ILLINOIS
SOYBEAN PRODUCTION GUIDE

Department of Agriculture
Illinois State University

Systematic Strategies to Increasing Yields

Illinois Soybean Association

Our Soy Checkoff
Progress Powered by U.S. Farmers

ILLINOIS SOYBEAN ASSOCIATION

The Illinois Soybean Association (ISA), with support from the Illinois soybean checkoff, focuses on targeted strategy to maximize profitability and produce measurable results for Illinois soybean farmers. As we approach the year 2020, our objectives include:

- utilize 600 million bushels of Illinois soybeans,
- develop the highest quality soybean, soy oil and soy meal products,
- implement best management practices to maximize profitability,
- and increase soybean production in a sustainable manner to meet global market needs.

ISA identifies several target areas to support and increase global market share for Illinois soybeans, including animal agriculture, transportation, yield, high quality, sustainability, market access and advocacy, aquaculture, industrial uses, image building, alignment, producer communications, organization excellence and other revenue. For more information, contact:

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ISA Mission Statement:
To ensure Illinois soy is the highest quality and most dependable, sustainable and competitive in the global marketplace.

ISA Vision Statement:
ISA strives to enable Illinois soybean producers to be the most knowledgeable and profitable soybean producers around the world.

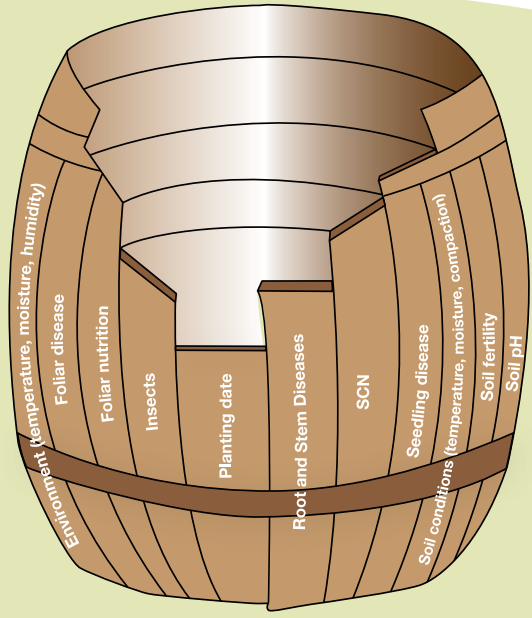
ILLINOIS SOYBEAN ASSOCIATION

Introduction

The opportunity to increase soybean yields is at the fingertips of every soybean farmer in Illinois. It begins with understanding the needs of the soybean, the environment it prefers, adopting the best agronomic practices and stacking technology to optimize yield.

Improving soybean production on your farm requires a systematic approach. Make sure you account for the entire production system – from seed selection to soil preparation, to planting and weed and pest control, all the way through harvesting – all in one continuous loop of possible decisions you can make. You must strive to optimize all factors, not just eliminate limitations. Learn to exploit the plant itself.

Liebig's Law of the Minimum states that just one factor can limit plant growth, and that can cause yields to stagnate even if all other factors are optimal. This law compares the potential of a soybean crop to a barrel made from planks of varying lengths. Such a barrel could be filled only as high as the shortest plank. The barrel's capacity can only be increased by remediating the limiting factor – in this case, lengthening that shortest plank. As your crop's manager, make sure you're working with the longest possible planks to reach your optimal yield potential.



Liebig's Law Barrel
To maximize production, all limiting factors must be accounted for and optimized.

Breaking Your Own Yield Barrier

So how do you go about breaking your soybean yield barrier? First, identify that barrier – is it 45, 55, 65 or 75 bushels per acre? Increasing soybean yields can be a greater challenge than increasing corn yields. Corn seems to be more responsive to new technology, thus corn yields have increased at a faster rate than soybeans. Many farmers believe corn possesses more yield-improving opportunities, so they've concentrated their efforts there at the expense of soybeans. But that perception is far from the truth. In fact, with some additional knowledge, a few changes in practices and the adoption of new technology, most soybean farmers could add five to ten bushels per acre. But it does take some effort.

Breaking your yield barrier begins with assessing your practices and seeing how they measure up to university and industry recommendations. For example, planting full-season varieties early usually out-yields planting short-season varieties.

Your challenge comes in three stages:

1. Select the best variety with the optimal defensive package for your field.
2. Adopt the best agronomic management practices to optimize your yield.
3. Look for add-on technologies like seed treatments, starter fertilizers starters, foliar fertilizer and foliar fungicides to increase yield.

Ask yourself questions to figure out what barriers exist, then develop a strategy to break those barriers and achieve yields beyond what you thought were possible.

Setting Yield Goals

Soybean farmers continually strive for higher yields but sometimes become frustrated when they do not achieve their goals. This disappointment can lead to a mindset where efforts to improve soybean production take a backseat to other crops such as corn.

To achieve higher yields, soybean farmers should be willing to do things differently, perhaps even design a new management system. Developing a new strategy for soybean production takes time and effort, and desired results may not come as fast as farmers would like. A new approach requires studying the latest technologies from reliable sources, testing ideas, making changes, talking to others, filtering information and moving forward.

Soybean farmers need to be flexible enough to embrace new technologies and methods. They need to look above and beyond their current cultural practices. They can tweak plant populations, planting depth, row spacing and seed treatments to improve stand and, ultimately, yields, but other factors can also contribute to moving the yield to a higher plateau.

To move yields to the next level, the soybean farmer must first examine their basic production system. Have you adopted the best agronomic practices for your geographic area? Have any practices or products been overlooked or neglected? Once satisfied with those answers, soybean farmers should begin to consider value-added technologies that can be "stacked on" to their production system.

Ways to Reach the Next Yield Level

Consider integrating these additional technology options on top of sound agronomic practices:

- Protect the seed with a seed treatment
- Protect the crop from insects and foliar diseases
- Remove weeds early and completely to prevent in-season competition
- Feed and stimulate the crop through foliar nutrition
- Develop strategies to manage Soybean Cyst Nematodes (SCN)

Understanding the Soybean Plant

Basic agronomic requirements for soybean production

Soybeans have adapted to diverse environments around the globe, from Argentina to Canada to China to Australia. However, to produce a crop, farmers should pay attention to the plant's specific requirements.

As a cool-season crop, soybean seeds require soil temperatures between 55 and 60 degrees to germinate. Plants require air temperatures of at least 68 degrees during the summer, about 25 inches of water and about five months from germination to harvest.

Soybean varieties can either be determinate or indeterminate. Southern varieties tend to be determinate (Maturity Group, (MG) 5 to MG 8), which means they cease vegetative growth when the main stem terminates in a cluster of mature pods. Northern varieties are indeterminate (MG 00 to MG 4.9) and develop leaves and flowers simultaneously after flowering begins.

Soybeans respond to the length of days and begin to flower as nights become longer. Select varieties that have been specifically adapted to your area. Planting a specific variety farther north than its adapted range will extend the period of vegetative growth and delay flowering and maturity due to longer days and cooler temperatures. Planting a variety farther south than its appropriate range shortens the vegetative growth period, causing earlier flowering and earlier maturity due to shorter days and warmer temperatures.

Soybeans adapt to a range of soil textures and conditions. Soil pH should be 6.5 or above, so apply lime accordingly. Loose, well-drained, loamy soils are most ideal. Fields can be compacted or become crusted as soils dry out, to manage for both.

Soybeans require all the same nutrients as corn and wheat, but they require them in different amounts. Soybeans, as a legume, fix enough nitrogen to produce 50 bushels and depend on soil nitrate for the rest. Without sufficient nitrogen, crop yields could run short. Lastly, if you apply phosphorus or potassium before corn and let soybeans scavenge for what's left, you could be short-changing yourself in fields with low soil test levels. Apply appropriate fertilizers for soybeans.

Understanding the language of the soybean plant

Soybeans produce seed-bearing pods, and the goal of any soybean farmer should be to produce and fill as many pods as possible. However, this process begins with flower set. The number of flowers is determined by the number of nodes on the main stem and branches with flower-bearing nodes. The greater the number of nodes and branches, the greater the flowering potential.

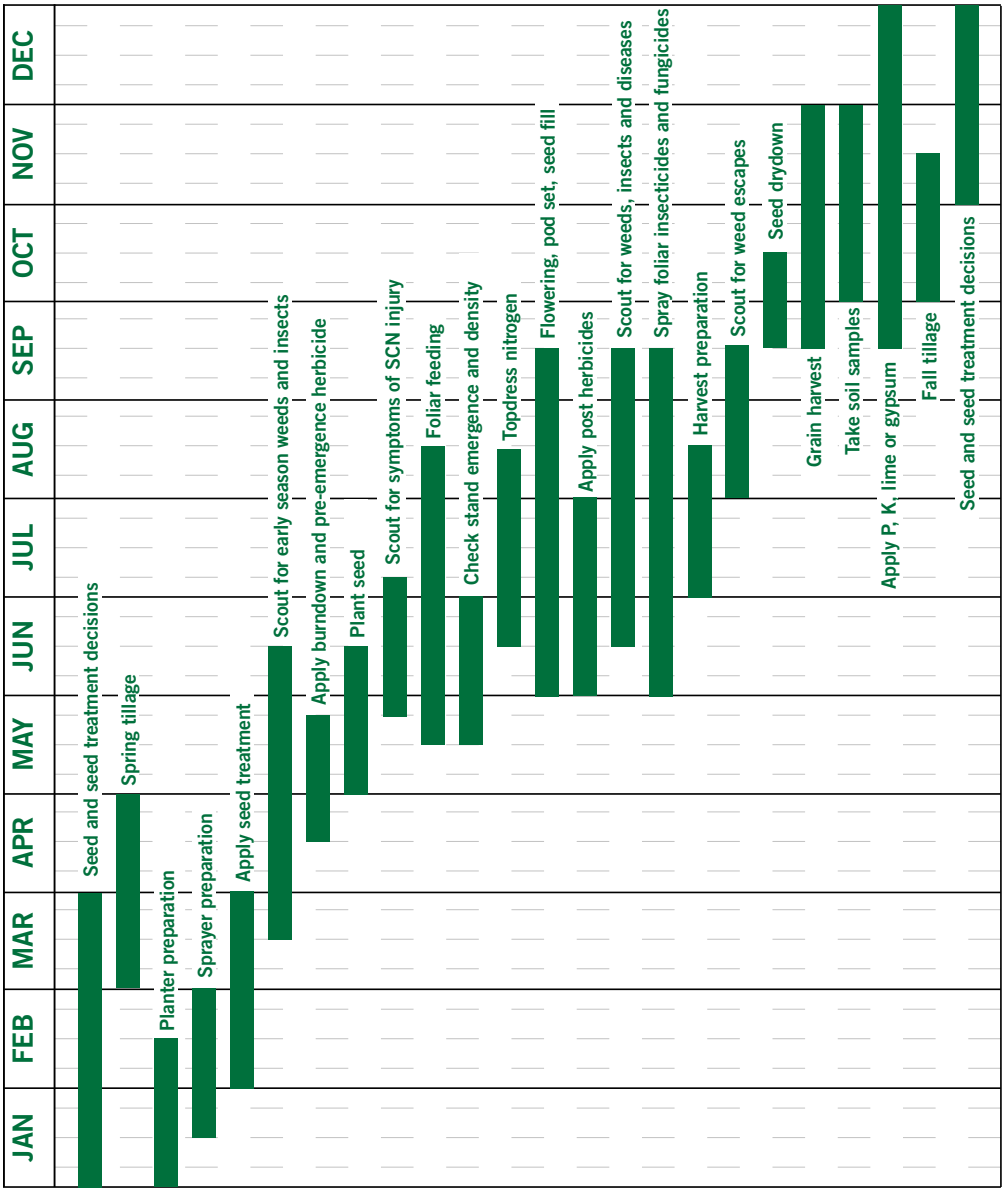
Soybeans have an almost unlimited potential to produce flowers. However most of these flowers abort and never produce pods. Eliminating or mitigating stress ensures that a greater number of flowers will survive to produce pods. Technologies have become available to increase node number and flower set with more flowers surviving to become pods. For pods to survive and become seed-bearing, they need to reach a length of at least one-fourth of an inch.

Lastly, filling each pod with 2, 3 or 4 seeds requires ample supplies of nitrogen, other nutrients and sugar. It also requires mitigating stresses. Similarly, technologies have become available that keep the foliage green, fight off fungal attacks on the leaf and provide the necessary nutrients to fill the pod.

Managing Stress

Stress remains one of the primary obstacles to increase yield, and it can come from all sides: soil, climate or weather, pests, diseases, insects, weeds, nutrient deficiencies and lack of proper management. Preventing or mitigating stress in a timely manner remains one of your primary roles as a crop manager.

Full-Season Soybean



Top Management Tips:

1. Improve the physical aspects and health of the root zone.

2. Customize varieties for each field.

3. Monitor soil pH and fertilize soybeans separately from corn.

4. Plant early and pay attention to depth. Try to plant early to take advantage of as much of the growing season as possible and plant deeper into moisture.

5. Choose the right row spacing and plant population to optimize production, save on seed and take advantage of your equipment configuration.

6. Rotate with corn and other crops. Keeping soybeans out of a field for one or two years improves yield per acre.

7. Manage weeds early and completely, beginning with a pre-emerge program, followed by a post-emerge program that controls herbicide-resistant weeds.

8. Pay attention to soybean cyst nematodes: monitor egg counts, select varieties with resistance and rotate sources of resistance.

9. Use the appropriate seed treatments for your conditions and the appropriate fungicide for seedling diseases. Use insecticides for early season insect pressure and a rhizobia inoculant on fields with no recent history of soybean production.

10. Scout for pests and diseases throughout the season. Know how to scout your fields and understand treatment thresholds or hire a consultant to do it for you. Recognize whether the variety you will plant has ample resistance or if you can select a better variety.

Monitor your crop, pay attention to detail and keep complete records. Recognize problems that arise and seek and execute solutions next season. Continue to look for and evaluate technologies that mitigate stress or add bushels to your production system.

Time to Get Serious about Soybeans!

Illinois continues to be a leading soybean producing state. Additionally, Illinois is recognized as one of the top soybean yielding states but yields have remained flat over the past decade.

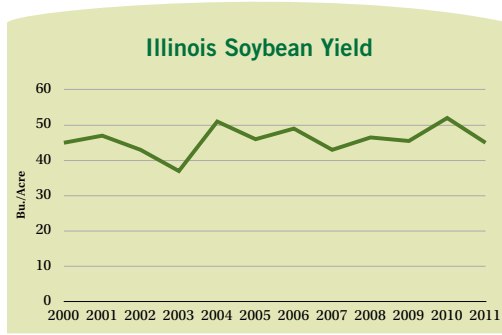
Individual farmers can increase soybean yields by employing a combination of sound agronomic practices and taking advantage of new available technologies.

Soybean vegetative and reproductive growth stages occur over a period of several weeks. While environmental conditions such as moisture level, cloud cover and temperature at specific stages of growth can affect final yields, sound and timely management practices represent options within a farmer's control that can also have major impacts on soybean yields.

Four factors determine final soybean yield:

- Number of plants per acre
- Number of pods per plant.
- Number of seeds per pod.
- Seed weight (or size)

Yield variances result from a change in any of these factors, and a surplus in one can compensate for a reduction in another.

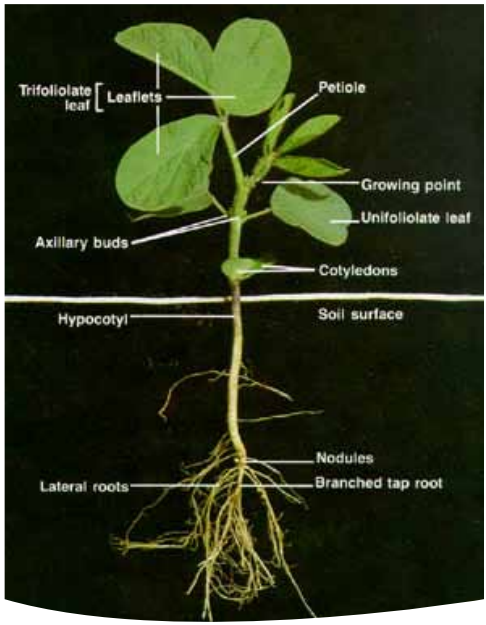


During vegetative and reproductive growth, soybeans have an ability to adapt to environmental conditions, stress and injury. In early growth stages, soybeans can adapt for reduced stands and stem and leaf damage.

Plants can overcome stressful conditions that last just a short time or occur early in the reproductive stages of growth. However, as plants progress through the reproductive stages, extended stress reduces the capacity to recover and salvage yields.

This guide provides you an overview of the various factors that impact soybean yield, including some recommended practices farmers can implement. Recommendations and ideas will be organized into the following sections:

- *Preplant*
- *Planting*
- *Vegetative Growth (VE-V4)*
- *Bloom to Pod Development (R1-R4)*
- *Maturity (R5-R8)*



CREDIT: www.ag.ndsu.edu/pubs/plantsci/rowcrops

PREPLANT

PREPLANT

Factors Influencing Yield at the Preplant Stage

Tip from the experts
Make a plan or checklist. Your list should include purchasing inputs, timing of applications, scouting, etc. Use the list to make sure you don't miss anything. Review your field notes from past years and make any necessary changes.

☐ Planting Equipment

Before the planting season begins, inspect, repair and calibrate your planting equipment. To maximize soybean yields, maintain uniform seed spacing and depth. Follow the instructions for your drill or planter to make sure they are correctly calibrated and functioning properly to meter seed at desired rates and establish a uniform stand.

Tip from the experts
Always calibrate your planting equipment by seeds per foot of row or seeds per acre. Recalibrate whenever seed size changes.

☐ Field drainage

Pay close attention to field drainage. Well drained soil enhances soybean yields. Loose, aerated soil allows for air to reach roots and nitrogen-fixing nodules, increases water-holding capacity and ultimately reduces erosion. Use yield monitor data to determine the effects of drainage challenges that may be affecting yields.

☐ Soil Fertility – pH

Take soil samples for nutrient and pH analysis. Nutrient limitations could negatively affect the plants' water transport, photosynthesis and production of protein, oil and carbohydrates. Maintain proper soil pH for nutrient availability. A soil pH of 6.5 should be targeted for soybeans.

Tip from the experts

Optimize phosphorus (P) and potassium (K). This remains critical to achieving higher soybean yields. Aim for P and K levels in line with the University of Illinois Agronomy Handbook and International Plant Nutrition Institute recommendations (www.ipni.net).

☐ Soil Fertility – Sulfur

Consider a preplant application of sulfate, such as ammonium sulfate, or gypsum (calcium sulfate). As a consequence of declining sulfur dioxide emissions from coal-burning facilities, less sulfur now falls on cropland. Sulfur deficiency may impact soybean yields, and studies are underway that explore the effect of sulfur supplements. Gypsum will help build soil structure and improves porosity and tilth.

Tip from the experts

Use Varietal Information Program for Soybeans (VIPS) (www.vipsoybeans.org) to determine the best variety choice. Consider varieties for your geographical area and maturity group that have resistance to disease, nematodes and pests for a particular farm and have the best three year yield history.

☐ Variety Selection

Select maturities that make the best use of the growing season for your area. Select for good yields and important characteristics such as oil and protein content. Also consider your fields' pest histories and choose varieties with genetic resistance to those pests. Plant multiple soybean varieties to ensure genetic diversification across fields.

CREDIT: Growmark

☐ Soil Testing – Sample Density

Use no less than 2 ½-acre-composite soil samples to ensure the most complete and detailed soil fertility conditions. With today's precision application technology, very specific corrections can economize costs. Test soil at seven to eight inches deep to coordinate with Illinois fertilizer recommendations.

☐ Soil Sample Timing

Consider sampling your soil more frequently to better manage both nutrient use and soil test levels. Collect soil samples as close as possible to the same time period each year. Variations occur as the residue degrades and begins to return nutrients to the soil. If data collection occurs during a consistent collection time period, a more focused soil fertility management plan can be prepared.

PLANTING

PLANTING

Factors Influencing Yield at the Planting Stage

The planting stage is a critical time period for managing soybeans. It's the stage when time, mechanical technology, the weather and soil conditions will hopefully enable you to successfully apply the decisions you made during the preplant stage. Starting the season off in a positive manner can make a difference at harvest time. This section will provide agronomic recommendations and tips to consider during the planting stage.

☐ Row Width

Research shows that by narrowing rows from 30 inches to a narrower width, a yield response occurs at least until they reach 15 to 20 row widths. Drilled soybeans can out-yield 20-inch rows, but farmers need to be sure the seed is placed at a uniform planting depth. Some potential gains from drilling may be offset by inconsistent planting depth.

Tip from the experts

The goal for soybean plant population is to attain a 100,000-plant-per-acre population at harvest. Soybeans have the ability to initiate additional buds on the stem to produce leaves and branches and additional pods at harvest. Ideally, you'll distribute plants as uniformly as possible to maximize the sunlight for photosynthesis and ventilation to discourage diseases. Row closure assists with blocking sunlight to keep soils cooler, retaining soil moisture and inhibiting weed growth.

☐ Seed Size

As you organize your seed before planting, take a look at the size of the seed. Most research indicates that the preferred seeding rate is about 100,000 seeds per acre in northern and central Illinois, with some response up to 150,000 seeds per acre in southern Illinois. Soybean seeds can range in size from "small," with more than 3,400 seeds per pound, to "large," with fewer than 2,000 seeds per pound. With that variance in seed sizes, correct populations may be difficult to attain. Farmers should plan to adjust planting equipment to attain desired populations.

☐ Seed Inoculation

Consider a high-quality seed inoculant to ensure maximum nitrogen fixation by the plant, especially if soybeans have not been grown on that field for the last four or five years. For nitrogen fixation to occur, you'll need to establish a

nitrogen-fixing bacteria named *Bradyrhizobum japonicum* in the soil. Soybeans can obtain up to 75 percent of the nitrogen they need from the air when nitrogen-fixing bacteria have established functioning nodules on the roots.

Tip from the experts
Native populations of Rhizobia naturally age in the soil and become less efficient at fixing nitrogen. Consider inoculating soybean seed every year with improved strains that are more efficient at fixing nitrogen.

☐ Planting Date

Since it's difficult to predict the weather, it's also difficult to predict when to plant soybeans. Still, researchers suggest planting full-season soybeans as early as possible in your given area and season. Soybeans planted extremely early have not shown consistent yield gains to offset the risk of cool-weather diseases that may occur in cold, damp soils and frost that may occur after leaf emergence. Early maturing varieties may be planted in mid-May with less yield loss than full-season varieties as long as you finish planting by late May. Delays in planting may result in fewer pods per acre.

Tip from the experts
Consider planting soybeans one week after starting corn. Soybeans adapt better to early season conditions than ever before. New varieties with better seedling vigor, resistance to chilling damage, disease pressure, stacked with seed treatments and planted in better-conditioned soil using better planting technology greatly increases the potential of soybeans emerging quickly and achieving your stand expectations.

Tip from the experts
Experts say the date of planting may be one of the most important yield determinants, contributing as many as 7 bushels per acre in some research locations.

☐ Use Appropriate Seed Treatments

Seed treatments can help protect seeds and seedlings from fungal pathogens and insect pests. Fungal pathogens can cause diseases that can impact germination and plant growth. Today's seed treatments can help control soybean diseases such as Pythium, Phytophthora, Fusarium and Rhizoctonia. Seed treatments can also protect against both above-ground insects, such

as bean leaf beetles and aphids, and below-ground pests, such as seed corn maggots, wireworms and white grubs.

Tip from the experts
If treating seed, consider what you want to control and know what you are buying. Do you want a fungicide to control seedling diseases or fungicide-plus-insecticide to control seedling pests? Consider even adding a nematicide to reduce SCN. When choosing a fungicide, consider a product with multiple active ingredients to enhance control of diseases, especially tougher Pythium and Rhizoctonia species.

Tip from the experts
Consider using a growth regulator applied on the seed or in-furrow. Certain technologies can stimulate early season seedling and root growth as well as nodule formation. With any new product concept, it is important to ask for the data and talk to different sources before making a decision.

☐ Planting Depth

Soybean seeds should be planted at about 1 ½ inches below the surface. Trying to achieve that depth with modern, wide planters and uneven soil surfaces may result in a range of between 1 and 2 inches. The greater the uniformity in planting depth, the better your chance to optimize stand establishment and maximize yield. Row planters have historically held an advantage over grain drills because they can place seed more uniformly. Deeper planting may result in poor stands and challenges in achieving emergence. In addition, soils generally stay cooler at lower depths, and this may slow germination or allow for soil pest activity.

Tip from the experts
There has been great debate over whether to plant deeper than normal during dry seasons. Most experts-prefer planting at a depth of 1.5 inches and assume rainfall infiltration from surface or for moisture migration from below to germinate the seed.

☐ Germination Soil Temperature

While soybeans begin the germination process when soil temperatures are slightly below 50 degrees, most experts suggest planting when soil temperatures are at least 50 degrees and trending upwards at planting depth.

Increased residue cover will slow soil warming and delay germination. Soil temperature remains an important determinant of bean germination. Soil temperatures below 50 degrees will delay germination and impact final plant population.

☐ Nitrogen (N)

Consider applying 25 to 50 pounds per acre of nitrogen (N) in the form of di-ammonium phosphate (DAP) or ammonium sulfate, either by banding in the row area or across the entire field or top dressing with urea. Soybean plants fix most of their required N. However, the nodules' efficiency at producing N tends to decrease during the later reproductive growth stages when the plant needs this nutrient most.

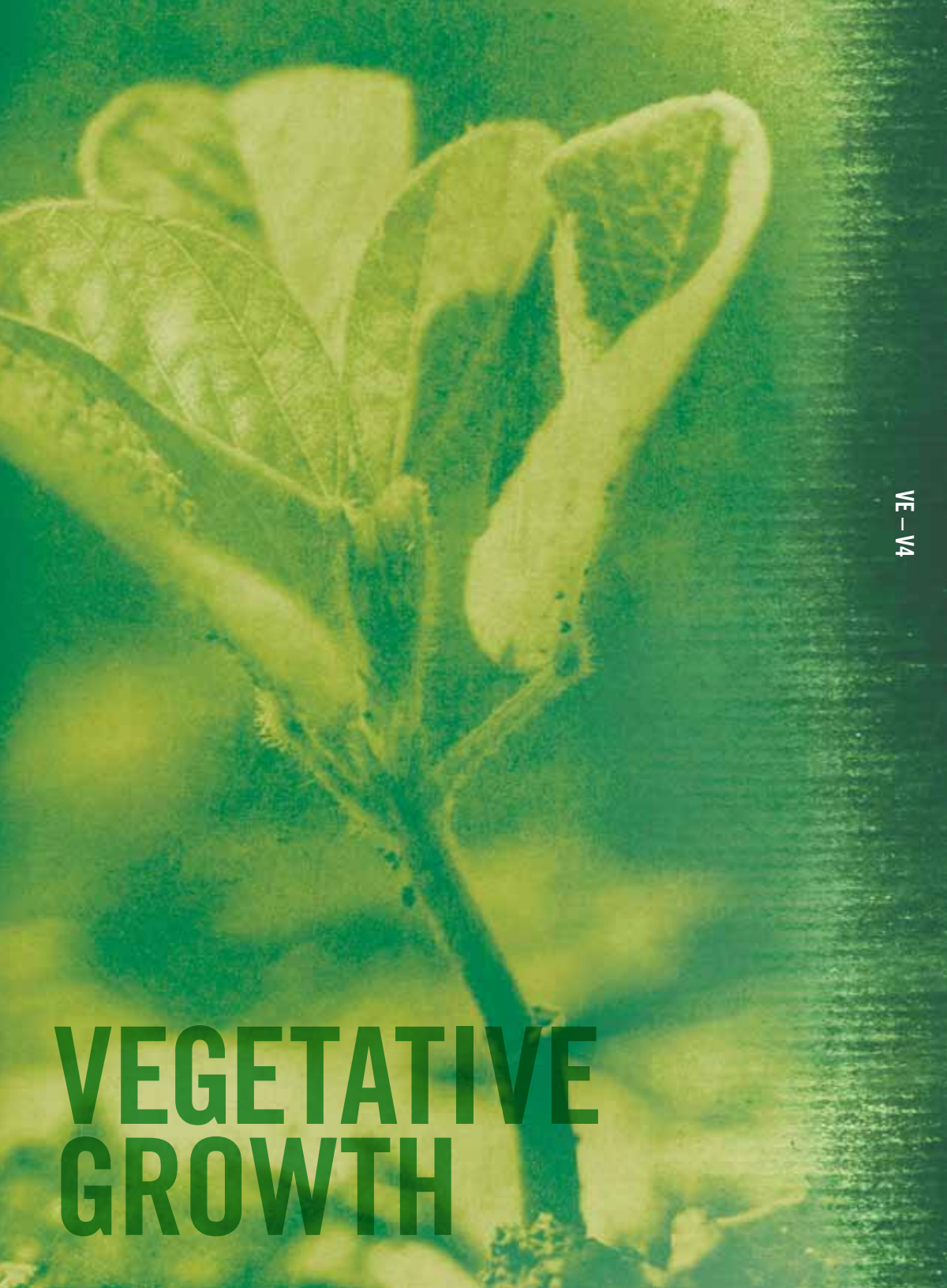
☐ Starter with Micronutrients

Analyze soil types and pH soil maps to determine the value of applying additional iron or manganese. In some field areas, the soil pH decreases the availability of micronutrients and may be silently robbing yield. Correcting pH may correct the problem.

- Use scouting records and yield monitor data for micronutrient management.
- Monitor soybean fields during periods of stress to determine if foliar-applied iron manganese or lime could help eliminate this yield-limiting factor.
- Scout fields to map problem spots and use harvest yield monitors to track yield loss areas.
- Compare those areas with soil types and pH levels.

☐ Weed Control

In some cases, the growth of winter and spring annual weeds can pose problems at planting time. Dense weed growth can affect soil drying and warming in the spring and affects seedbed quality and timely planting. The fall application of a residual herbicide may reduce your spring workload as well as increase the opportunity for more timely planting.



VEGETATIVE GROWTH

VE – V4

VE – V4

VEGETATIVE GROWTH

Factors Influencing Yield in Early Vegetative Stages

Vegetative Growth Stages

	**VE**	**Emergence** – cotyledons have been pulled through the soil surface.
	**VC**	**Unrolled unifoliate leaves** – unfolding of the unifoliate leaves.
	**V1**	**First trifoliate** – one set of unfolded trifoliate leaves.
	**V2**	**Second trifoliate** – two sets of unfolded trifoliate leaves.
	**V3-Vn**	**Fourth trifoliate** – four unfolded trifoliate leaves.

☐ Scouting

Farmers should develop a scouting plan to monitor field conditions throughout the entire growing season. This includes walking a random course through the field and stopping at multiple locations to look for damaged leaves, insect infestations, weeds and nutrient deficiencies. Data should be recorded for future reference.

Tip from the experts
Take stand counts in the field. Check that your planter functions properly and the soybean plants show uniform emergence. Record any problems so that you can adjust your equipment the before the next season.

☐ Post-Emergent Weed Control

Field scouting remains critical for post-emergent weed control. Yields will be reduced if weeds compete with soybeans for moisture, light and nutrients during the critical development period from the second trifoliate stage to the beginning of the flowering stage. Treat fields with heavy weed populations as soon as possible after weed emergence.

Tip from the experts
Post-emergent herbicide applications should be made before weeds grow taller than two inches. Weeds at that height begin to impact yield potential.

☐ Tissue Sampling

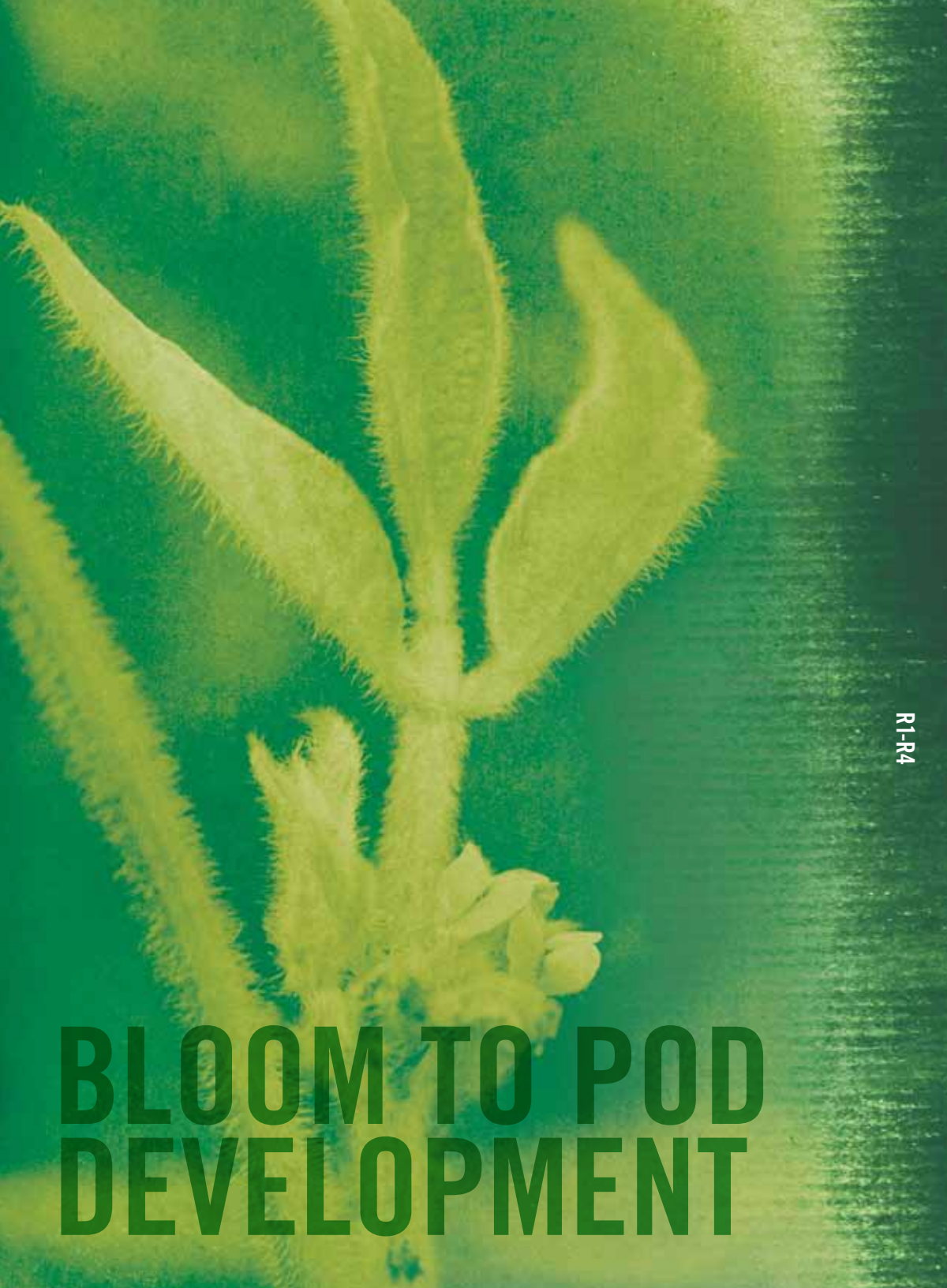
Tissue sampling helps determine proper nutrient uptake in the soybean plant at different growth stages. Tissue samples should be collected at the V3 stage. Tissue samples verify the amount of primary nutrients, secondary nutrients and micronutrients contained within the leaf tissue and if those micronutients are sufficient or inadequate.

Tip from the experts
Consider pulling tissue samples to see if nutrient levels are sufficient. Consult your preferred analytical laboratory for sampling and shipping instructions, available measurement parameters and how to interpret the results.

Tip from the experts
To prevent a manganese deficiency in soybeans, a foliar application of four to eight pounds per acre of manganese sulfate should be applied when the plants have two or three trifoliate leaves. Consider using a tank mix of chelated manganese EDTA with glyphosate applications

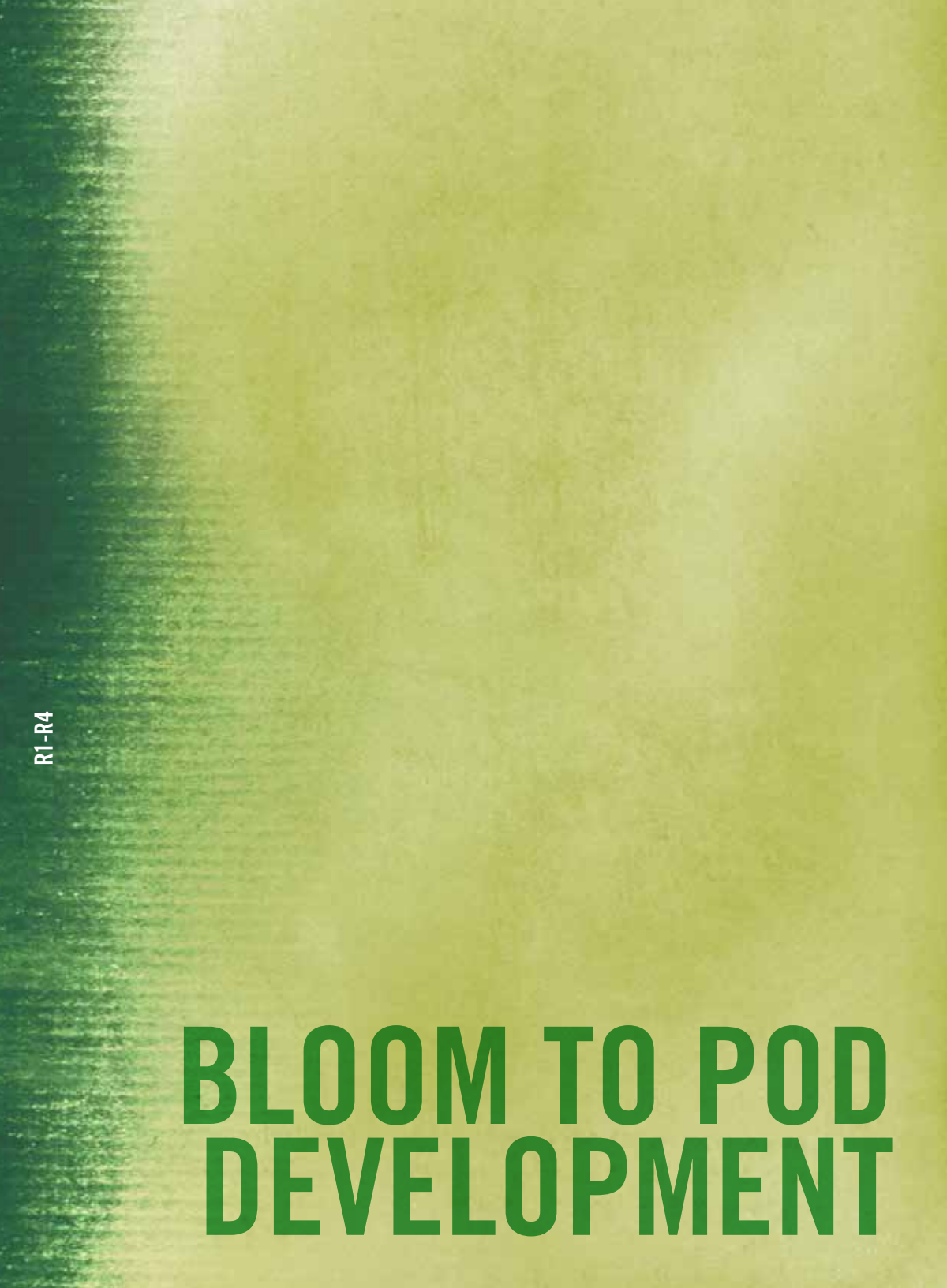
☐ Foliar Feeding

A foliar feeding of fertilizer beginning at V4 and through the V5 stage can increase yields. A wide choice of product formulations are available. Study the information and data and do your own testing.



BLOOM TO POD DEVELOPMENT

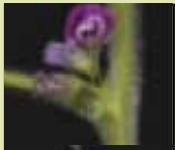
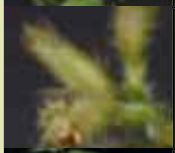
R1-R4



BLOOM TO POD DEVELOPMENT

Factors Influencing Yield at the Flowering Stage

Reproductive Stages

	R1	**Beginning flowering** – plants have at least one flower on any node.
	R2	**Full flowering** – there is an open flower at one of the two uppermost nodes.
	R3	**Beginning pod** – pods are 3/16 inch (5 mm) at one of the four uppermost nodes.
	R4	**Full pod** – pods are 3/4 inch (2 cm) at one of the four uppermost nodes.

The soybean plant transitions from vegetative to reproductive stages as a response to length of darkness. Longer nights initiate flowering and higher temperatures seem to move the flowering biochemistry at a faster pace maybe as early as stage V3.

Reproduction (R1) begins with an open flower at any node on the main stem. Flowering occurs at approximately 520 Growing Degree Days (GDDs), or six to eight weeks after seeding, and will last four to six. Full bloom (R2) occurs when plants have an open flower at one of the two uppermost nodes on the main stem. Soybeans reach the beginning pod (R3) stage when pods reach 3/16 inch long at one of the four uppermost nodes on the main stem with a fully developed leaf. The full pod (R4) stage occurs when pods reach 3/4 inch long.

Most soybean varieties have an indeterminate growth habit in Illinois, especially in northern and central Illinois. This allows for additional plant height, stems and leaves to be added as well as additional flower initiation. Flowering on indeterminate plants can occur for as long as six weeks after R1 growth stage, but it usually occurs in a 3- to 4-week period.

Determinate varieties slow down or stop vegetative growth at R1 growth stage and may produce all flowers within a day or two, although some of the pods may develop at a faster pace than others after flower initiation.

Up to 75 percent of all flowers produced on a soybean plant may abort due to physiological or climatic conditions. Weather and other stresses may be the cause for many aborted pods, but with the extended flowering and pod-fill time period, soybeans seem to be able to handle short stress periods better than other crops. If all pods could be developed, yields could grow to greater than 200 bushels per acre. Management decisions that alleviate stresses could be the secret to yield enhancement.

☐ Soybean Aphids

During soybean flowering stages, plan to monitor for presence of soybean aphids. Symptoms may include stunted growth, sticky leaves from aphid secretions or the presence of black, sooty mold. Effects of this pest may include fewer pods and problems with soybean seed size and quality.

Tip from the experts
Consider using a foliar insecticide whenever you find an average of 250 aphids per plant in a soybean field that has reached the R1–R5 growth stages range.

☐ Spider Mites

Pay close attention for outbreaks of spider mites. Dry conditions sometimes lead to rapid outbreaks. By conducting early scouting, you might find damage in areas where mites overwintered on weeds and other host plants. However, treatments applied too early may damage beneficial insects, and the mites may rebound rapidly following the treatment.

Tip from the experts

When controlling spider mites, consider the efficacy of the insecticide before applying. Organophosphates are the recommended insecticidal chemistry for spider mite control. Examples include dimethoate and chlorpyrifos. Avoid using pyrethroid insecticides because control is short-lived and not as effective, and populations can flare up.

☐ Japanese Beetle

Japanese beetles can become a major pest for soybean farmers. The adult beetles consume the leaf tissue between the leaf veins, giving the leaf a skeletonized appearance. Typically the beetle infestation occurs in a localized area of the field and may cause severe injury to plants. Control may be necessary if defoliation reaches 30-40 percent prior to bloom, 15-20 percent from bloom to pod fill, or 25 percent from pod fill to maturity. Several insecticides are labeled for control of the beetle. Beetles present during the application will be killed, but beetles migrating into sprayed fields may not be controlled. If soybean defoliation continues, additional applications may be necessary.

☐ Bean Leaf Beetle (BLB)

BLBs persist as a multi-generational insect. Early planted soybeans and early emerging soybeans may exhibit seedling injury due to feeding by overwintering adult BLB populations. During this growth stage, it can be common for a population of second-generation BLBs to build in fields and damage leaf tissue. They may continue until fall as a succession of first- and second-generation BLB adults emerge and feed on the crop. Feeding damage can reduce leaf area and limit the plant's maximum photosynthetic capacity.

Tip from the experts

Be careful with products such as dimethoate because hard water may affect its breakdown in spray tanks. A water-acidifying agent may be necessary to enhance product performance.

☐ White Mold

Cooler-than-normal temperatures, higher humidity and fog-like conditions can increase the potential for white mold outbreaks. In addition to preplanting decisions, such as crop rotation and genetic resistance, in-season solutions may involve the use of foliar fungicides.

Tip from the experts
Learn to recognize and scout for Septoria brown spot, frogeye leaf spot and Cercospora leaf blight. If disease pressure remains high, make a fungicide application at R3.

Tip from the experts
In addition to crop rotation and row spacing to manage the risk of white mold, control or suppression can be achieved with an application of specific fungicides such as Contans® WG, Incognito®, Domark®, Endura® or Topsin® M or herbicides such as Cobra®. Be sure to check with a local agronomist or crop consultant before making an application.

☐ Soybean Cyst Nematode (SCN)

Many experts believe SCN remains the biggest challenge to soybean yields. While SCN has been confirmed in most Illinois fields, it may not be visibly detectable on plant roots in other fields but still affecting yield. In some years, it is easier to see the visible effect of SCN on entire fields or parts of fields that have a lower productivity index (PI). A field with a higher PI can mask SCN's symptoms, but the disease might still be robbing yields. Scout fields during this growth stage to determine the presence of SCN even in fields showing no above-ground symptoms.

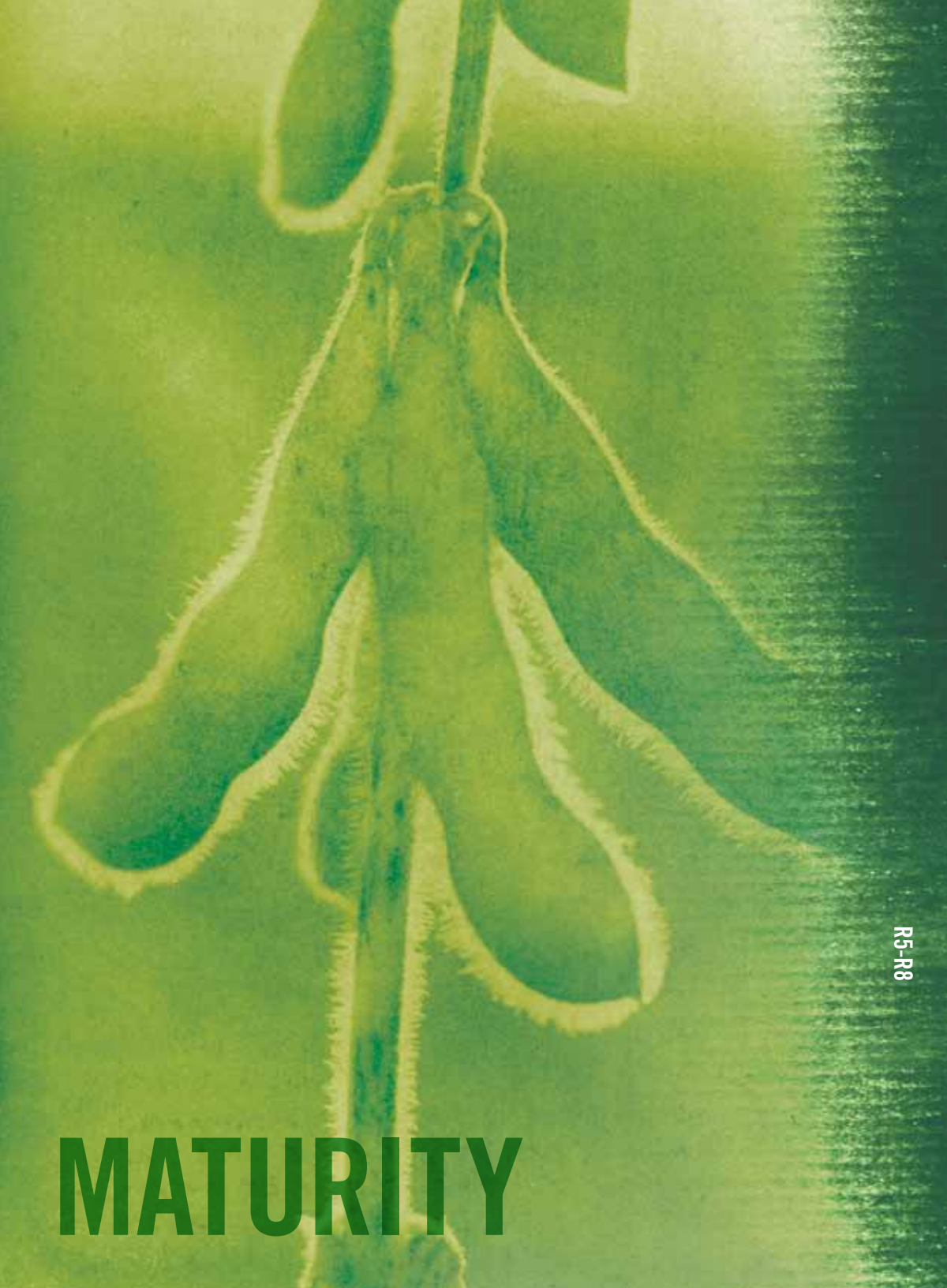
Tip from the experts
Consider tissue analysis as a regular part of your crop-scouting program. Testing during the early season may allow for corrections of sulfur and other micronutrients in time to make a yield difference.

☐ Soil Fertility – Micronutrients – Iron and Manganese

Farmers have recognized iron and manganese deficiencies as problems in certain soybean fields in Illinois. However, soil tests may not provide the reliability needed to manage this problem. Knowing the effect of soil pH on these micronutrients may be a key to the possible management of the deficiencies. Usually pH zones greater than 7.3 are the primary places to watch. Foliar applications of manganese or iron chelates as needed may be the best management approach.

Tip from the experts

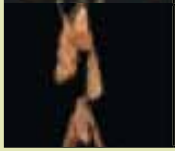
Some consultants recommend applications of calcium anytime the soil test pH exceeds 6.3 to keep the cation ratio at a certain level. It hasn't been proven by university research as a consistent practice yet, but it could be an idea that merits further exploration.


R5-R8
MATURITY


R5-R8
MATURITY

Factors Influencing Yield from Seed to Full Maturity

Reproductive Stages

	**R5**	**Beginning seed** – seed is 1/8 inch long (3 mm) in the pod at one of the four uppermost nodes on the main stem.
	**R6**	**Full seed** – pod containing a green seed that fills the pod capacity at one of the four uppermost nodes on the main stem.
	**R7**	**Beginning maturity** – one normal pod on the main stem has reached its mature pod color.
	**R8**	**Full maturity** – 95 percent of the pods have reached their full mature color.

Seed fill begins at the R5 stage, when seeds require considerable water and nutrients from the plant. Root growth slows during this stage as seed growth begins. Between R5 and R6, the plant reaches maximum height, node number and leaf area. Nitrogen fixation peaks and then begins to rapidly decline. The nutrient accumulation in the leaves peaks and then begins the process of redistribution of dry matter and nutrients to the seeds.

The R6 stage is known as the “green bean” stage. Total pod weight peaks at this stage, nutrient accumulation slows and root growth ends. Leaf yellowing also begins, and typically three to six trifoliate leaves fall from the lowest nodes.

Dry matter increases as the plant reaches the R7 stage and begins to mature. Pods and seeds also begin to turn yellow. At this stage, the crop’s yield has been established and a frost will not affect the plants. The biggest ongoing risk to yields will be pods opening up and allowing seeds to drop to the ground and seeds shattering.

At R8, the plants have fully matured. At this stage, 95 percent of the pods have reached their mature color. Soybeans lose moisture rapidly during this stage and should be harvested as soon as moisture levels reach an acceptable level.

☐ Late-Season Scouting for Weeds

As the crop begins to mature, remember to continue scouting for weeds. Many weeds growing below the canopy may not have been seen earlier, but as plants shed their leaves, you'll be able to see them again. This will give you an idea of what weeds to expect next, giving you a head start on your weed control program. Keep in mind to check for below-canopy weeds because even common dandelion can compete with soybeans for moisture.

Tip from the experts
Note the survival of individual species of weeds as an indication of evolving herbicide resistance. Pay close attention to weeds such as waterhemp, marestail, giant ragweed and Palmer amaranth.

☐ Late-Season Scouting for Insects

Continue to scout for insect infestation and damage through the R7 stage. Yield-robbing insects such as bean leaf beetles and two-spotted spider mites may need to be controlled in the R5, R6 and R7 stages. In some cases, treatment might be warranted, but mapping insect populations is more important because it can aid in controlling those pests in subsequent crops.

Tip from the experts
Spider mites can cause yield reductions as long as green pods are present. Be sure to check the pesticide label at pre-harvest interval when considering late-season treatment. Treatment beyond R7 provides little impact on yield.

Tip from the experts
Bean leaf beetles can cause pod damage that could result in lower yield. Treatment can be justified if the percentage of pod damage reaches 10-15 percent and adult beetles remain present.

☐ Harvest at the Optimum Stage

Most experts suggest that minimal gathering losses occur when soybean harvest happens during the 12 to 15 percent moisture range. Harvesting at moistures below 12 percent may cause excess seed shattering and seed coat damage.

☐ Check Soybean Cutting Height

The "flexible" header technologies available today make less than 2 percent loss during harvest a reasonable goal. Make adjustments to keep cutting height as low as possible without also drawing excessive soil into the combine. The majority of soybean harvest losses are related to "gathering losses".

☐ Measure Losses Early in Harvest

After harvesting a field, measure a 10-square-foot area the same width as the combine head in the middle of the field. Count all the soybeans in that area, including loose beans and beans in pods. Divide this number by 40 to estimate bushels per acre lost in the field.

☐ Gather Yield Data to Study after Harvest Completion

Modern computer technology can make plotting yield data after harvest simpler, offering a way to analyze limiting factors that may exist within a field. By comparing yield data in each sample grid area, it may be possible to compare yields in areas with different soil types, locations of cyst nematode, pH levels, soil fertility levels or drainage. This helps to determine which limiting factor may be the culprit for lost yield.

Tip from the experts

Harvesting soybeans when moisture content falls to 15 percent for the first time produces the highest test weight and yield. Harvest losses due to shattering increase when beans undergo successive wetting and drying cycles.

Additional Guidelines

Watch for New Products and Vet Them Yourself

Wherever there's a new product, you can be sure marketing information will follow closely behind. Most products are legitimate, but some might not be. The responsibility of vetting new products falls on farmers. First, study the concept and see if it makes sense. Read articles about the technology, study the results from trials and filter the information through your own network of farmers, agronomists and other experts. Second, test the product on your farm.

Do Your Own Testing

Today, it is easier and more important than ever to do your own testing. You can lay out strips and blocks, replicated or not, and apply your own treatments with check strips. Yield monitors enable you to collect and analyze data. Don't rely on the experience of another farmer or the word of a salesman. You need to prove it to yourself so you are comfortable with your decision.

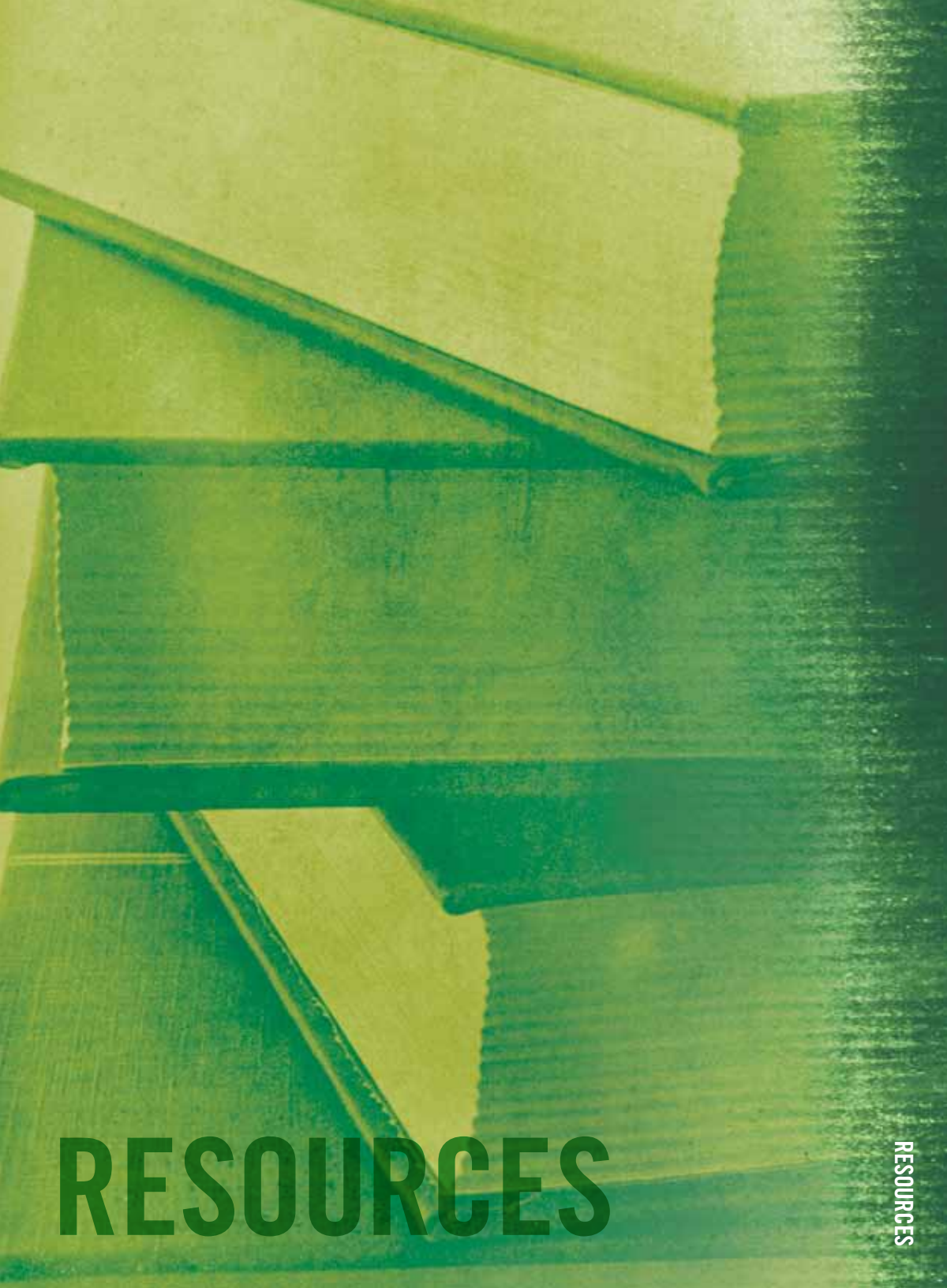
Products Don't Work Every Time

What happens in a research environment will not necessarily match reality on the farm. Set up with enough sites and over a long enough period of time, scientists can remove much of the variation from their experiments and feel confident in the results. Farmers neither have that luxury nor expect every practice to work every time. For example, newly released varieties do not always outperform earlier varieties. The variations from year to year and field to field have a great impact on the outcome.

If a new practice delivers as promised 60-70 percent of the time, it is probably solid technology and might be worth adopting. Don't let one negative or neutral result sway your final decision. Remember the importance of testing and gaining personal experience, but also look at data from other sites and sources and filter the information through your own network.

Weather = Big Equalizer

Farmers know that, generally, weather both has the biggest impact on crop production and is the one factor they have the least control over. Consider that some technologies respond better under normal or ideal conditions while others might perform better when the crop is under stress. The impact of weather can negate the performance of a practice in any given year. Remember to test over several years and look at data for other sites and sources.



RESOURCES

RESOURCES

Resources:

Guide to Soybean Growth Stages
Mississippi State University Extension Service
http://msucares.com/pubs/publications/p2588.pdf

Illinois Agronomy Handbook
University of Illinois
http://extension.cropsci.illinois.edu/handbook/

Illinois Grower's Guide to Superior Soybean Production
University of Illinois
College of Agriculture Cooperative Extension Circular 1200

Modern Corn and Soybean Production
by Robert Hoeft, Emerson Nafziger, Richard Johnson and Samuel Aldrich
First edition, copyright 2000, from MCSP Publications, Champaign, IL 61822.

Soybean Management
Ohio State University
http://ohioline.osu.edu/b827/pdf/Soybean_Management.pdf

Soybean Production
Iowa State University Soybean Extension and Research Program
http://extension.agron.iastate.edu/soybean/production_growthstages.html

Top 10 Yield Limiting Factors in Wisconsin Soybeans
University of Wisconsin-Extension
http://fyi.uwex.edu/fieldcroppathology/2012/02/15/10_soybean_yield_factors/

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Illinois State University

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Our Soy Checkoff™
Progress Powered by U.S. Farmers

Tech Transfer is a soy checkoff program, in collaboration with state soybean boards and universities, providing research results to improve profitability of U.S. soybean farmers.

The United Soybean Board/soy checkoff neither recommends nor discourages the implementation of any advice contained herein, and is not liable for the use or misuse of the information provided.

Please refer to the information contained in this booklet as a guide to improved soybean production practices and not an exact recommendation. Readers should take responsibility for studying the information, talking to various sources and adopting approaches that best match their farming operations and philosophies.

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