# Synthetic Auxin Resistance in Kochia

*Available from the HRAC website: hracglobal.com*

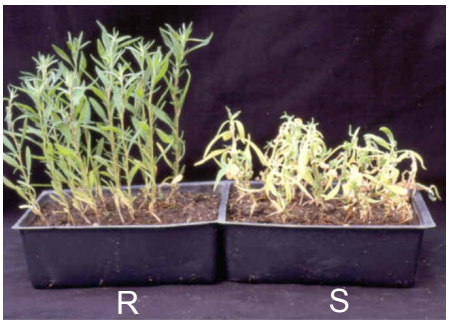
HERBICIDE RESISTANCE ACTION COMMITTEE

## Auxin Resistant Kochia

Kochia is a widespread annual weed known for its adaptability. Evidence of triazine resistance was detected as early as 1976 and to the ALS herbicides in the 1980's. Populations of Kochia (resistant to dicamba and fluoxypyr were first identified in Montana, US and Nebraska, US in 1994. These Group O/4 herbicides are also known as Synthetic Auxins and some herbicides within this mechanism of action have been used widely to control kochia. Since the initial discovery, other populations have been identified in the US states of Colorado, Idaho, Montana, North Dakota, and Nebraska.

## Levels of Resistance and Cross-Resistance

Levels of resistance to synthetic auxin herbicides in kochia are relatively low, normally less than 5 fold, although artificially selected inbred lines have exhibited up to a 30 fold increase. Resistant plants are injured by synthetic auxins but recover, whereas susceptible plants die. Dicamba has been one of the more popular auxin herbicides used to control kochia. Therefore auxin-resistant biotypes are often identified in fields with a history of dicamba use and dicamba is the herbicide most often used to study these biotypes. However, these populations also can demonstrate cross-resistance to other auxin herbicides such as fluroxypyr. Pre-emergence applications of soil-active auxins, such as dicamba, may suppress auxin-resistant kochia biotypes, though the practice would likely select for higher resistance levels and is not recommended as a control measure.




*Dicamba — 0.125 lb ai/A | Photo: Dr. Bill Dyer*

## Mechanism of Resistance

Auxinic herbicides mimic the action of the phytohormone IAA and rapidly induce a wide variety of genetic and physiological responses by binding to IAA receptor(s). Plants die from un-controlled cell proliferation. Studies found no difference between R and S populations in herbicide absorption, translocation or metabolism of dicamba and the mechanism of resistance is not well understood. Dicamba resistance in kochia is conferred by a single dominant gene. Mechanisms and inheritance with fluroxypyr in these biotypes has not yet been studied.

## Rate of Spread

Compared to the rate of spread of ALS inhibitor and Glyphosate resistant kochia the dicamba and/or fluroxypyr resistant populations are unusually slow at spreading. Synthetic auxin resistant kochia is present in less than 1% of fields in the USA, possibly due to some yet undiscovered fitness penalty.

## Resistance to Other MOA's

Management of synthetic auxin resistant kochia is complicated by resistance to other herbicide mechanisms of action (MOA's). Kochia has also evolved resistance to the following MOA's in North America in agricultural fields, on railways and along roadsides.

1. PSII-inhibitors (TSR*) — first identified 1976, and now in the US states of CO, IA, IL, IN, KS, MT, ND, NE, WI, and WY.
2. ALS-inhibitors (TSR*) — first identified 1987, ALS inhibitor Kochia occurs in most of North America where kochia is a weed.
3. Glyphosate (NTSR* - amplified EPSPS) — first identified 2007 and it has been reported in the US states of CO, ID, KS, MT, ND, NE, OK, OR, SD, WY, as well as in the Canadian provinces of AB, MB, and SK. In 2012 it was estimated that 1/3 of fields in Kansas contained GR kochia.

## Multiple Resistance

Kochia populations with resistance to more than one herbicide mechanism of action present growers with the biggest challenge. The most common combinations are ALS inhibitor resistance with resistance to glyphosate or dicamba. One population, from Kansas, exhibited resistance to PSII inhibitors, ALS inhibitors, EPSPS inhibitors and synthetic auxins.

** TSR = Target Site Resistance, NTSR = Non Target Site Resistance*

***Additional information on herbicide resistance can be found at weedscience.org***

## Best Management Practices

Integrated weed management including herbicide rotation, mixtures, and cultural/ mechanical controls should be practiced to delay the selection of synthetic auxin resistant kochia. The fact sheet “Synthetic Auxin Resistant Weeds” provides more detail on how to delay and mitigate resistance.

*Photo: Dr. Phillip Stahlman*

## Facts about Kochia

### SCIENTIFIC NAME

*Kochia scoparia*

### OTHER COMMON NAMES

burning bush, fireball, firebush, Mexican burning bush, and belvedere-cypress

### DESCRIPTION

Kochia is a native of Eurasia and was introduced into North America as an ornamental in the mid to late 1800s. It is a common and economically important weed of cropping systems in semi-arid and arid regions of North America. Kochia is highly competitive in these regions because it emerges early, grows rapidly and it tolerates drought ($C_4$ plant), heat, and salinity. These characteristics make it difficult to control through cultural practices such as early planting and higher seeding rates.

It is most troublesome in small grains, soybean, and sugar beet, and particularly problematic in no-till systems. At moderate densities kochia has been reported to cause yield losses of 25-33%.

### SEED LONGEVITY AND EMERGENCE

Fortunately kochia seed is short lived in the soil (<3 yrs.) which means effective control over several years can deplete the kochia seed bank. Keeping the seedbank low is a good way to delay resistance. The early emergence of kochia can be exploited by shallow spring tillage prior to planting.

### HIGH LEVEL OF GENETIC VARIABILITY

While some work has indicated a high degree of self-pollination, significant out-crossing also occurs. Kochia can be cross-pollinated by both wind and insects. This creates a high level of genetic variability both within and between populations resulting in a high propensity to evolve resistance to herbicides.

### SEED PRODUCTION AND DISPERSAL

Individual kochia plants can produce up to 30,000 seeds. After maturity the shoot breaks off at ground level and is blown large distances (tumbleweed), dropping seed as it tumbles across fields. This is an extremely effective means of dispersal, and is one reason why herbicide resistant kochia is difficult to contain. Control of herbicide escapes prior to maturation will reduce spread.


**REFERENCES**

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