Broccoli, Cabbage, & Cauliflower

Interference from weeds is unacceptable in cole crops. Weeds can reduce crop yields by competing for water and nutrients. This is particularly true for crops grown in wide rows that do not have enough leaf architecture to shade out weeds.

In crops such as these that are marketed by size, any stress on development can make a significant impact on marketability and ultimate profit. For example, in a trial using wide-row broccoli, researchers found that one common lambsquarters plant per 10.7 square feet reduced seeded broccoli's total yield by 18 to 20 percent and its marketable yield by 22 to 37 percent (Bitterlich & Upadhyaya, 1990). The yield reduction was attributed to the broccoli's reduced head weight.

Studies have also been conducted to determine the *critical weed-free period* for cabbage: the maximum time interval from seeding that weeds can be tolerated without affecting crop yield. Investigations have shown this to be between two and four weeks in seeded cabbage (Miller & Hopen, 1991; Roberts et al., 1976).

Fortunately, most of the broccoli, cabbage and cauliflower grown in North Carolina is transplanted. Lawson (1972) reported that no effect on cabbage growth occurred if weeds are removed from transplanted cabbage prior to rapid growth. Weeds left beyond this point resulted in smaller marketable heads. Keeping weeds out early in the season is very important for cole crops.

The use of cultivation and herbicides can help growers achieve good, early-season weed control and avoid losses in yield and profits. In North Carolina, broccoli, cabbage and cauliflower are usually grown in rows wide enough (36 to 44 inches) to accommodate cultivation with the vast majority grown on bare ground (Sanders, 2001a, 2001b, 2001c).

CULTIVATION OPTIONS IN COLE CROPS

Shallow cultivation can help to control weeds after they emerge between rows. When cultivating in these crops, care should be taken to cultivate as much of the row middle as possible without disturbing or damaging the crop roots. Cultivation is most effective for weed control when properly timed. Cultivating too early could lessen the benefits of any preemergence herbicides. Weeds may be too large to kill with shallow cultivation, however, if cultivation occurs too late.

HERBICIDE OPTIONS IN COLE CROPS

Preplant and Preemergence

Glyphosate (Roundup and other trade names) may be applied prior to crop transplanting or emergence for control of emerged weeds. It will control susceptible weeds. Apply 0.5 to 1.5 pounds of per acre. The rate of product per acre will change based on the particular formulation used. Perennial weeds may require higher rates of glyphosate. Be sure to read the product label. Some formulations of glyphosate have been manufactured with surfactants included and need no further adjuvants. *If applying glyphosate prior to transplanting a crop into plastic mulch, its residues must be removed with ½-inch of rainfall or irrigation to prevent crop injury.* See

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the label for further details.

Paraquat (Gramoxone Inteon 2 SL, Gramoxone Max 3 SL, Firestorm 3 SL) may also be used to control emerged weeds prior to crop emergence. Paraquat will not translocate in plants as well as glyphosate. Therefore, it should be applied to small weeds. Form beds several days before application to encourage maximum weed germination and emergence prior to treatment. Apply Gramoxone Inteon at 2.6 to 4 pints per acre and Gramoxone Max or Firestorm at 1.5 to 2.7 pints per acre (0.65 to 1.0 pound active ingredient per acre). These products can be applied with either a nonionic surfactant (16 to 32 ounces per 100 gallons of water) or a crop oil concentrate (1 gallon per 100 gallons of water). *Paraquat used for preplant weed control over plastic mulch may injure transplanted crops that contact the plastic.* Sufficient rainfall or irrigation is required to remove residual paraquat before transplanting. Because paraquat does not translocate within the plant, it has limited effectiveness on perennial weeds.

Trifluralin (Treflan 4 EC and others) may be applied at 1.0 to 1.5 pints of product per acre (in specific situations, the product label allows 2.0 pints per acre) prior to planting and incorporated into the soil to a depth of 2 to 3 inches. Incorporation should occur within 24 hours of application. Trifluralin will control annual grasses and small-seeded broadleaf weeds. *If direct seeding the crop and trifluralin is incorporated into cool, wet soil, reduced stand and stunting may occur.* On coarse and medium soils (sand, loamy sand, sandy loam), use the rate of 1 pint per acre. On heavier soils, higher rates may be necessary. See the label for specific instructions on soil considerations as well as instructions for different incorporation devices.

Bensulide (Prefar 4 EC) is registered for use only on mineral soils as a preplant-incorporated or preemergence treatment. The Prefar label claims control of only grass species when used in states other than Arizona, New Mexico, Texas, and California. The use rate is 5 to 6 quarts per acre, with a maximum of 6 quarts per acre per season. Incorporation to 1 inch is recommended if applying before planting. Research has shown that when using Prefar preemergence, irrigating immediately after application is required for best activity.

DCPA (Dacthal W-75) may be applied preplant incorporated or broadcast to the soil at seeding or immediately after transplanting. The labeled use rate is 6 to14 pounds of product per acre, depending on soil type. At lower labeled rates, Dacthal will control carpetweed, common chickweed, common lambsquarters, and several common annual grasses. As rates are increased, more weeds are susceptible (see label). The Dacthal label states that incorporation to depths greater than 2 inches may result in reduced herbicidal activity. Dacthal will not control nutsedge species. To reduce Dacthal use in a crop, band this product over the row and use cultivation to keep middles between crop rows free of weeds.

Clomazone (Command 3 ME) may be used for direct-seeded and transplanted cabbage. The use rate in seeded cabbage is 0.67 pints of product per acre. For transplanted cabbage, 0.67 to 1.3 pints per acre may be used, depending on the soil type (see label). Command is not registered for use in broccoli or cauliflower, and it is weak on pigweed species. *Avoid applying Command within 300 feet of desirable vegetation.* Temporary yellowing and/or whitening of cabbage and other plants can occur through the drift or volatilization of Command. Read and follow all precautions on the label prior to application. The Command label only claims suppression of lambsquarters when the product is used for weed control in cabbage. *Do not make more than one application per season, and do not apply within 45 days of harvest.*

Napropamide (Devrinol 50 WDG) is labeled for control of many grasses and several broadleaf weeds. At rates registered for cole crops, Devrinol will control common lambsquarters, redroot and smooth pigweed, purslane, Florida pusley and carpetweed. The use rate for the southeastern United States is 4 pounds of product per acre applied preemergence to the weeds after transplanting or seeding the crop. Wet soil to a depth of 2 to 4 inches within 24 hours of Devrinol application to obtain high activity. Devrinol will not control emerged weeds.

Oxyfluorfen (Goal 2 XL, Galigan 2 E, GoalTender 4 F) can be applied only as a soil-surface application prior to transplanting broccoli, cabbage, or cauliflower. *Do not apply preemergence to direct-seeded cole crops.* Research indicates that broccoli is marginally tolerant of oxyfluorfen applied at rates needed to sufficiently control weeds (Herbst & Derr, 1990).

Goal 2XL and Galigan may be applied at 1 to 2 pints of product per acre for control of carpetweed, purslane, redroot pigweed, and Pennsylvania smartweed. Due to a more concentrated formulation, the GoalTender use rate is 0.5 to 1.0 pint per acre. Suppression of galinsoga, common lambsquarters, and wild mustard is also claimed with these rates. Application to muck soils may result in lower

levels of weed control. See label for further information.

Postemergence

Glyphosate (Roundup WeatherMax 5.5 L) may be applied as a hooded or shielded spray or wiper application to row middles between crop rows. *Glyphosate must not contact the crop.* Apply at 0.5 to 0.94 pounds active ingredient per acre or 11 to 22 ounces of product per acre. Be aware that some formulations of glyphosate have been manufactured with surfactants included and need no further adjuvants. *Glyphosate may not be applied within 14 days of harvest.*

Clopyralid (Stinger 3 EC, Clopyr AG 3 EC) will control most legume weeds, such as vetch and clover. Vetch can be a problem in spring crops because their growing seasons coincide. Clopyralid is an excellent choice for controlling vetch postemergence. Apply at 0.25 to 0.5 pint of product per acre. It is labeled for use on leafy greens as well. See the label for a complete list. The Stinger label specifically states that it does not control mustards, henbit, chickweed, kochia, lambsquarters, pigweed, Russian thistle, and bindweed.

Clethodim (Select 2 EC and other trade names, Select Max) and sethoxydim (Poast 1.53 EC) may be used postemergence for control of emerged grass species. Neither of these products will have activity on broadleaf weeds or nutsedge species. Differences in grass control from the two products, applied at labeled rates, are small. However, Select is more efficacious on annual bluegrass than Poast. Select is also considered slightly better at controlling perennial grasses such as bermudagrass.

Poast can be applied at 1 to 1.5 pints per acre. Include a crop oil concentrate at 1 quart per acre with Poast. Rates of Select range from 6 to 8 ounces per acre. Again a crop oil concentrate is recommended. When using Select, the crop oil concentrate should be added at a rate of 1 quart per 100 gallons of water. The addition of a crop oil concentrate to either of these products may increase the chances of crop injury. *Applications of these products should be made on days that are not unusually hot or humid.*

Select Max (1EC) may be applied at 9 to 16 ounces per acre for emerged grass control. The label for Select Max allows the use of a nonionic surfactant at 2 pints per 100 gallons of water to reduce the risk of crop damage that may occur by using a crop oil concentrate.

Do not apply Poast, Select, or Select Max within 30 days of harvest.

RECOMMENDED WEED MANAGEMENT PROGRAMS

Preplant: Glyphosate or Paraquat

Preplant incorporated: Trifluralin

Preemergence: Napropamide vs. DCPA, depending on weed species

Postemergence: Cultivation of row middles. Sethoxydim or Clethodim for emerged grasses. Clopyralid if clover, vetch, or a mixture of these threatens the crop.

RESOURCES

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Table 1. Herbicide Use Patterns in Cole Crops

Herbicide		Cole Crops		
Active Ingredient	**Trade Name(s)**	**Broccoli**	**Cabbage**	**Cauliflower**
Preplant or Preemergence		**Crop Specific Registrations**		
Bensulide	Prefar	PP, PPI, PRE	PP, PPI, PRE	PP, PPI, PRE
Clomazone	Command	**	PRE, PRE-T	**
Glyphosate	Roundup, various generics	PP, PRE, PRE-T	PP, PRE, PRE-T	PP,PRE, PRE-T
Oxyfluorfen	Goal, GoalTender, Galigan	PRE-T	PRE-T	PRE-T
Paraquat	Gramoxone Inteon and others	PP, PRE-T	PP, PRE-T	PP, PRE-T
Trifluralin	Treflan, other generics	PPI	PPI	PPI
Postemergence				
Clethodim	Select and others	POST	POST	POST
Clopyralid	Stinger, Clopyr AG	POST	POST	POST
DCPA	Dacthal	POST[a]	POST[a]	POST[a]
Glyphosate	Roundup Weather Max	RM	RM	RM
Napropamide	Devrinol	POST[a]	POST[a]	POST[a]
Sethoxydim	Poast	POST	POST	POST

PP = Preplant to soil surface or emerged weeds
PPI = Preplant incorporated
PRE = Preemergence of crop
PRE-T = Soil-applied prior to transplant
POST = Postemergence to crop and weeds
POST[a] = Applied directly over transplants
RM = Shielded or hooded to row middles between crop rows
** = Not registered for use.

Always read and understand the entire label prior to using any herbicide.

Recommendations for the use of agricultural chemicals are included in this publication as a convenience to the reader. The use of brand names and any mention or listing of commercial products or services in this publication does not imply endorsement by North Carolina Cooperative Extension nor discrimination against similar products or services not mentioned. Individuals who use agricultural chemicals are responsible for ensuring that the intended use complies with current regulations and conforms to the product label. Be sure to obtain current information about usage regulations and examine a current product label before applying any chemical. For assistance, contact your county Cooperative Extension agent.

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