Tanks for the Memories - what you already knew about tank mixing but were afraid to remember...

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Pressure!!

Increasing fuel costs, soybean rust, trend to prophylactic treatments & increased inputs (plant health). LOTS of pressure towards adoption of tank mixing!
Benefits

• Cost effective
  • Time & application cost
  • Decrease yield loss associated with damage to canopy from ground application

• Convenient

• Potential increase in control
  • Synergistic or additive effects
  • Control additional pests / lower application rate
Beneficial effects

• Additive effects
  • Get the bang for both pesticides, i.e. see the benefit that each has alone
  • Have to evaluate this in perspective of overall effect (adding Lorsban to Warrior for soybean aphid – get a quicker kill but overall mortality not necessarily increased)

• Synergistic effects
  • Greater effect than that of both insecticides added together
  • Happens with some adjuvants – e.g. Piperonyl butoxide (PBO) has some insecticidal activity on its own but real benefit is adding it to pyrethrum/pyrethrin. It suppresses Mixed Function Oxidases which the insect uses to detoxify insecticide so insect gets greater wallop than from pyrethrum alone
It saves money! But does it really?

- Treating in absence of insects is 1950’s agriculture and there’s a reason we don’t do this anymore!
- Lots of data indicating better economic return from treating only when populations require control
  - What’s that flushing sound?
- If the tank mix goes wrong, could be a big economic loss…
Drawbacks

• Economic loss if incorrectly used
• Incompatibility
  • Mechanical
    • Calibration, Nozzles, Agitation, Carriers
  • Physical
    • Mixing, precipitation, etc
  • Chemical
    • Antagonism, loss of effect of one or both pesticides, phytotoxicity (often too much adjuvant present in tank mix),
• Timing
  • Not optimum for one or both pesticides
Mechanical incompatibilities

• Nozzles/rates - different pesticides may require different droplet size to be most effective
  • Translocatable herbicides can get by with less coverage than can insecticides or fungicides
  • spray volumes may vary

• Carriers
  • Change in H₂O pH, etc
  • Adjuvant recommendations may vary

• Agitation
  • Overagitation may cause foaming in some older products
Physical incompatibility

- Two incompatible pesticides precipitate, gel, flake, foam or form sludge on bottom of tank, resulting in unsprayable mess! Often a gummy deposit on the bottom of the tank
  - may be cause pH or temp of H₂O
  - Can sometimes be avoided with jar test
  - Sometimes a problem in EC formulations which don’t have a good stabilizing agent
- Mixing
  - In general follow WALES – Wettable Powders, Agitate (& Adjuvants - anti-foaming compounds, etc), Liquid (& Soluble compounds), Emulsifiable Concentrates, Surfactants
MustangMax & 10-34-0
Jar test
• Using appropriate safety equipment:
  • add proportionate amounts (convert gallons or pounds to ml’s, oz’s, or tsp’s) of components in clear quart jar (with liquid fertilizer carrier, many herbicide labels recommend two jars, 1 with, 1 without compatibility agents)
  • label jar(s) clearly, then fill one-half full with your carrier
  • add proportionate amounts of each of the products, one at a time, in the suggested order
  • gently shake or invert capped jar, let stand 15 - 30 minutes
  • if the mixture shows signs of physical incompatibility, shake the jar again to disperse ingredients
  • if it disperses, you will not need a compatibility agent but will need constant agitation in spray tank
  • if the mixture will not disperse after 2nd shaking, you may want to perform test again, with compatibility agent, or decide not to perform the tank mix
  • Recommended even if mixing has worked in different circumstances because of H₂O differences

BUT – doesn’t check for chemical incompatibility
Chemical incompatibility (antagonism)

• Decreased activity (deactivation)
  • Caused by any change that denatures a.i. (e.g. pH, etc)
  • Not uncommon in insecticides (esp. organophosphate EC formulations)

• Phytotoxicity
  • Often not caused by a.i. but by adjuvants
    • Individual formulations have levels of adjuvant not damaging to crop, but if adding full rates of multiple pesticides, also two full rates of adjuvants (plus whatever compatibility agents…)
  • Seen very frequently in oil-based pesticide mixtures (e.g. ECs)
Phytotoxicity

• Solvents, impurities in spray water, using more than label rate pesticide, or poor mixing.
• Plant condition can affect phytotoxicity
  • stressed plants generally more susceptible.
• Environmental conditions
  • Light, temp, Rh, all influence phytotoxicity.
  • High temperatures may increase pesticide degradation and volatilization, BUT also increase phytotoxicity in some pesticides.
  • UV light degrades many pesticides.
  • Soil properties - texture, temperature, moisture, microbial activity and pH also influence phytotoxicity.
    • High pH soils less binding and may increase phytotoxicity.
    • High microbial activity may reduce phytotoxicity.
Timing

• Rarely is time optimal for application of multiple pesticides, so tank mix results in one or more of the pesticides being applied at a less than optimal time
  • Decreases efficacy
  • May negate application
• Tempting to depend on residual of some of these products…. BUT
  • Remember those factors that break down pesticides? Volatilization (aided by wind), high temp, very high or very low humidity, UV light (esp. extended periods of sunshine), percipitation, etc
  • Is there anytime in the summer we don’t have a number of these occurring in MN???
• Bottom line – delaying / spraying early are both risky practices
Legal stuff - labels

- Unless prohibited on the label, tank mixing pesticides is legal.
- BUT in the absence of any notes on label, results may be responsibility of expert making recommendation and/or application.
Fungicide & herbicide in wheat


Figure 1. Leaf injury comparison between Headline tank-mixed with herbicides or applied separately; Quilt tank-mixed with herbicides or applied separately; and, leaf injury caused by herbicide application without fungicide where some tan spot lesions can be seen.
Fungicide & herbicide in wheat

- Vomitoxin (DON) levels highest when fungicide not used. Averaged over all treatments, tank mixing fungicides reduced DON by 9% over untreated BUT sequential application reduced DON levels by 25% over untreated.
- When compared to sequential application, tank mixing Headline with Puma & Bronate Advanced had 7% less grain yield, 51% lower DON levels, and increased no. of spikelets on heads exhibiting FHB by 71%.
- Tank mixed Stratego – DON 30% > sequential.
- Tank mixed Quilt, decreased FHB across plots but plant leaf injury 30% > sequential application.

Source – Cropping Issue in NW Minnesota, June 7, 2005.
Soybean rust tank mixing potential problems - timing

- If it appears, fungicides will be applied & there will be discussion about tank mixing to decrease application costs – BUT
  - Timing may not be appropriate
    - RR applications V2-V3, needed to control weeds prior to competition with soybeans but way too early for rust application (R1 or later) and waiting this long will affect weed control (bigger weeds)
    - Warrior, Asana, Lorsban? Timing may be better fit but should only be done if both pests present – SPs may not provide >7d activity, Lorsban gone pretty quick so if aphids arrive more than a week post application …..
  - Fungicides may impact entomopathogenic fungi that help control soybean aphids
Tank mixing – soybean aphid

- Insecticides & herbicides (esp. glyphosate)
  - Timing & application problems
    - Aphids in MN can develop as late as July/Aug
    - Glyphosate applied prior to this means you don’t get coverage down the line
    - What about extended activity of SPs? Need high rates to see this and anything past 7-10 days is a gift! This year, we didn’t get 10 days in some of our Warrior plots because of very heavy reinfestation
    - Glyphosate is translocatable and so can be applied with large drops and low pressure to decrease drift, IA data indicates lower pressure & larger droplet size impacts insecticide activity, we’ve not seen the same in NW / WC MN but still may be an issue in some conditions
Potential decreased efficacy - *Headline & Warrior?*

Limited dataset only - approach with caution! Lab trials with Headline & insecticides look okay.....

Data Source – B. Potter, SWROC, Lamberton
Soybean rust tank mixing potential problems – drift

- Mechanical/drift – smaller droplet size required for fungicides (not translocatable, best coverage needed), larger droplets to avoid herbicide drift will negatively affect fungicide efficacy
Soybean rust tank mixing potential problems – label

- Label precautions – as seen previously, if not prohibited on label then legal but that doesn’t mean effective. New problems arising and previous lack of problem is best guideline
Many tanks.....