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ALL-PURPOSE SPRAY ADJUVANT CONCENTRATE

NUTRIPLANT APSA-80 ALL-PURPOSE SPRAY ADJUVANT CONCENTRATE. THE CHOICE OF GROWERS EVERYWHERE.

HOW DOES IT WORK?

It may seem contradictory, but water does not always “wet” well. This is because water (H_2O) is a polar molecule: It has both positive and negative ends. When these ends are linked by an electrical charge, a chain forms and droplets occur. This is called hydrogen bonding and is the cause of surface tension.

Figure 1

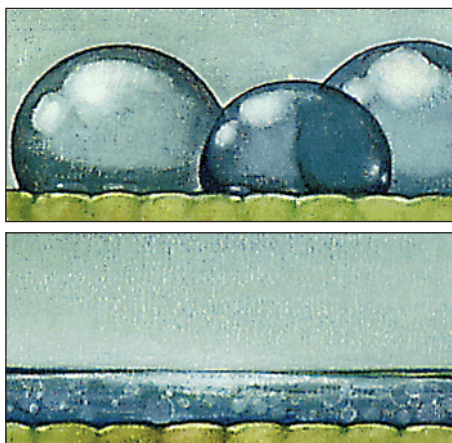


Figure 1 shows drops of water. On top is just water, on the bottom is a solution with Nutriplant® APSA-80® All-Purpose Spray Adjuvant Concentrate (5 oz./20 gal. water). Both form drops, but the drop containing the APSA-80® Adjuvant has spread more, has lower height, and will tend to run off the leaf less.

Surface tension isn't easily visible when viewing a glass of water or a farm pond. It is evident, however, when water is placed on a water-repellent surface such as a waxy plant leaf. The water is NOT SOLUBLE in the wax and remains on the surface of the leaf. The water molecules form chains within themselves, beading into tiny droplets.

Surfactants overcome the effects of beading or surface tension. One end of the surfactant molecule is soluble in oily or waxy substances, and the second end is water-soluble. When a surfactant is added to water and oil, its molecules align themselves at the appropriate ends of the interface and pull the layers together, reducing the beading or surface tension.

This is visible on the leaf surface as the surfactant molecules pull the water and the wax (on the leaf surface) together, causing the droplet to spread out.

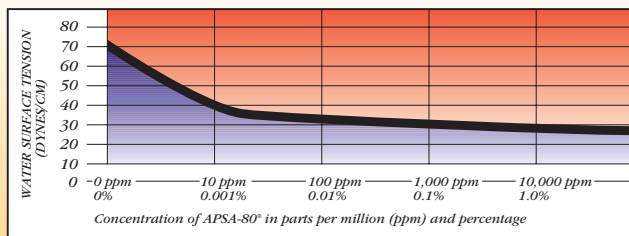
Since water is a carrier for pesticides, when you increase its “wetability” and cause it to spread more evenly, the result is much better pesticide coverage. Air pockets are reduced or eliminated. The pesticide stays on the leaf and penetrates the surface faster and more evenly.

Figure 2



Figure 2 demonstrates what happens when the same two solutions are sprayed on the leaf surface (common lamb's-quarters). The leaf at the left has been sprayed with plain water. Distinct droplets occur resulting in spotty coverage of the leaf surface. The leaf on the right has been sprayed with water containing APSA-80® Adjuvant (5 oz./20 gal. water). It's evenly covered with the spray solution and will resist runoff, thus saving costly herbicide.

SURFACE TENSION OF WATER WITH APSA-80®



Note: This chart shows what happens when APSA-80® is added to distilled water.

In technical terms, water's normal surface tension is about 72 dynes/cm. When APSA-80® Adjuvant is added at a rate of 5 oz./20 gal. water (equivalent to about 2,000 parts per million [ppm]), the water's surface tension is reduced by more than half – to less than 29 dynes/cm.

ACTS AS A SPREADER

APSA-80® Adjuvant is designed to be added to a spray solution such as a tank mix. As such, it is highly effective in causing spray droplets to spread and penetrate the surface of foliage.

ACTS AS AN ACTIVATOR, TOO!

An “activator adjuvant” increases the activity of certain herbicides. Activators are used primarily in post-emergent foliar pesticide applications.

FASTER SOIL PENETRATION

Because APSA-80® Adjuvant reduces surface tension and makes water “wetter,” it also helps water (and whatever pesticide it is carrying) penetrate the soil faster and more evenly.

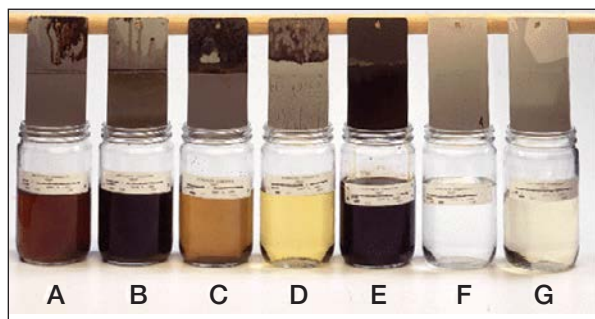
AIDS IRRIGATION*

Many types of soils, because of their very compact nature or natural water repellency, tend to resist water’s penetration. By making water wetter, APSA-80® Adjuvant helps water penetrate these soils more easily to do the job for which it is intended. Because of the faster soil penetration, there is less runoff. Which wastes less water.

HELPS KEEP PESTICIDES IN SUSPENSION

Many pesticides can be classified as either an emulsifiable concentrate (a liquid that is meant to be used with water) or a “wettable” powder (also meant to be used with water). Often, the pesticide doesn’t mix well with water and separates rather quickly.

When APSA-80® Adjuvant is added to the pesticide solution according to directions, it helps keep pesticides dispersed to greatly reduce or entirely eliminate separation problems.



Note the difference in appearance of these mild steel panels immersed for 28 days in adjuvants. The panel placed in APSA-80® (G) is corrosion free. Panels A, B, C, D, E, and F were placed in competitive brands.

NONCORROSIVE

APSA-80® Adjuvant is made with a unique, noncorrosive formula to protect metal pumps, tanks, and other metal equipment from the dangers of rust and corrosion. It is less corrosive than plain water and is actually up to 97% less corrosive than its major competitors.

HELPS KEEP EQUIPMENT CLEAN

Because of its ability to help keep pesticides in solution, APSA-80® Adjuvant helps to keep equipment clean and prevent nozzle clogs. This results in less downtime for your machinery, fewer mechanical worries, and easier machine maintenance.

HELPS MAXIMIZE WEED CONTROL

- Acts as a spreader – provides more uniform spray deposit on plants; improves coverage of herbicides, insecticides, and fungicide sprays.
- Acts as an activator – thorough wetting action helps improve performance of post-emergent herbicides, insecticides, and fungicides.
- For use on growing and harvested crops.
- Helps alleviate costly downtime.
- Helps disperse powders and oil-base liquids.
- Helps keep spray equipment clean and prevents clogged nozzles, reducing downtime.
- Noncorrosive to equipment.
- Biodegradable.

For hard-to-wet soils*

- Increases water penetration – gets more water into the soil.
- Aids irrigation by increasing the rate at which water soaks into soil; promotes more efficient water usage.
- Also aids irrigation by reducing runoff; saves water.

*Not for sale for this purpose in Arkansas, California, or Minnesota.

NUTRIPLANT APSA-80 ALL-PURPOSE SPRAY ADJUVANT CONCENTRATE

Nutriplant® APSA-80® All-Purpose Spray Adjuvant Concentrate contains 80% actives and is based on a nonionic surfactant that acts as a wetting agent or spreader. Alcohol is added for better solubility and cold temperature storage characteristics. However, we do not count alcohol as an active ingredient. Many competitive adjuvants do count alcohol as an active ingredient or functioning agent. Don't be confused – if alcohol is included as an active ingredient, it is not all surfactant!

CONCENTRATED FORMULA MEANS EXTRA SAVINGS!

Concentrated – APSA-80® Adjuvant gives growers 80% active surfactants! The 80% ingredient level complies with university and manufacturer recommendations for an 80% active product. At the recommended rate of 2½ to 5 oz. per acre, a 30-gallon drum of APSA-80® Adjuvant will cover between 768 and 1,536 acres.

USE DIRECTIONS

Before mixing, read all pesticide labels for specific mixing instructions and caution statements.

To avoid the potential of crop damage, use APSA-80® Adjuvant at the recommended dilution rates.

FOR USE WITH HERBICIDES

1. Following the manufacturer's instructions, add the proper amount of water to the spray tank and turn on the agitator or recirculation pump.
2. Add the herbicide according to manufacturer's instructions.
3. Add 2½ to 5 oz APSA-80® Adjuvant to 20 gallons of water per acre (0.1%–0.2%).

FOR USE WITH 2,4-D

Use 2½ to 5 oz. APSA-80® Adjuvant per 100 gallons of spray solution. Mix as above.

FOR AERIAL SPRAY APPLICATIONS

Herbicides: Use ½ to 1 oz. APSA-80® Adjuvant per 3 gallons of spray solution.

Fungicides, insecticides: Use ¼ oz. APSA-80® Adjuvant per 3 gallons of spray solution. Follow manufacturer's use directions.

FOR USE WITH INSECTICIDES OR FUNGICIDES

1. Following the manufacturer's instructions, add the proper amount of water to the spray tank and turn on the agitator or recirculation pump.
2. Add the insecticide or fungicide according to manufacturer's instructions.
3. Add 2½ to 5 oz. APSA-80® Adjuvant to 100 gallons of water per acre (0.02%–0.04%).

FOR USE WITH FOLIAR FERTILIZERS

1. Following the manufacturer's instructions, add the proper amount of water to the spray tank and turn on the agitator or recirculation pump.
2. Add the foliar fertilizer according to manufacturer's instructions
3. Add 2½ to 5 oz. APSA-80® Adjuvant in 100 gallons spray solution (0.02%–0.04%).

FOR USE WITH NUTRIPLANT AG

1. Add APSA-80® Adjuvant to Nutriplant® AG plus water mixture at 5 oz. APSA-80® Adjuvant per 100 gallons of spray mixture.

FOR USE AS AN IRRIGATION AID*

Always dilute APSA-80® Adjuvant when applying for irrigation purposes, especially in over-the-top applications.

1. Wet the ground with a solution of 2½ to 5 oz. APSA-80 Adjuvant per 10 gallons of water minimum per acre prior to irrigation.
2. For spray irrigation, APSA-80® Adjuvant may be injected into the spray equipment during the initial irrigation phase.

FOR USE ON COMPACTED SOILS*

Always dilute APSA-80® Adjuvant when applying for soil compaction purposes, especially in over-the-top applications.

1. Wet the ground with a solution of 15 to 45 oz. APSA-80® Adjuvant per 10 gallons of water minimum per acre prior to irrigation.
2. For spray irrigation, APSA-80® Adjuvant may be injected into the spray equipment during the initial irrigation phase.

FOR USE ON TURF AND SOD*

1. Apply 15 oz. of APSA-80® Adjuvant per 20 gallons of water minimum per acre.
2. Follow application with normal watering procedure. For best results, treat early in season and monthly, if needed, throughout the season.

FOR CONTROL OF DRY SPOTS ON GOLF COURSES AND LAWNS*

1. Apply 2½ oz. of APSA-80® Adjuvant per 1,000 sq. ft., with a minimum of 20 gallons of water.
2. Follow application with normal watering procedure. For best results, treat early in season and monthly, if needed, throughout the season.

*Not for sale for this purpose in Arkansas, California, or Minnesota.

These amounts of APSA-80® Adjuvant have been found to do the best job in the vast majority of situations. However, we realize that some growers have used other concentrations to their advantage in overcoming specific problems related to any number of factors . . . soil conditions, individual pesticides, degree of “water hardness,” and so on. In some cases, you may wish to use a little less or a little more, strictly at your discretion. Always double-check compatibility.

COMBINING PESTICIDES WITH LIQUID FERTILIZERS TO SAVE TIME

APSA-80® Adjuvant may be used with certain pesticide and fertilizer mixtures, thus providing more uniform distribution and saving time by allowing you to do two or more jobs with one trip over the field.

COMPATIBILITY TESTING

The first time you use APSA-80® Adjuvant with any chemical or combination of chemicals, we recommend you make a small compatibility test before adding any of the chemicals to the spray tank.

To do this, in a jar, add all ingredients in the same order and in the same proportion as you would in the tank. Then, thoroughly stir or shake the mixture.

If all the ingredients combine without separation, you have a complete mixture and can use the combination in your tank. If the ingredients DO NOT combine (“creaming” at the top, settling at the bottom, or “gelling”), the mixture is incompatible and you should not use it.

CAUTION:

When used with pesticides, one of the net effects of APSA-80® Adjuvant may be to increase the effect of the pesticide. For example, 2,4-D, Bladex, Banvel, propanil, propanil + Prowl, and other similar herbicides have been known to cause crop injury with post-emergent applications. A similar condition can occur with 2,4-DB on soybeans. In these situations, the use of APSA-80® Adjuvant or any other surfactant product may increase the risk of crop injury as it increases the efficiency of the herbicide.

READ THE PESTICIDE LABEL CAREFULLY:

Some manufacturers warn on their labels against the use of an adjuvant. Other pesticide labels may not properly warn against use with an adjuvant. Under certain drought or relative humidity conditions, some of these herbicides recommend the use of a surfactant. IF YOU HAVE ANY QUESTIONS REGARDING THE USE OF SURFACTANTS WITH A PARTICULAR PESTICIDE, CONSULT YOUR COUNTY EXTENSION AGENT.

CLEANING EQUIPMENT

Many growers like to use APSA-80® Adjuvant to thoroughly clean their equipment after spraying. To do this, simply add 4 to 5 gallons of water to the spray tank, turn on the agitator or recirculation pump, and add 1/4 oz. APSA-80® Adjuvant per gallon of water. Let the solution circulate for a few minutes, then turn on the sprayer and spray the solution through the entire system. For nozzle maintenance, detach the nozzles and soak in a solution of 1 oz. APSA-80® Adjuvant per gallon of water.

GOVERNMENT REGULATIONS

All adjuvants are subject to U.S. Environmental Protection Agency approval if used with herbicides, insecticides, or fungicides on any growing crop, or on raw agricultural commodities after harvest. Rules explaining and restricting the use of adjuvant ingredients are covered by Section 180.1001 of the Code of Federal Regulations. APSA-80® Adjuvant is made from ingredients listed in subsections c and d, which means it can be used on growing and harvested crops.

CALIFORNIA REGULATIONS

In California, any person who retails a pesticide that includes APSA-80® Adjuvant for agricultural use must first obtain one or more licenses through the state of California. These licenses include pest control dealer license, agricultural pest control adviser license, and/or pest control dealer designated agent license. If you sell these products exclusively to customers for their own personal use at home and not for agricultural use, these licenses are typically not required. We instruct IBOs to evaluate their own business practices to determine whether they need to be licensed.

TEST RESULTS PROVE APSA-80 ADJUVANT PERFORMS

APSA-80® Adjuvant represents more than 30 years of exhaustive research and testing. Undertaken to assure the finest adjuvant product possible, these studies have resulted in numerous modifications and improvements to the basic formula as our adjuvant technology has grown.

ECONOMIC BENEFITS OF WEED CONTROL

The effect of weeds on crop yield can be substantial, even from low levels of weed infestation. Weeds compete with crops for water, sunlight, and soil nutrients. In addition, some weeds give off chemicals in the soil that inhibit crop growth. In studies done in the United States, as little as one weed per square foot in a wheat field can reduce yield by 9%. (1) At 40 bushels per acre this would amount to 3.6 bushels, which at \$3 per bushel is \$10.80 per acre. In soybeans, pigweed infestations of as little as one weed per 8 row feet can reduce yield as much as 30%, or 12 bushels per acre. (2) At a soybean price of \$4 per bushel, that is \$48 per acre. In corn, as little as one giant foxtail plant per row foot can reduce yields as much as 7%. (3) At 100 bushels per acre, that can amount to 7 bushels per acre, which at \$2 per bushel, is \$14 per acre.



When weed populations do escape or if post-emergent application of herbicides is the farmer's normal practice, it becomes quite clear that weed control is essential to maximum yields. APSA-80® Adjuvant can increase the effectiveness of post-emergent herbicides. In studies with atrazine on corn, crabgrass control was increased from 57% to 86%. (4) In studies with aciflourfen on soybeans, pigweed control was increased from 51% to 96%. (5) In studies with chlorsulfuron on wheat, total weed control was increased from 86% to 98%. (6) APSA-80® Adjuvant costs less than \$1 per acre. With the tremendous effect of weeds on crop yield, doesn't it make sense to use APSA-80® Adjuvant? The cost is so small and the benefits can be so large.

¹Johnson, B., 1970, The High Cost of Cocklebur. The Progressive Farmer, 85(3):5.

²Asberry, J. and C. Harvey, 1969 Proc. Southern Weed Sci. Soc. 22:96.

³Knake, E. L. and F. W. Slife, 1962, Weeds, 10:26-29.

⁴Brochure Test Series #2.

⁵Brochure Test Series #22.

⁶Brochure Test Series #15.

The following pages summarize portions of the test results, achieved to date, which illustrate the potential of the product. We commissioned 41 leading universities and 28 independent agricultural stations across the country and the world to conduct a wide range of tests. This testing was conducted in 30 states, five provinces, and eight countries. The actual results you achieve will depend on many factors, including the condition of your spraying equipment, weather, soil conditions, and your general crop management practices. Nevertheless, these test results demonstrate that, over the years, APSA-80® Adjuvant has increased the performance of a number of different pesticides on a variety of crops.

All herbicide and pesticide tests are conducted with trademarked products not affiliated with Amway.

WHAT YOU SHOULD KNOW ABOUT NONIONIC SURFACTANTS, CROP OILS, AND CROP OIL CONCENTRATES

The three main categories of spray adjuvants are nonionic surfactants, crop oil concentrates, and fertilizers. Nonionic surfactants are chemical compounds that are soluble in water yet have surface-active properties. The best are sold as 80% active surfactant products and are usually recommended at 1–2 pt. per 100 gallons of spray solution. Crop oil concentrates are petroleum or vegetable oils made with 15%–20% emulsifiers and are recommended at 1–2 qt. per acre. Fertilizers used as adjuvants are usually nitrogen fertilizers such as 28-0-0, 10-34-0, or ammonium sulfate. Fertilizers are usually recommended at 1–2 qt. or 1–2 lb. per acre. Many herbicides recommend one type of adjuvant or another, or in some cases all three. Unless one type is not compatible with the herbicide spray mixture, all three will enhance the activity of most post-emergent herbicides. With certain herbicides, one adjuvant may work better than another on certain weeds or one adjuvant may be more phytotoxic

(poisonous to the plants) than another to the crop. Particularly on hot, humid days, crop oil concentrates have been known to cause more crop damage than nonionic surfactants. Fertilizers have been known to enhance velvetleaf control but may be less effective on other weed species.

A grower is always cautioned to apply pesticides/herbicides according to the manufacturer's label recommendations. However, the better the farmer manages his crop, the more details he should know about adjuvants. By consulting with the manufacturer on specific conditions and problems, he may find that alternate adjuvants would be better for his situation.

APSA-80 ADJUVANT VS. CROP OIL CONCENTRATES VS. FERTILIZERS USED WITH STORM

Storm is a post-emergent herbicide composed of a pre-mix of aciflourfen and bentazon, for broadleaf weed control on soybeans. Recommendations on the Storm label suggest using an adjuvant. Crop oil concentrates are recommended at a maximum of 1 qt. per acre. Fertilizers are recommended at either 2 lb. or 2 qt. per acre. Nonionic surfactants are recommended at 1–2 pt. per 100 gallons. Recommended spray volumes are 20 gallons per acre. Only one of these adjuvants should be used at one time. Listed below are the test results for a field trial on soybeans using Storm and each of the three recommended spray adjuvants. Storm was used at a rate of 1.5 pt./acre. Assure was applied prior to the Storm application to control grasses. The crop oil concentrate was a petroleum based COC used at 1.25% or 1 qt./acre. The fertilizer used was a 28-0-0 urea ammonium nitrate product used at 5% or 1 gallon per acre. The nonionic surfactant was APSA-80® Adjuvant used at 0.25% or 1 qt. per 100 gallons, as recommended on the Storm label. Spray volume was 20 gallons per acre at 21 psi using an 8003 flat fan nozzle. Air temperature was 74°F at 56% relative humidity on dry soil.

APSA-80 VS. CROP OIL CONCENTRATES VS FERTILIZERS USED WITH STORM

Weed Control	APSA-80®	Crop Oil Concentrate	Fertilizer
Velvetleaf	89.6%	88.8%	94.7%
Redroot Pigweed	94.1%	92.8%	91.1%
Ivyleaf Morning Glory	90.9%	91.3%	87.1%
Jimson Weed	93.8%	93.3%	93.3%
Average Weed Control	92.1%	91.6%	91.6%
Crop Damage	3.0%	7.1%	2.6%
Crop Yield (bu/a)	31.4	27.3	24.6

Average weed control was similar for all three adjuvants. As expected, the fertilizer was better on velvetleaf but was less effective on the other weeds. APSA-80® Adjuvant was best on pigweed and jimson weed and crop oil concentrate was best on morning glory. The crop oil concentrate caused the most crop phytotoxicity, but all three adjuvant treatments saw crop recovery and growth out of the initial spray damage. At the end of the test, APSA-80® Adjuvant had the greatest yield with crop oil concentrates second and fertilizers third.

The net payback to the farmer in each of these treatments is listed below:

Weed Control	APSA-80®	Crop Oil Concentrate	Fertilizer
Adjuvant cost/acre	\$1.26	\$1.38	\$0.67
Crop Value per acre			
Soybeans @ \$4.75/bu	\$149.15	\$128.29	\$116.18
Net to the farmer compared to APSA-80		(\$19.60)	(\$31.71)

These results were obtained for this test and are not guaranteed in every situation, but in this case the use of APSA-80® Adjuvant was the best spray adjuvant to use with Storm and resulted in a considerable increase in profit to the grower.

ENHANCE POST-EMERGENT HERBICIDE EFFECTIVENESS WITH ADJUVANTS

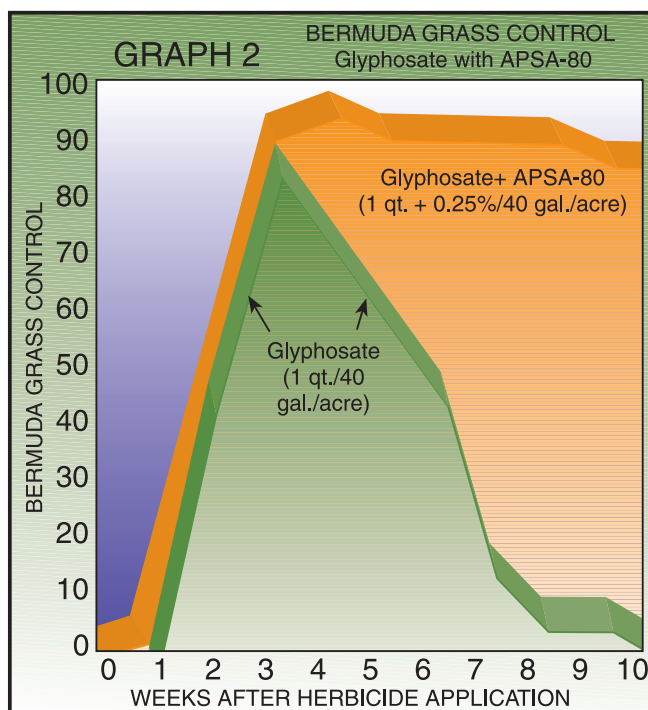
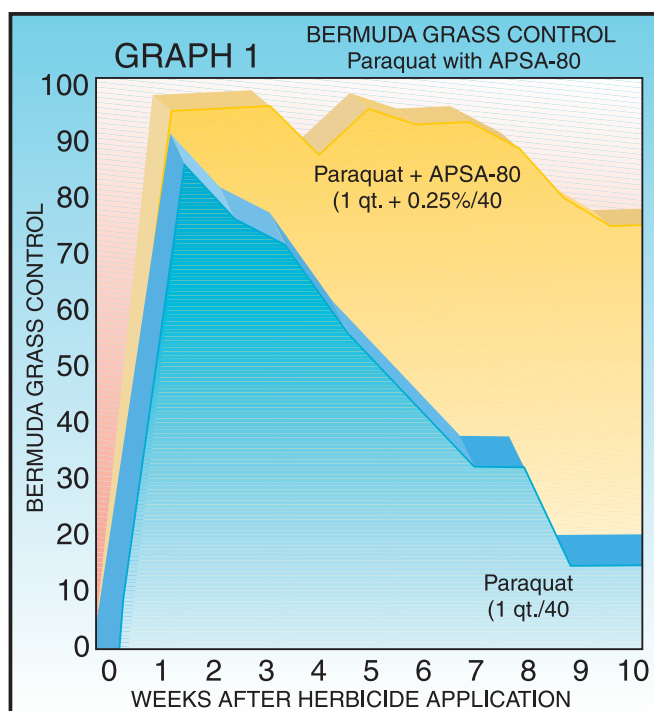
Post-emergent herbicides operate by either or both of two mechanisms. Contact herbicides are those that kill on contact

with plant surfaces. They cause death or necrosis on or near the surfaces with which they come in contact. Weed control with contact herbicides is usually proportional to the percentage of the plant surface covered. If coverage is low, the plant will sprout new leaves and recover or escape from the herbicide treatment. Paraquat is an example of a contact post-emergent herbicide.

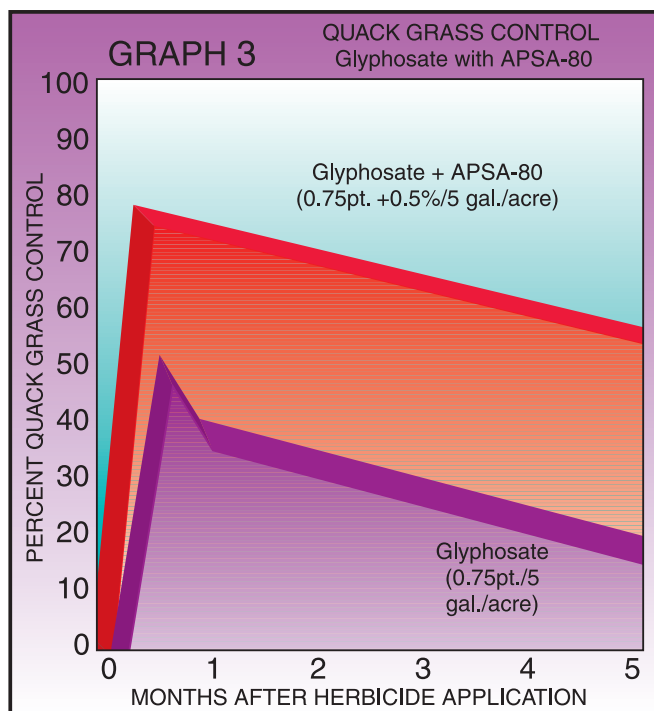
Systemic herbicides, on the other hand, are those that must be absorbed into the plant itself and then transported or translocated within the plant to the site where the herbicide is active. Post-emergent herbicide sprays such as Glyphosate are active on certain perennial weeds by killing the rhizomes from which new shoots emerge. Since Glyphosate is inactivated by contact with clay particles, it must be sprayed on the weed above ground and then translocated to the underground rhizomes.

Both Glyphosate and Paraquat exhibit some herbicidal activity without additional adjuvants being added to the spray solution. However, the increased coverage of the herbicide spray provided by the addition of an adjuvant can be substantial, as demonstrated in the following graphs.

When an adjuvant, in this case APSA-80® Adjuvant, is added to the contact herbicide Paraquat and applied to Bermuda grass (Graph 1), weed control is slightly better than with Paraquat alone one week after application. However, the increased coverage afforded by the addition of APSA-80® Adjuvant maintained excellent weed control over a 10-week period. When adjuvant was not added to the herbicide, the weeds were initially stunted, but began to recover after one week. Ten weeks after treatment, Paraquat without adjuvant showed only 5% weed control.



When the systemic herbicide Glyphosate is applied with APSA-80® Adjuvant to Bermuda grass (Graph 2), the immediate effects are similar to Glyphosate applied without adjuvant. Since systemic herbicides must be translocated to the rhizome, it takes Glyphosate longer to kill Bermuda grass than a contact herbicide would. Ninety-five percent weed control is achieved three weeks after application with both treatments (alone and with APSA-80® Adjuvant). However, the more complete coverage of the plant surface provided by APSA-80® Adjuvant allowed more herbicide to be translocated to the rhizomes, which resulted in 90% weed control 10 weeks after application. The treatment without APSA-80® Adjuvant began to fail after three weeks and showed only 5% weed control at 10 weeks.



When APSA-80® Adjuvant was added to Glyphosate and sprayed on perennial quack grass (Graph 3), the initial control after seven days and season-long control after five months were substantially higher than when Glyphosate was used alone. Again, the increased coverage provided by adjuvant in the spray solution gave more complete weed control that lasted well into, and even beyond, the growing season.

Both of the Bermuda grass control experiments were run in citrus groves in Florida, where Bermuda grass is a problem. The quack grass control experiment was run in North Dakota and represents a rescue operation in a cornfield.

In each of these cases, the cost of the APSA-80® Adjuvant represents a small percentage of the herbicide cost. Yet, the use of the APSA-80® Adjuvant results in a large increase in season-long weed control. The use of APSA-80® Adjuvant can increase weed

control at costs of less than a bushel per acre of corn. It makes sense to use APSA-80® Adjuvant. The cost is so small, but the benefits can be so large.

SATISFACTION GUARANTEE

We stand behind the quality of our products and guarantee your satisfaction. If you are not completely satisfied with your purchase, you may return it to receive an exchange or refund. (Limited guarantees apply to designated products.) This guarantee does not apply to products that have been intentionally damaged or misused. Some products allow a specified time period for return, and certain products, if not covered by the Satisfaction Guarantee, are covered by express limited written warranties.

REDUCED RATES

The use of herbicides at rates below those recommended by herbicide manufacturers is becoming more common. The use of adjuvants with post-emergent herbicides will generally increase the activity of the herbicides in such an application. However, we cannot assume liability for herbicide failure in reduced rate applications.

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