point on the stem. Loss of these leaves reduces soybean yields less than does loss of the cotyledons.

STAGE 1. DEVELOPMENT OF FIRST TRIFOLIOLATE LEAVES.

At stage 1, the plants are 4 to 6 inches tall, the first trifoliolate leaf is completely unrolled, the second trifoliolate leaf is unrolling.

Trifoliolate leaves have three leaflets per petiole. One of these develops at each node (joint). They serve as the major photosynthetic structure of the plant. A 50-percent leaf loss at this stage would reduce yields about 3 percent.

MANAGEMENT GUIDES

Nutrients and food reserves in the cotyledons supply the needs of the young plant during emergence and for about 1 week after emergence. Since the root system is relatively small and the soil is cool, a high concentration of fertilizer nutrients stimulates early plant growth. However, the amounts of nutrients required are relatively small.

Fertilizer placed in a band 1 to 2 inches to the side and slightly below the seed—where the early root system will contact it—will be effectively taken up at this stage. Roots are not attracted to this fertilizer band, so the fertilizer must be placed where the roots will be. Placement of too much fertilizer too near or with the seed can result in salt injury to the young plant.

MANAGEMENT GUIDES

The leaf carries on the primary unique function of the plant—photosynthesis. Photosynthesis is the process by which plant cells make sugar from carbon dioxide and water in the presence of chlorophyll and light. Yield is a function of light interception by the leaves. The earlier in the growing season that most of the sunlight is intercepted by the leaves, the greater is the yield potential.

Soybeans planted in 20-inch rows will intercept most of the available sunlight earlier in the year than soybeans planted in 40-inch rows. They will also yield 15 to 25 percent more, depending on variety.



STAGE 2.2. FOUR TRIFOLIOLATE LEAVES.

Plants at stage 2 are 7 to 9 inches tall. Three trifoliolate leaves have completely unrolled, the fourth one is unrolling. Some plants have dropped one or both cotyledons.

Plants at stage 3 are 12 to 14 inches tall. Five to 6 trifoliolate leaves have unrolled. One to 5 percent of a field of plants are flowering.

The junction of the main stem and a leaf is called an axil. In each axil, a structure referred to as an axillary bud is present. This bud may (a) develop into a branch, (b) form a flower cluster and finally pods, or (c) remain dormant. Axillary buds that develop into flowers develop toward the base of the stem (commonly starting at the fourth or fifth nodes). They develop progressively later toward the tip. Fifty-percent leaf loss at stage 3 reduces yields approximately 3 percent.

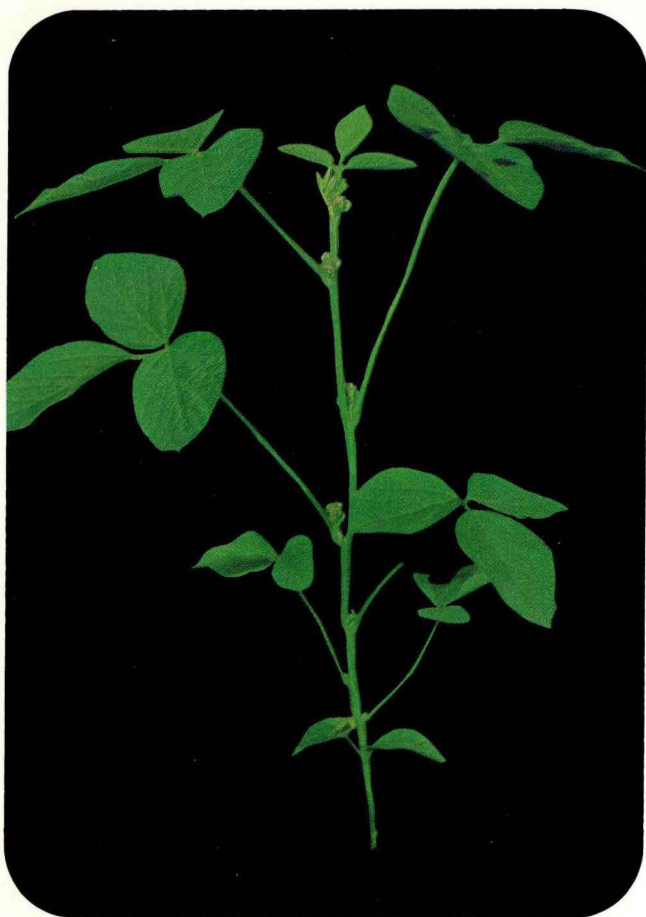


STAGE 3. BEGINNING FLOWERING.

MANAGEMENT GUIDES

The soybean plant has tremendous capacity to recuperate from damage such as from hail. The buds in the axils of the unifoliolate and trifoliolate leaves and the cotyledon are largely responsible for the soybean's ability to survive damage.

The buds in the axils of the cotyledons frequently form one or more new stems if the plant is cut off immediately **above** this point. If the stem is severed at some point in the trifoliolate leaf area, those buds remaining will be stimulated to form new branches and leaves. This reaction is apparently due to the loss of dominance which the stem apex has over the plant's growth. Whenever this stem apex is removed, the axillary buds grow more profusely. Severing the plant **below** the cotyledon kills it, because there are no buds below the cotyledon attachment.



STAGE 3.7. MID-BLOOM.

At stage 4, plants are 15 to 18 inches tall. Seven to eight trifoliate leaves are unrolled. There is stem branching. Forty to 60 percent of plants are flowering, with one to four flowers per plant.

Stage 5 is reached about July 20 in central Iowa. Plants are 21 to 24 inches tall. Nine to 10 trifoliate leaves are unrolled (one trifoliate and both unifoliate leaves are lost). More stem branches are evident. This is the full bloom stage with withered flowers in lower leaf axils.

Fifty-percent defoliation at this stage reduces yield about 9 percent.



STAGE 5. FULL BLOOM.

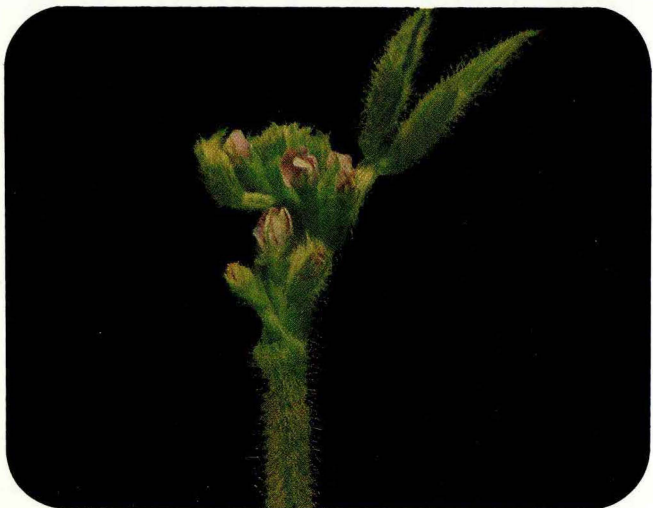
MANAGEMENT GUIDES

Plant population affects podding height, lodging and competition with weeds. High populations compete with weeds. They pod higher, but lodge more compared with low populations.

Optimum yields and satisfactory pod height, standability and weed competition are obtained with a planting rate of 12 beans per foot of row in 40-inch rows, 9 in 30-inch rows and 6 in 20-inch rows with bushy or "fat-line" varieties such as Hawkeye. For "thin-line" varieties, such as Amsoy and Hark, plant about 15 beans per foot of row in 40-inch rows, 11 in 30-inch rows and 8 in 20-inch rows.



Plant with leaves removed, shows beginning pod development at lowest nodes and flowering at all upper nodes.



Plant at full bloom. Flowering at all nodes to top of plant.



Closeup of soybean flower calls attention to the beautiful bloom.



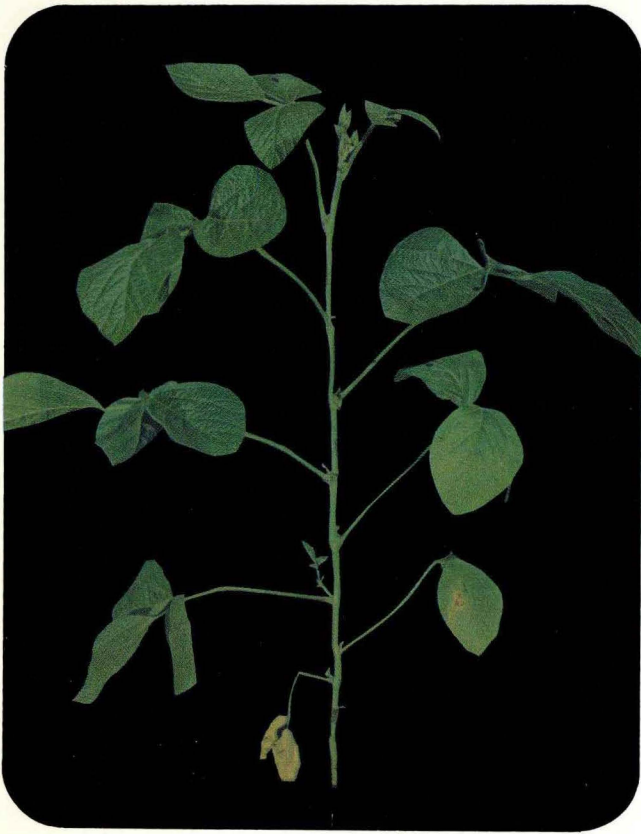
Lower node showing early pod development, withered and fresh flowers on same plant.

STAGE 5.5. BEGINNING OF POD DEVELOPMENT.

MANAGEMENT GUIDES

Soybeans start flowering at the lower nodes and flower progressively up the stem. It is not uncommon to find pods, withered flowers and buds on the same plant. Under Corn Belt conditions, soybeans will flower during about a 3-week period. About 70 to 75 percent of the soybean flowers abort—never form pods.

We haven't learned to take full advantage of the potential of this plant. Practices such as fertilization, narrow rows, proper planting rate and weed control are all attempts to reduce the amount of flower abortion and thus to increase yields.



Plants 26 to 28 inches tall. Pods in lower half of plant are well-formed and up to 1/2 inch long. Blooming is nearly complete.

STAGE 6. RAPID POD GROWTH.

MANAGEMENT GUIDES

Stage 6 is the end of the flowering period and the beginning of rapid pod formation. The bean filling period lasts 3 to 5 weeks. Stress (lack of moisture, light or fertility; too much heat; or physical damage) during this period causes greater reduction in yield than the same amount of stress earlier in the growing season. Stress at this time reduces the number of beans per pod and reduces bean size.

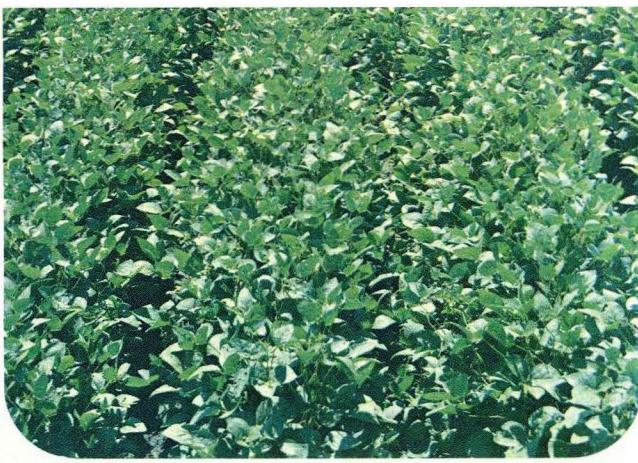
Where possible, irrigate to assure adequate moisture for bean production. Losses from hail are greater than at any earlier period in plant development.



Plants at successive stage of pod development. Left plant at stage six.



From left to right the progressive increase in size of pods from top to lower part of a soybean plant.



STAGE 7. BEANS GROWING IN SIZE.

The pictures above show the difference in growth habit between varieties. Both fields were planted the same day in 40-inch rows, and both pictures were taken the same day. Both varieties are at approximately stage 7.

Left field is Chippewa 64, right is Hark. Chippewa 64 is a typical bushy or "fat-line" variety that fills in 40-inch rows by about stage 6 or 7. Hark is a "thin-line" variety that does not fill in 40-inch rows. Hark also has a more upright leaf which allows for greater light penetration into the leaf canopy so more leaves receive light to carry on photosynthesis.

When planted in narrow rows, "thin-line" varieties usually yield more than "fat-line" varieties. Weeds can be a problem in "thin-line" varieties planted in 40-inch rows since these varieties will not shade the middle of the row.



Nodules contain millions of bacteria (*Rhizobium japonicum*). The bacteria enter the soybean root hairs and work with the plant through a process called symbiosis. Bacteria in nodules convert nitrogen from the air into a form usable by plants. In time, the plant supplies sugars to the bacteria.

Recent experiments indicate that: (1) Well nodulated soybeans do not need nitrogen fertilization. (2) Nodulation and nitrogen fixation are decreased by high soil nitrogen. (3) When soybeans are grown regularly in a rotation, they may not need to be inoculated each time. (4) It may be possible to increase symbiotic N fixation further with more competitive and effective strains of nodulating bacteria, together with improved inoculation techniques.

Liming, fertilization and management to provide ideal conditions for these bacteria (as well as the soybean plants) result in higher yields.

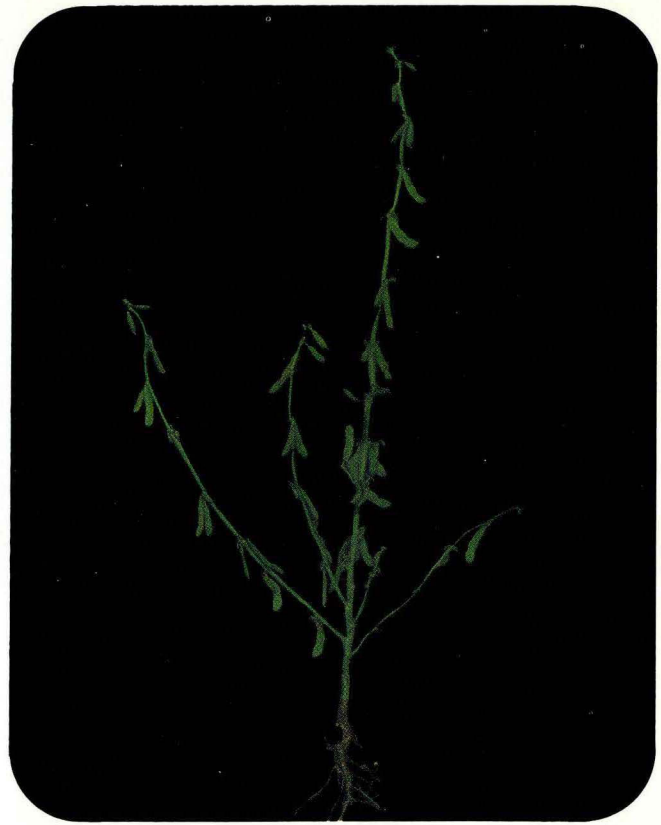


Right: Healthy, normal soybean plant. Plant on left has brown stem rot. Brown stem rot is caused by a soil-borne fungus that enters the plant through the roots or lower stems. The center of the lower stem in infected plants is destroyed by the fungus. This lowers yields—as much as 30 percent or more in severely infected fields. There is no profitable treatment for an infected field.

Control of the disease involves: (1) identification—split lower 3 to 4 inches of stem and look for brown color; (2) if brown stem rot is present, grow 3 years of corn or other crop before returning to soybeans; (3) do not border cornfields with soybeans; (4) use a rotation to prevent buildup of brown stem rot.



At stage 7, plants are 31 to 34 inches tall. Fifty-percent defoliation at this stage reduces yield about 18 percent.



Leaves removed showing podding to top of plant. Lower pods nearly full length with beans developing. Flowering has ceased.

STAGE 7.4. BEANS ARE FILLING RAPIDLY.

MANAGEMENT GUIDES

Beans are filling rapidly at this stage. Demand for moisture and nutrients is large. Have at least part of the phosphorus and potassium plowed down where the soil will more likely be moist; the nutrients will be more available to the plants.

Hail at this stage causes greater yield reduction than at any other stage—either earlier or later. At stage 7, the beans are beginning to fill. Leaf removal by hail removes the photosynthetic factory that manufactures the food that will be stored in the beans. One hundred-percent leaf loss at stage 7 can reduce soybean yields by more than 80 percent.



Fully developed pods with beans. Pictures left to right show increase in size of beans from top to bottom of plant.

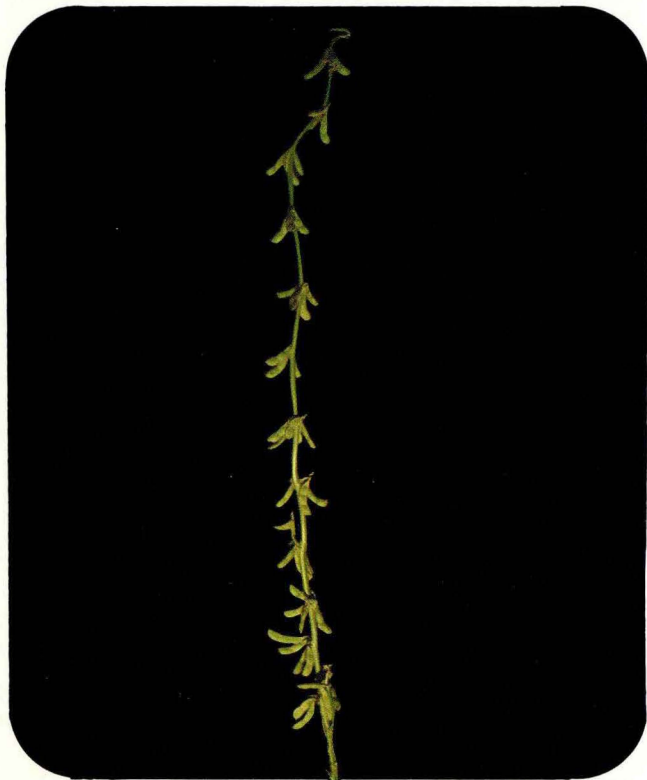


Plant 33 to 36 inches tall. Bottom leaves beginning to yellow; top pods almost fully developed, approaching "green bean" stage. Fifty-percent leaf loss will cut yields 7 percent.

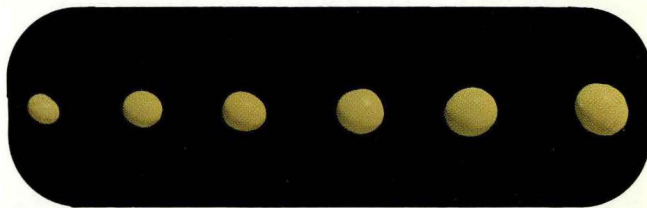


Plant had been partially lodged. All leaves growing toward the light or top side of plant.

STAGE 9. APPROACHING "GREEN BEAN" STAGE.



Stem with leaves removed showing pods about same size along full length of stem.



Dried seeds weighing 0.10, 0.15, 0.20, 0.25, 0.30 and 0.35 grams. All such sizes may be found on plants at stage 9.

MANAGEMENT GUIDES

Branched plant at upper left is indication of low population. Branching is the soybean's way of compensating for low population. But harvest losses from branched plants are often high if field is ridged from cultivation.

Plant at upper right is an example of excessively high population. The plant grew tall and lodged. Toward upper part of the stem, there is only one pod per node on several nodes, which is typical on lodged plants. This condition reduces yields in addition to increasing harvest losses.



Plants 34 to 37 inches tall. Leaves 30 to 50 percent yellow with a few falling. Lower pods yellowing.



Leaves on plant at this stage range from green at the upper part of the plant to yellow and falling on the lower part.

STAGE 10. APPROACHING MATURITY.



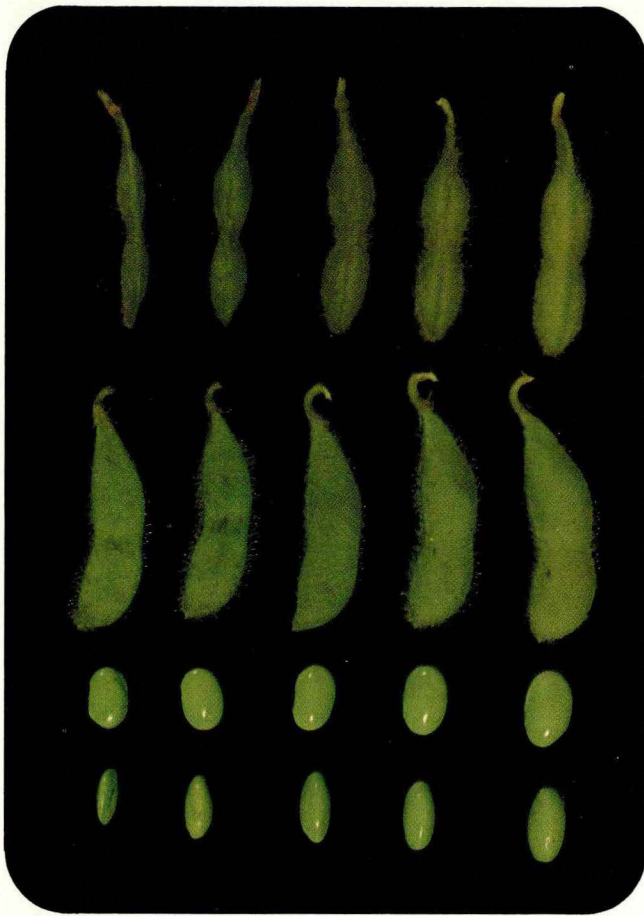
Stem of plant with leaves removed, showing pod development along entire stem.

MANAGEMENT GUIDES

Accumulation of dry matter in the beans begins at stage 7 and continues at the same rate through stage 10, about 35 days later. Rate of dry matter accumulation ranges from 60 to 90 pounds per acre per day.

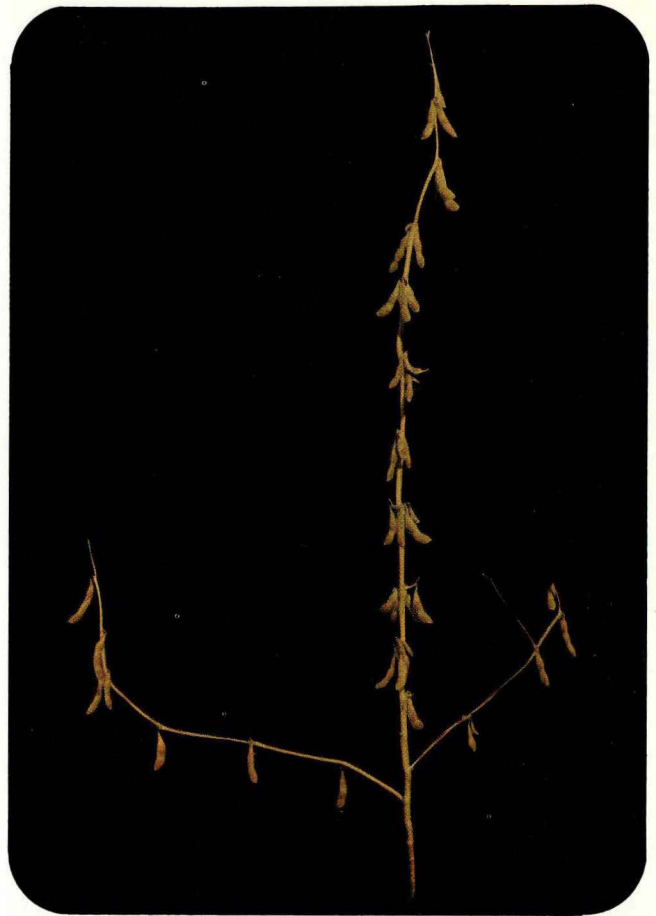
There is relatively little difference between varieties in the rate of dry matter accumulation in the seeds. Seed yields depend upon **the rate** of dry matter accumulation in the seeds and **the length of time** that dry matter accumulates in the seeds. There is often relatively little difference between adapted varieties in the rate of dry matter accumulation, but they do vary in **the length of time** that dry matter accumulates in the seeds. Stress (lack of moisture, nutrients, diseases, hail, etc.) may influence both the **rate** and **length of time** that dry matter accumulates in seeds.

The potential number of seeds and the ultimate seed size for any variety appears to be genetically controlled, but various environmental factors may reduce the number or size of the seeds produced. This may explain why there is a severe decline in soybean yields when plants are damaged by hail after pods begin to form, particularly at stage 7.



Pods and seeds removed from the same plant on Aug. 16, Aug. 23, Sept. 6, and Sept. 13 (left to right) respectively.

MATURE STAGE.



Mature soybean plant. Leaves have fallen and crop is ready for harvest. Ideal moisture content at harvest is 13 percent.



Pods and beans showing development from green (left) to mature, respectively.

MANAGEMENT GUIDES

All of the yield is made. Wait until the moisture is down to 13 percent before combining. To reduce harvest losses: drive slowly, check concave clearance, check cylinder speed, check sieves and air velocity. Be sure reel speed and ground travel are synchronized to minimize sickle-bar shatter loss. Leave a short stubble. A 3½-inch stubble contains 5 percent of the crop; a 6½-inch stubble, 12 percent.

SUMMARY

How A Soybean Plant Grows

Soybean plants increase in weight slowly early in the growing season, see fig. 2. Leaves, petioles and stems are the principal plant parts up to stage 5. Their individual dry matter accumulation patterns are the same as for the total plant. Although not easily seen, pods start to form at stage 5.

It appears that dry matter accumulates at the same rate between stages 5 and 9. Accumulation of dry matter in the bean begins at stage 7 and continues at the same rate until stage 10. The rate of dry matter accumulation in the beans during this period will range from 60 to 90 pounds per acre per day. Stress (lack of moisture, disease, etc.) influences more the length of time than the rate of dry matter accumulation.

The number of seeds and the ultimate seed size for any variety appears to be genetically controlled, but various environmental factors may reduce the number or the size of the seeds produced. This may explain why there is a severe decline in soybean yields when

plants are damaged by hail after pods begin to form, and particularly at stage 7.

If a soybean plant is grown without competition from other plants, it will branch profusely and have a large number of pods per plant. Increasing the number of plants in a given area increases height, increases lodging, reduces branching and reduces the number of pods per plant, but allows more pods and beans per unit area. As lodging increases, yield decreases. The optimum plant population is different for different varieties and in different environments.

Highest yields are obtained only where environmental conditions are favorable at all stages of growth. Unfavorable conditions in early growth stages may limit the size of the leaves (the photosynthetic factory). In later stages, unfavorable conditions may reduce the number of pods set, reduce the number of beans per pod, and reduce the size of each bean.

Nutrient Uptake

High soybean yields require adequate mineral nutrition. All growth requirements must

Fig. 2. TOTAL PLANT WEIGHT

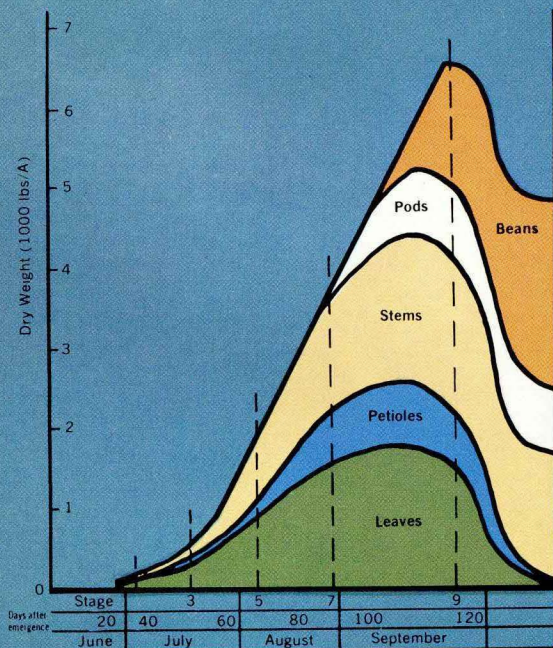
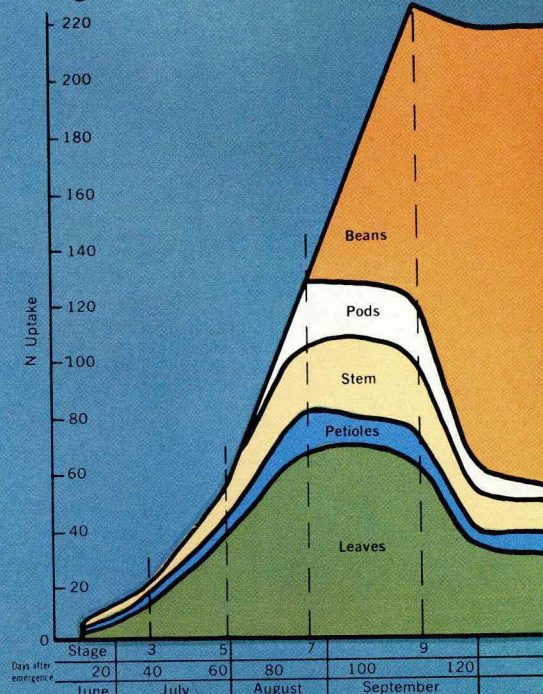


Fig. 3a. NITROGEN



be provided in proper combination in order to achieve optimum production. From a physiological viewpoint, nutrient deficiencies primarily inhibit either growth or sugar utilization. Mineral nutrition of soybeans is very complex and is less well understood than for many other field crops.

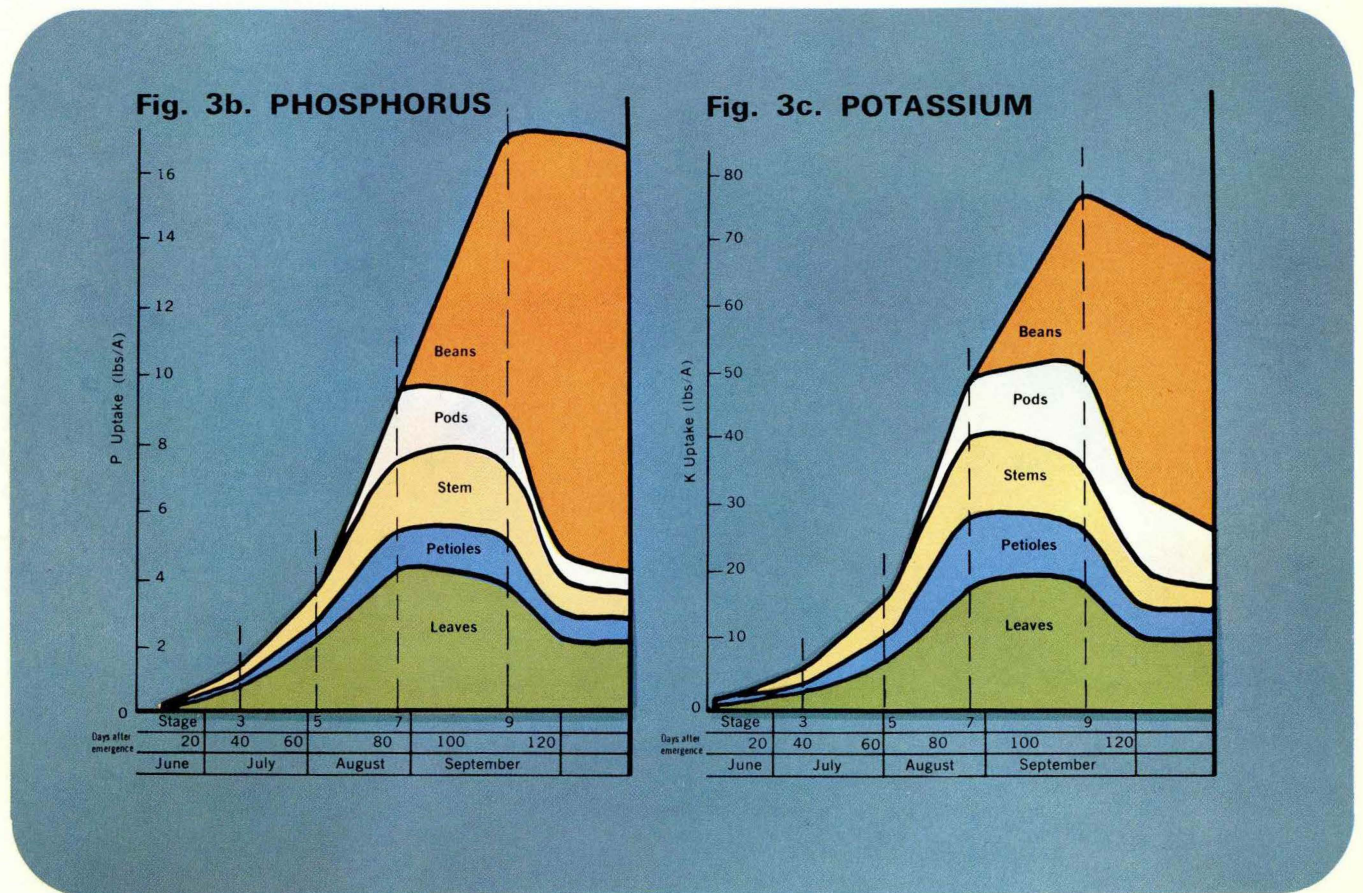
Nutrient uptake by soybeans will vary depending on season, variety and fertility status of the soil. The amount of nutrients taken up by soybean plants early in the season is relatively small because the plants are small. The rate of nutrient uptake increases at about stage 3 as the plant grows and develops. However, an adequate supply of nutrients at each stage is essential for optimum growth and development.

The uptake of nitrogen, phosphorus and potassium (fig. 3) is at a relatively constant rate from stage 5 through 9. This is in contrast to corn where potassium uptake is completed soon after silking. Plants with adequate nutrition can take up a greater quantity of nutrients than required for immediate needs. These nutrients are stored in older tissues to be redistributed to tissues of great

est need during a period when plant uptake does not meet immediate needs. All of the mineral nutrients are translocated (redistributed) in varying degrees during plant growth. Much of the nitrogen, phosphorus and some of the potassium are translocated from other plant parts to the beans as they develop.

When the soil cannot supply the plant nutrient requirements, fertilizers must be added to supplement the nutrient supply. Yield increase is a measure of the effect of added nutrients. Uptake of added nutrients is not an efficient process. Recovery the year of application under good conditions ranges from 5 to 20 percent for phosphorus, and 30 to 60 percent for potassium.

At maturity, the beans contain approximately 75 percent of the nitrogen and phosphorus and about 60 percent of the potassium taken up by the plant. The stems, pods and petioles contain a higher concentration of potassium than of nitrogen and phosphorus. This relatively large removal of nutrients in the harvested beans should be reflected in the fertility management for crops following soybeans.



The soybean plants (as well as the symbiotic bacteria associated with them) require other nutrients such as calcium, magnesium, sulfur, iron, boron, manganese, molybdenum, zinc and copper. These nutrients are not as commonly deficient in soils as are nitrogen, phosphorus and potassium. However, on certain soils, liming is beneficial to correct acidity (to pH 6.0 to 6.5) and to supply calcium.

Fertilizer Application

Although only relatively small amounts of fertilizer nutrients are required in the very early stages of plant growth, high concentrations of nutrients in the root zone at that time help promote early plant growth. Even though the amount of nutrients taken up is relatively small, final size of the leaves and of the total plant depends to a large degree upon having an adequate supply of nutrients available to the plant during this early part of the growing season.

During early growth, the root system is small. Fertilizer placement in a band 1 to 2 inches to the side and slightly below the seed can help get the young soybean plant off to a good start. Placing the fertilizer too near the seed or with the seed can result in salt injury to the plant. Soybeans are much more susceptible to salt injury than is corn.

At later stages of growth, the plants require much larger amounts of nutrients. These nutrients must be in moist soil, because roots function only in moist soil. Since nutrients are taken up only from moist soil, it is necessary to plow under adequate amounts of fertilizer to supply nutrients to the plants at the later growth stages.

Environment versus Yield

Light, air (oxygen and carbon dioxide), temperature, water and nutrients are the primary environmental factors influencing soybean yields. Each soybean variety has a genetically determined yield potential. Environment determines how closely actual yield approaches genetic potential. Potential yield is seldom achieved because at some time during the growing season, one or more of the environmental factors are limiting.

Environmental factors can be differentiated on the basis of the processes they influence.

Water and nutrient uptake factors are water, oxygen and nutrients in the soil. Soil cultural practices influence these factors. *Photosynthetic factors* are light, carbon dioxide and water. *Growth factors* are photosynthate (sugars), water and nutrients. *Yield product factors* (protein, oil, etc.) are photosynthate (sugars) and nutrients.

Vegetative development depends upon abundant sugar to make leaves, stems and other plant parts. Moisture stress may limit plant development through reduced carbon dioxide availability. Under moisture stress, the stomates in the leaves may close, making carbon dioxide unavailable for photosynthesis.

Nutrients, especially phosphorus, are required for rapid cell division and growth. During seed set, abundant sugar and nutrients are needed to nourish the young embryos or an unusually high number will abort. Moisture stress may also cause embryo abortion through retarded growth.

With good vegetative development and high seed set, yield becomes dependent upon environment during the *yield product formation*. Environment affects both number and size of seed. *Yield product formation* is almost entirely determined by sugar availability (influenced by the photosynthetic factors of light, carbon dioxide and water) and abundant nutrients to convert the sugar to protein, oil or starch. Moisture stress will influence yield products almost entirely through the photosynthetic mechanism.

Pointers for High Yield

The illustrations tell us that the amount of beans produced by the soybean plant depends upon the rate and length of time of dry matter accumulation. To produce high yields, then, carry out all known cultural practices to maximize the rate and length of time of dry matter accumulation in the grain. More specifically—

- Fertilize according to soil test.
- Prepare a good seedbed.
- Select the variety best suited to your farm operation.
- Plant at the optimum population and row spacing.
- Eliminate competition from weeds, diseases and insects.
- Avoid ridging when cultivating.
- Harvest all you produce.



Many people never see the dramatic beauty of the soybean flower, though ever-increasing acres of soybean fields dot the Iowa landscape. Photographic closeups like this make even the soybean growers more aware of the beautiful flower.

Flowering begins at the lower nodes of the soybean plant, and blooms unfold progressively up the stem. Following pollination, pods develop from the fertilized ovary of the flower. Seeds then develop within the pod, and their birth at harvest completes the soybean's life cycle.

Unfortunately, about three-fourths of the soybean flowers abort. Since no pods and seeds develop from aborted flowers, yield is only about one-fourth of the genetic potential. Practices such as fertilization, narrow rows, proper planting rate and weed control are attempts to reduce flower abortion and thus increase yields.