NEW YORK & PENNSYLVANIA

2015 BEST MANAGEMENT PRACTICES GUIDE

NEW YORK CORN & SOYBEAN GROWERS ASSOCIATION
SOYBEAN CHECKOFF

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BEST MANAGEMENT PRACTICES

The primary goal of the New York and Pennsylvania soy checkoff boards is to increase the profitability of soybean production for each state's soybean farmers. The volunteer farmer-leaders that serve on the ***New York Corn & Soybean Growers Association (NYCSGA)*** and ***Pennsylvania Soybean Board (PSB)*** invest your checkoff dollars in ongoing public research and extension programs that address your state's production challenges. This research helps determine the best-management practices to help make your farm more profitable and ensure the sustainability of New York and Pennsylvania soybean production.

This Best Management Practices (BMPs) Guide provides a summary of management practices that can help you be more successful in your soybean operation. These practices are proven to contribute to higher yields in both research environments and farmers' fields.

With each practice, you will find a rationale for why you should consider using it. It may be because it creates a yield advantage, protects the growing crop or improves the quality of the harvested seed. Some will clearly be no-brainers, while others may require more careful consideration. Regardless, it will give you options that could lead you to better yields.

We wish you success in determining which practices are applicable to your situation.

William Beam, PSB Chairman

Steve Van Voorhis, NYCSGA President

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FERTILITY

Soybean-fertilization needs differ from corn, small grains and other crops. As a legume, soybeans produce their own nitrogen (N) from N-fixing bacteria in the soil, which can be used by other plants the following year. In fields where soybeans have not been grown for a long period, achieving good nodulation has been an issue. In these fields it may be good to consider multiple inoculation methods, such as preinoculated seed plus a liquid or peat product applied to the seed. Soil factors such as low temperature, saturated conditions, dry soils, or high N availability may inhibit the nodulation process on these virgin soils.

"Soybean yields increase the longer farmers wait to introduce them back into the rotation," says Bill Cox, Ph.D., Cornell University professor of crop and soil sciences. "When soybeans are rotated with another crop every other year or every third year, yields can increase by 5 to 10 percent."

Soil pH is important and should be maintained between 6.0 and 7.0 for optimum production. If soil tests call for lime, it's preferable to apply it in the fall so it can react before spring planting.

"When needed, farmers should apply lime following harvest and before planting when soil conditions permit," says Greg Roth, Ph.D., Penn State University (PSU) professor of agronomy. "Often lime is applied on dry fall days, frozen soils in late winter, or dry soils in the spring. These avoid interference with the growing crop, and avoid compacting the soil like applying lime on moist soil."

SOIL SAMPLING

As soybean yields continue to increase (national average increase since 1980 is about 0.5 bushel per year), more nutrients are pulled from the soil, and additional fertilizer may be needed to replace them. Soil testing is the only way to know if supplemental fertilizer is necessary prior to planting. When implementing a soil-testing program, follow these BMPs:

- Collect soil samples soon after harvest.
- Test each field at least once every three years.
- To ensure consistently sample of nutrient removal across multiple years, sample at the same time of year and follow the same crop in a rotational system.
- Soil tests should be used mainly to test for phosphorus, potassium and pH but can also be helpful in determining micronutrient issues.
- In tilled fields, gather soil samples from a depth of 6 inches. In minimum- or no-till fields, take

  samples from a 4-inch depth. And in pasture and hayfields, take samples from a 2-inch depth. Keep in mind, most fertility recommendations are based on soil-sampling at a 6-inch depth, as shown in the above picture.
- Consistency when collecting samples and keeping records from year to year are critical to fully understanding the nutrient needs of your fields. The more data generated over time will allow for better fertility recommendations from specialists.

Soil-sample results are essential for adequate application of fertilizer. Under-fertilizing may cost farmers money through lower yields. Over-fertilizing may add costs that are not recouped through increased yields.

Especially with increased yields in recent years, adequate fertilization becomes even more important. More bushels per acre also means more nutrients being removed from the soil.

"Our soil-test data indicate about 30 percent of the fields tested for soybean production are deficient in potassium

(K)," says Roth. "Soybeans have a taproot and are less able to extract K from soils than grass crops with more fibrous roots. As a result, potassium deficiency is not uncommon in soybeans. If caught early, a timely potash application can correct the problem."

As seen in Fig. 1, K-deficiency symptoms include yellowing (chlorosis) along the edges of mature leaves or leaf death (necrosis). The youngest leaves usually appear to be normal. K deficiencies are difficult to correct in a standing crop, so prevention is the best management practice.

***Fig. 1**: Photo demonstrates a Pennsylvania soybean field exhibiting symptoms of K deficiency. (Photo by Greg Roth, Ph.D., PSU)*

PLANTING PRACTICES

Important factors for good stands and favorable yields include planting date and rate, row spacing and planting depth.

PLANTING DATE

The typical planting period in New York and Pennsylvania runs from early- to mid-May, depending on weather conditions. If a farmer plans to plant corn as part of the crop rotation, it is a good practice to plant corn first, followed by soybeans, because corn can tolerate cooler soil temperatures (50 degrees) vs. soybeans (55 degrees). Later plantings do not cause soybean yields to decrease as much as corn yields.

ROW WIDTH

Cornell research has shown the potential to increase yields by 5 bu./ acre or more by planting drilled soybeans in 6- to 10-inch rows, compared with using row planters with widths of 30 inches in cool or dry growing seasons or for late-planted beans because wide-row beans will not fill in entirely . Drilled beans become even more advantageous in double-crop systems. Cox recommends farmers drill soybeans in 7.5-inch rows or in15-inch rows with a row crop planter, unless white mold becomes a serious problem (see disease section for more information on white mold). Where white mold is a potential problem, soybeans planted in 30-inch

RECOMMENDED SOYBEAN SEEDING RATES

Row width (inches)	Approximate lbs. of seed needed/acre			Seeds to plant per 10 ft. of row†	Seeds per acre	Expected plants per 10 ft. of row†	Expected final plants/ acre†
	@ 3,200 seeds/lb.	@3,000 seeds/lb.	@2,600 seeds/lb.				
30	40	42	49	73	127,000	51-58	89-102
15	52	56	64	48	167,000	34-38	117-134
Drill (6-8)	63	67	77	23-31	200,000	17-23	140-161

†Assuming between 70% and 80% emergence of planted seed, based on 90% germination seed and average soil conditions.

Increase seeding rate by: (not cumulative) 5% for each rotary hoeing planned; 10-15% for very early or very late planting; 10-15% for short-season varieties; 10% for cold soils; 10% for no-till; 10% for rough seedbeds or high-speed planting.

Decrease the seeding rate by: 10% if lodging has been a problem; or 10% if planting under ideal soil conditions with high-quality seed (greater than 90% germination).

rows can yield 10-20 bushels/acre more than narrow row beans. He adds that 40 percent of the remaining New York soybean farmers plant in 15-inch rows, and but that 10 percent plant in 30-inch rows, mostly because of potential white mold problems.

RECOMMENDED SEEDING RATES

The table on page 5, developed by Rutgers Cooperative Extension and made available through soy checkoff funds administered by the New Jersey Soybean Board, provides recommended seeding rates and desired plant populations, along with adjustments for various situations.

PLANTING DEPTH

Under most conditions, the ideal planting depth is 1½ inches. Soybeans should never be planted deeper than 2 inches or shallower than 1 inch. Planting speed is one factor that most affects uniform depth. Planting faster than 5 mph often causes "planter-unit hop," so slowing down or applying more down pressure may be needed to maintain a uniform, desired depth.

PESTS AND RELATED PROBLEMS

Soybean pests include weeds, diseases, insects, nematodes and environmental stress problems. Because the number of pests that can affect soybeans totals is in the hundreds, this publication cannot provide details on all. References to other publications and websites will be offered to provide more detailed information. For assessing and treating many pest problems, follow integrated-pest-management (IPM) principles. This generally involves identification of the pest(s) or problem; the severity of the problem fieldwide and on individual plants; agronomic aspects of the crop, such as growth stage; evaluation of chemical and non-chemical control measures; and the economics of the choices. New York and Pennsylvania soybean farmers can find additional information on pests in the ***2015 Cornell Guide for Integrated Field Crop Management*** and at ***www.fieldcrops.org***, or the **(PSU Agronomy Guide)**, available at ***http://pubs.cas.psu.edu/***.

WEEDS

Most farmers in New York and Pennsylvania plant herbicide-resistant soybean varieties, which allow for the use of herbicides to control most unwanted vegetation while leaving the soybeans unharmed. Farmers must monitor fields to be sure these herbicides control all weeds present and that common problem weeds are not developing resistance.

Glyphoste resistant marestail in a soybean field in PA. (Photo by William Curran, Ph.D., PSU)

"The only confirmed herbicide-resistant weeds in New York are triazine-resistant (Group 5) common lambsquarter, smooth pigweed, common ragweed and common groundsel," says Russell Hahn, Ph.D., Cornell University professor of weed science. "It is likely that populations of glyphosate-resistant horseweed and tall waterhemp exist in a couple of locations, and we are attempting to confirm that."

According to Penn State extension weed specialist Dwight Lingenfelter, M.S. currently the biggest threats for Pennsylvania farmers are glyphosate-resistant (Group 9) marestail and incoming Palmer amaranth and waterhemp. Some populations of these species are ALS-resistant (Group 2) as well. Glyphosate-resistant giant ragweed is another looming weed threat to the region that could impact soybean production.

Various cultural and herbicide-application BMPs can be used to slow the development of herbicide resistance, including:

Marestail research studies in PA (Photo by Dwight Lingenfelter, M.S., PSU)

- **Crop rotation:** Crop rotation offers opportunities for herbicide mechanism or site of action (MOA) rotation to prevent or delay development of herbicide-resistant weeds. Crop rotation will determine the frequency and type of herbicide that you apply. It is a major factor in the selection of cultural weed-control options. The principle of crop rotation as a resistance-management tool is that different crops will allow the use of herbicides with different MOAs.

- **Rotating Herbicide Mechanisms of Action:** The most important practice to prevent or manage herbicide-resistant weeds is using herbicides with different MOAs prior to planting and throughout the growing season. Farmers should check the MOA group number (see examples in Fig. 2) on the herbicide label to ensure selection of the correct MOA to match targeted weeds. Frequent use of herbicides with the same MOA is the single most important contributor to the development of resistant weeds. More details about herbicide MOAs and premixed products can be found online, in the Take Action Herbicide Classification Guide on the University of Delawares Cooperative Extension's weed management guides. This chart was specially designed for the Northeast region.

GROUP	2	14	HERBICIDE
GROUP	9		HERBICIDE

Fig. 2

- **Group number examples:**
  - It is assumed that all weeds species are capable of developing resistance, however, so far there are certain species that are more prone to developing resistance than others. In order to be practical, focus on problem weeds such as horseweed/marestail, lambsquarters, pigweeds, and ragweeds. In fields that contain these species, each acre should get a minimum of two MOAs that are effective for control of the weeds you're targeting. If glyphosate-resistant weeds are present, farmers should use two MOAs in addition to that of glyphosate on the target species.
  - Rotate herbicides with different MOAs yearly. Simply rotating herbicides that have the same MOA will only delay the inevitable occurrence of resistant weeds.
  - If there are no herbicide-resistant weeds in a field, it is still very important to rotate herbicides with different MOAs to prevent or delay the establishment of resistant weeds. If a weed's resistance to glyphosate is not documented in a particular field or fields, then using glyphosate remains a viable option

Palmer amaranth inflorescences in PA soybean fields (Photos by Dwight Lingenfelter, M.S., PSU)

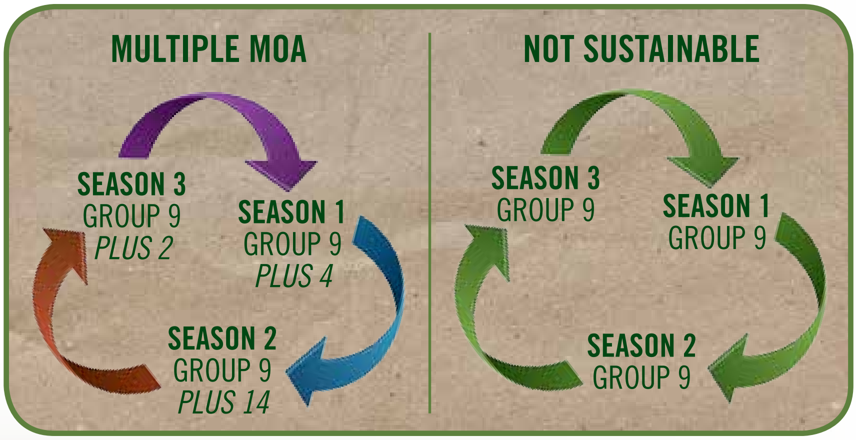
Palmer amaranth in corn field in PA (Photo by William Curran, Ph.D., PSU)

when used in rotation with other herbicide(s) with a different MOA. In fact, glyphosate used in rotation is an excellent resistance-management option if there is no documented glyphosate resistance.

- Rotate herbicide MOA to reduce the pressure applied by any one product. Tank mixes work best for this activity,or the inclusion of different and effective MOAs in the overall spray program (e.g., pre herbicides followed by planned post herbicides) during the growing season. In some cases, multiple chemical families that have similar chemical structures and cause similar injury symptoms exhibit the same MOA. Rotating between chemical families with the same MOA is not the same as rotating among MOAs.

- **Use the full rate:** In general, use the full labeled rate for all herbicides you apply. Spray before weeds get too tall. Kill them before they can propagate and produce seed. Annual weeds are more easily controlled postemergence when they are small. For example, marestail should be controlled before it reaches 4-6 inches tall and Palmer amaranth should be sprayed before it reaches 2-3 inches tall.

- **In-Season Weed Control:** The most critical time to control weeds is up to four weeks after crop emergence. When selected and used appropriately, pre-emergence herbicides can provide control of many annual grasses and broadleaf weeds. However if some weeds escape this treatment, a post application may be necessary to control existing weeds. Since fewer weeds emerge after a pre application, less pressure is placed on the post herbicide to control a larger weed population. This reduction in weeds exposed to the postemergence herbicides is the primary goal to proactively manage against herbicide resistance. In addition, when annual weeds are primarily controlled by pre herbicides, it allows for a properly timed post application that can provide better control of perennial weeds as well as any escaped annuals that may have occurred.



INJURY THRESHOLD OF DEFOLIATION BY STAGES OF GROWTH

STAGE OF GROWTH		PERCENT DEFOLIATION
VE, VC, V1, V2, V3	(cotyledon to 6 nodes - 10-12″)	50-65
V4-V(n)	(8-14 nodes)	40-50
R1	(1 open flower)	35-40
R2	(flower below top node)	30-35
R3	(pod visible at top node)	30
R4	(full podding)	25-30
R5	(beginning seed)	20
R6	(full seed)	25
R7	(physiological maturity)	45-50
R8	(maturity)	

Source: Missouri Soybean Handbook

- Scout for early-season weeds that survived the pre-emergence application, especially herbicide-resistant species. Control them soon after planting to avoid competition with soybean plants.

- Overlap residual herbicides during all applications from burndown to canopy closure to minimize the number of weeds that survive during the growing season.

- When weeds survive pre-emergence applications, use timely applications of postemergence herbicides that have MOAs different from that of glyphosate.

- Add a herbicide with in-crop residual activity in combination with post emergence foliar herbicide applications in cases where multiple flushes of weeds are expected.

• **Fall weed control:** Use fall weed-control measures, such as residual herbicides, to provide an edge going into the following growing season. However, fall herbicides use may impact the utility of cover crops. Depending on the severity of weeds, tillage could also be a viable option to control weeds.

INSECTS

Insect pests have not been of much concern or importance to New York and Pennsylvania soybean production to date. However, farmers must diligently scout fields to look for insect outbreaks.

"Some of the key insects and pests in Pennsylvania are the bean leaf beetle, seed corn maggot and slugs early in the season," says Roth. "In mid-season, the soybean aphid, grasshoppers, Japanese beetles and stinkbugs can be issues. Farmers should learn to identify these and consider treating when they exceed threshold levels."

According to Keith Waldron, Cornell Dairy and Field Crops IPM Coordinator, the most common soybean pests in New York are seed corn maggot, wire worm, white grubs, soybean aphids, two spotted spider mites and slugs.

INSECT HEADLINE

Japanese beetle

bean leaf beetle

slug

stinkbug

Soybean insect pests can be grouped into three classes – stem feeders, fruit feeders and foliage feeders. Insects posing the greatest potential damage to soybean crops are foliage feeders. Fortunately, soybeans can tolerate up to 35 percent defoliation until bloom, about 20 percent while pods are small and soft and about 35 percent when pods are hardening.

Photo shows a Pennsylvania soybean field suffering from white mold. (Photo by Greg Roth, Ph.D., PSU)

DISEASES

As with most crops, soybeans do best in well drained soils. Wet soils, particularly when cool, can cause various seedling and root rots such as pythium, phytophthora and damping-off diseases. Various leaf diseases can occur during warm, wet summer periods but often do not reach economic-threshold levels unless they continue into late summer and early fall, when pod fill and seed quality may become a problem.

"White mold is a fungal disease that was serious in some areas of New York and Pennsylvania in 2014," says Roth. "Soybean fields were likely inoculated with the sclerotia from this fungus and will be at risk when cropped to soybeans in the future. On fields with a high risk for white mold, we recommend selecting varieties with the best resistance, reducing populations to 140,000-150,000 seeds per acre and planting in 15- or 30-inch rows. Narrower rows can create an environment (cool and damp) for white mold to thrive. Farmers can also consider treatment with a fungicide one or two times, beginning at the first-flower, or R1, stage."

The challenge is that a fungicide needs to protect every flower. Soybean plants continuously flower, and white mold only needs to get on one unprotected flower to damage the crop. Therefore, you will need a minimum of two and possibly three applications to protect every flower on a plant. Some fungicides that have been effective for white mold include Topsin®, Endura®, Proline®, Topguard® and Aproach®.

New York and Pennsylvania farmers should also be aware of the symptoms of sudden death syndrome, brown stem rot, fusarium and rhizoctonia root rot, septoria brown spot, frogeye leaf spot, cercospora leaf blight (purple seed stain), pod and stem blight, northern stem canker, and phytophtora root rot as they are key diseases in the region. To find more information on the symptoms of these diseases, visit the PSU Extension website at ***www.extension.psu.edu/plants/crops/news***.

HARVEST MANAGEMENT

The two keys to harvest are minimizing losses and maintaining good seed quality. Losses can occur both prior to harvesting and as a direct result of the combining operation. Preharvest losses include lodged soybeans, seed shattering, weathering and pest damage. Variety selection and timely harvest can be helpful in reducing one or more of these losses. Combine losses result primarily from adjustments to the reel, header, cylinder, straw walkers and combine speed in the field.

DRYING AND STORAGE

Soybeans may be one of the easiest crops to dry and store, but they can also go "out of condition" faster than other crops. Unless harvested during an extremely wet, humid fall, most soybeans can be harvested 1 to 4 percentage points above the standard storage moisture of 13 percent and dried with natural air.

"In New York, many farmers harvest at 16-18 percent because we typically have few consecutive days in October when moisture will remain at 13 percent," Cox says. "In my experience, farmers will put light heat on their crop so they can dry 500 bushels in approximately one hour. This process is cheap and efficient."

When using supplemental heat, keep temperature increases to less than 20 degrees and preferably below 110 degrees for continuous-flow dryers. Retention time in the heated section of dryers should be less than 30 minutes.

Keeping temperatures below this for as short of a time as possible will minimize seed-coat damage and seed splits while also minimizing energy costs.

During the winter and spring, especially during rapidly fluctuating temperatures and humidity, beans can go out of condition if they're not monitored closely.

It is essential to have monitoring sensors for temperature and moisture in the storage structure, as well as outside, to be able to make adjustments to air flow, drying and overall conditions. Fig. 3 provides approximate storage times at various grain temperatures and moisture.

Fig. 3

APPROXIMATE ALLOWABLE STORAGE TIME FOR SOYBEANS

	GRAIN TEMPERATURE (F)					
Moisture Content (%)	30	40	50	60	70	80
	Approximate Allowable Storage Time (Days)					
11	*	*	*	*	200	140
12	*	*	*	240	125	70
13	*	*	230	120	70	40
14	*	280	130	75	45	20
15	*	200	90	50	30	13
16	*	140	70	35	20	10
17	*	90	50	25	14	7
19	190	60	30	15	8	3
21	130	40	15	10	6	2
23	90	35	12	8	5	2
25	70	30	10	7	4	2
27	60	25	5	5	3	1

Source: K. Hellevang, NDSU

*Allowable storage time exceeds 300 days

- Allowable storage time is the storage period before quality loss is expected to affect grain quality.
- Airflow through the grain permits maintaining the grain temperature, but does not extend the allowable storage time beyond that listed in the table.
- Allowable storage time is cumulative. If 16 percent moisture soybeans were stored for 35 days at 50 F, one-half of the storage life has been used. If the soybeans are cooled to 40 F, the allowable storage time at 40 F is only 70 days.

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