Top-dress Applications of UAN Fertilizer with Herbicides on Wheat

Department of Agronomy **MF2903** **Fertilizer**

Despite the advantages of combining herbicide and top-dress nitrogen applications, sometimes severe foliar burn occurs and causes concern about the possible effects on wheat yield.

Some advantages of co-application include:

- Combined operations eliminate an application, which saves time, money, and wear and tear on equipment,
- Less risk of nitrogen loss through leaching and more efficient use of applied fertilizer,
- Better herbicide performance during adverse environmental conditions and improved control of hard-to-control weed species.

Agricultural statistics show that nitrogen (N) fertilizer was applied to 88 percent of the wheat acreage in Kansas in 2006, with 60 percent of those acres receiving more than one application of nitrogen (USDA NASS 2007). It is reasonable to assume that a major portion of the second application was top-dressed nitrogen, principally as liquid urea ammonium nitrate (UAN) solutions of either 28 percent or 32 percent nitrogen or a UAN solution with added sulfur (S).

It is well-known that UAN applications can cause considerable foliar burn under certain conditions, especially when applied at later growth stages. Producer experience and numerous studies have shown that foliar burn from nitrogen fertilizers is temporary and seldom causes wheat yield loss on low fertility fields when applied before crop jointing.

Herbicides were applied to 53 percent of the Kansas wheat acreage in 2006 (USDA NASS 2007). Because the recommended timing for most postemergence herbicide applications in spring closely coincides with top-dress foliar nitrogen applications, the combined application of herbicides and nitrogen fertilizer — called weed-and-feed — to winter wheat in spring is an increasingly common practice. However, the foliar burn from top-dress nitrogen applications often is increased when co-applied with herbicides, especially when an adjuvant such as non-ionic surfactant (NIS) or crop oil is used. This risk increases with later wheat growth stages because of greater crop leaf area and shorter time to recover before periods of greatest need for photosynthetic capacity, i.e. head initiation and emergence, flowering, and grain fill.

Dry or liquid ammonium sulfate and liquid UAN fertilizers have been widely used as adjuvants to enhance postemergence herbicide activity or to overcome herbicide inhibition by salts in the water carrier. Most postemergence wheat herbicide labels allow or even recommend adding nitrogen fertilizer to the water carrier (spray solution) to improve weed control,

Key points to remember

- Applying nitrogen fertilizer with herbicides may improve weed control, but low nitrogen rates are not adequate substitutes for surfactant or crop oil adjuvants.
- To reduce the potential of foliar nitrogen burn, limit the amount of nitrogen fertilizer in the spray solution to no more than 50 percent by volume when applying herbicides with surfactant or crop oil adjuvant.
- Unless required on the herbicide label, consider not using a surfactant or crop oil adjuvant with herbicides when liquid nitrogen in the spray solution exceeds 50 percent by volume, but be aware that significant foliar burn may still occur and weed control may be reduced. However, if the herbicide label specifies that adjuvant is required, weed control likely will be decreased if it is not included in the spray solution.
- Avoid making weed-and-feed applications during warm, humid conditions and before expected periods of freezing temperatures that may limit the crop's ability to metabolize the applied herbicide(s).
- Liquid formulated herbicides, especially emulsifible concentrates, are more likely to increase foliar nitrogen burn than dry formulated herbicides.
- Foliar burn from nitrogen fertilizers is temporary and rarely causes yield loss when applied to low fertility fields under favorable environmental conditions before crop jointing.

and many herbicides can be applied using UAN as a major portion – usually up to 50 percent – of the carrier; some permit 100 percent UAN. Nevertheless, low to moderate rates of liquid fertilizer are not a substitute for NIS as highlighted in a study in Table 1.

For herbicides that require NIS when applied in water, the use of NIS is recommended for a carrier containing up to 50 percent UAN. However, most herbicide labels warn that adding surfactant increases the risk of crop injury when using high rates of liquid nitrogen fertilizer in the spray solution, and liquid nitrogen fertilizer solutions that contain sulfur further increasing the risk of foliar burn. Refer to the specific herbicide label for guidance when considering applying herbicides in UAN solutions. Some recent studies on the effects of nitrogen on herbicide performance and crop response are summarized below.

Study 1. A 3-year study at Hays, Kansas compared the effects of Amber® and/or 2,4-D herbicides with and without NIS on winter wheat foliar injury and grain yield when applied in water, water and nitrogen fertilizer (50 percent UAN), or UAN (100 percent UAN). The UAN (12 gpa, 36 lb/a) alone or as a carrier for herbicides caused moderate to severe injury in all 3 years. Adding NIS to the UAN spray solutions increased foliar burn, especially when herbicides were added. Diluting UAN 50 percent with water lessened foliar burn in 2 of 3 years, especially in the presence of NIS, regardless of whether herbicides were in the spray solution. Wheat regained normal color within 3 weeks and grain yields were not reduced in any year despite as much as 53 percent foliar burn in one year. (Stahlman et al. 1997).

Study 2. Field experiments were conducted at four locations in 2 years in Kansas to determine the effects of UAN concentrations and application timings on jointed goatgrass (same as jointgrass) and feral rye control with Beyond® herbicide in Clearfield winter wheat. Control of the two weed species increased as UAN concentration in the spray solution increased from 1 percent up to 25 percent as seen in Figure 1 and Figure 2. UAN concentrations higher than 50 percent did not further increase control of either weed species. When averaged over UAN concentrations, Beyond controlled both species better when applied in fall compared to applications made in spring. The greater weed control with fall application resulted in higher wheat yields compared to applications made in spring in two of the four experiments. However, wheat yields were similar among UAN concentrations in all four experiments. (Geier and Stahlman, 2009).

Study 3. A field experiment near Hays, Kansas in 2007 determined the effects of nitrogen concentration (2.5, 10, 25, and 50 percent by volume) in Beyond® and Clearmax® spray solutions applied in fall or spring on downy brome control in Clearfield winter wheat. Downy brome control with fall-applied treatments ranged from 92 to 95 percent and did not differ significantly between herbicides or nitrogen concentrations. Downy brome control was 30 percent to 50 percent lower when the herbicides were applied in spring compared to fall application, but unlike with fall application, there was a response to nitrogen in spring. For both herbicides applied in spring, downy brome control generally increased as nitrogen concentration was increased from 2.5 percent to 10 percent to

Table 1. *Downy brome control 26 weeks after treatment following Maverick application in mid-November*

		Hays		Manhattan	
Adjuvant	Carrier	1997	1998	1997	1998
		----------------------%	--------------------------		
None	Water	79	99	84	89
None	1:1 UAN:H20	63	97	63	71
None	UAN	63	98	62	61
NIS	Water	69	99	94	88
NIS	UAN	89	99	91	94
LSD (0.05)*		13	13	8	7

**Least Significant Difference. If the difference between two treatments is greater than the LSD value, then the difference is significant.*

Olson et al. 2000. Weed Technol. 14:750-754

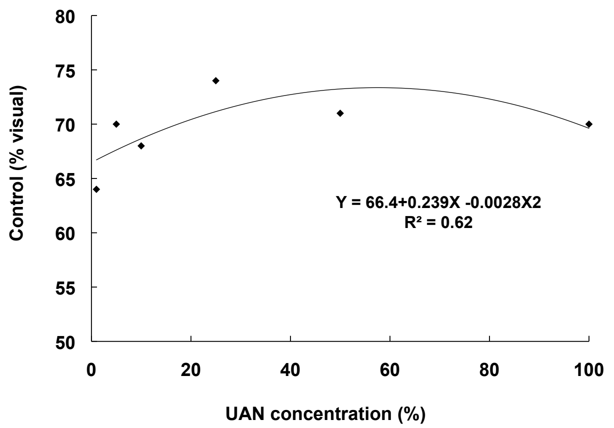

Figure 1. *Effect of urea ammonium nitrate concentration on jointed goatgrass control with imazamox, averaged over experiments and application timings.*

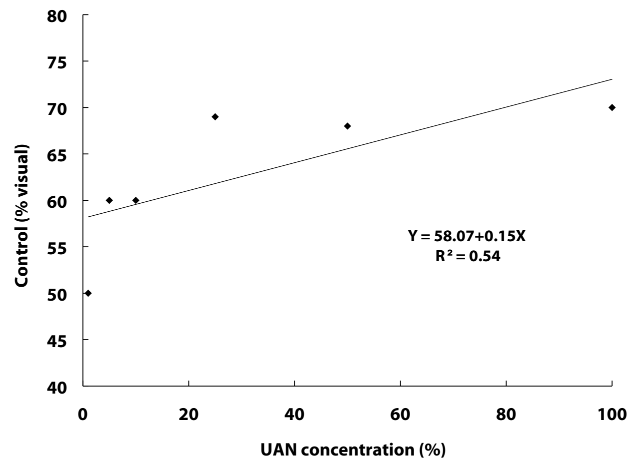

Figure 2. *Effect of urea ammonium nitrate concentration on feral rye control with imazamox, averaged over experiments and application timings.*

25 percent. Further increasing nitrogen concentration up to 50 percent benefitted Beyond but not Clearmax. However, no treatment applied in spring controlled downy brome by as much as 65 percent. The poorer control was reflected in 31 percent lower wheat yield for spring application compared to fall application. (Stahlman and Geier, unpublished data).

Study 4. A field experiment near Manhattan, Kansas in 2004 evaluated weed control and winter wheat response to Maverick®, Olympus®, and Olympus Flex® herbicides applied postemergence in water, 50 percent or 100 percent liquid nitrogen fertilizer as the spray carrier in both fall and spring. Application of Maverick, Olympus, or Olympus Flex in 50 percent UAN solution improved weed control with minimal risk to wheat. Early season foliar burn increased as UAN concentration in the carrier increased, regardless of herbicide. Late-season injury from Olympus was not affected by spray carrier, but injury was greater for fertilizer carrier than water carrier for the other herbicides, especially Olympus Flex. Wheat sprayed with herbicides in 100 percent UAN carrier yielded less compared to the same herbicides applied in water carrier. (Peterson and Hudec 2004).

Study 5. A field study near Hays, Kansas in 2007 compared downy brome and winter annual broadleaf weed control with Olympus® and Olympus Flex® applied in 5 percent or 50 percent UAN spray carrier in fall and spring. In early April, fall-applied herbicides had controlled downy brome about 90 percent and controlled blue mustard and flixweed greater than 98 percent. Spring-applied treatments were considerably less effective. UAN concentration did not affect control of the three species, but control of each species with Olympus Flex was greater when applied in 50 percent UAN carrier compared to 5 percent UAN carrier. The higher UAN solution was needed for Olympus Flex to provide similar weed control as provided by Olympus with only 5 percent UAN. Both Olympus Flex treatments delayed wheat maturity and caused more chlorosis and stunting than Olympus. However, wheat grain yields did not differ significantly among treatments. (Stahlman and Geier, unpublished data).

Literature Cited

Geier, P.W. and P.W. Stahlman. 2009. Nitrogen concentration and application timing affect imazamox efficacy in winter wheat. Crop Protection 28:573-576.

Olson, B.L.S, K. Al-Khatib, P.W. Stahlman, and P.J. Isakson. 2000. MON 37500 efficacy as affected by rate, adjuvants, and carriers. Weed Technol. 14:750-754.

Peterson, D.E. and G.W. Hudec. 2004. The influence of nitrogen fertilizer carrier on sulfosuofuron, propoxycarbozone, flucarbozone, and mesosulfuron efficacy. Proc. North Central Weed Sci. Soc. 59:171.

Stahlman, P.W., R.S. Currie, and M. A. El-Hamid. 1997. Nitrogen carrier and surfactant increase foliar herbicide injury in winter wheat (*Triticum aestivum*). Weed Technol. 11:7-12.

USDA NASS Agricultural Chemical Useage – 2006 Field Crops summary. 2007. Available at http://www.nass.usda/gov dated May 16, 2007.

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