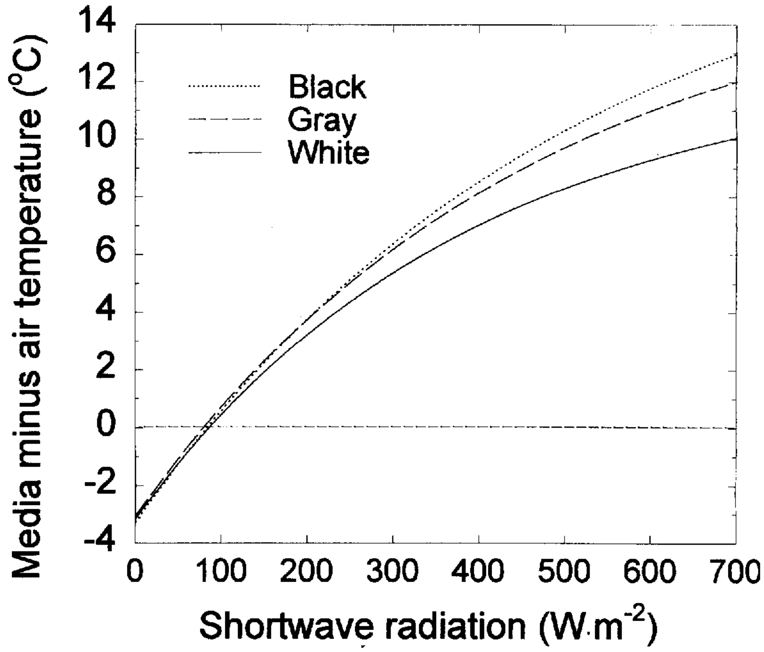

Fig. 2. The effect of plug-flat color on medium-surface temperature shown as a function of the incident solar radiation (280 to 3000 nm). Air temperature was maintained at 25 °C and the water vapor pressure deficit averaged 1.4 kPa.

point of the plastic tray where any four square plug cells connected was 3 °C warmer than the center of media surface during a sunny day. The plastic rib dividing any two adjacent plug cells was 2 °C warmer than the center of the media surface, and the media surface within 1 to 2 mm of the plastic was 1 °C warmer than the rest of the plug media surface. There was a <1 °C difference in media surface temperature across the center portion of the plug cell. Therefore, seeds placed near the edge of the cell could be influenced by the plastic's temperature and color more than seeds placed in the center of the plug cell.

The results of this experiment underscore the value of shading plug flats to control the amount of solar radiation received or using a closed chamber for germination. Commercial growers that germinate seeds inside the greenhouse will typically use 60% light-reduction shadecloth in addition to the shading caused by the greenhouse structure. However, this would still allow 400 to 500 $W \cdot m^{-2}$ of solar radiation to be incident on the medium surface. Our data suggest that temperature excesses of 7 to 10 °C could occur during germination under these solar loads; therefore, the irradiance should not exceed ≈200 $W \cdot m^{-2}$ (≈400 $\mu mol \cdot m^{-2} \cdot s^{-1}$) if medium temperatures are to remain within 2° to 3° degrees of the air temperature. Using white plug flats will help limit medium temperature elevation when solar radiation is high; however, high irradiance levels should be avoided. During the night, maintaining high humidity and using thermal screens will help limit medium-surface temperature depressions. The amount of bottom heat required to maintain medium temperature near air temperature during the night depends on how much thermal and evaporative losses can be minimized (Yang and Albright, 1985).

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Broadcast versus Band Fertilizer Applications on Vegetable Crops

R.L. Parish,[1] R.P. Bracy,[2] and H.F. Morris, Jr.[4]

ADDITIONAL INDEX WORDS. fertilizer, fertilizer application, band, broadcast, application, sweetcorn, turnip, cabbage

SUMMARY. A study was conducted to evaluate the effect of banding or broadcasting fertilizer on yield and quality of turnip (*Brassica rapa* L. Rapifera group), sweetcorn (*Zea mays* var. *rugosa* Bonaf.), and cabbage (*Brassica oleracea* L. Capitata group). Preplant fertilizer was applied broadcast before bedding, broadcast after bedding, or banded after bedding. Sidedress applications were broadcast or banded on the beds. Differences in plant size and vigor were noticed early in the season in the spring turnip crop, with the growth in the broadcast-and-bed treatment appearing superior. The yield at first harvest and total yield were lower for turnip grown with the bed-and-broadcast treatment. No differences in yield of cabbage or sweetcorn resulted from the treatments. Few differences in turnip stem-to-leaf ratio were noted due to fertilizer treatment. Few differences in yield due to sidedress method were noted with any of the crops. Analysis of soil samples in a

[1]Professor, Biological and Agricultural Engineering Department, Hammond Research Station, Louisiana Agricultural Experiment Station, Louisiana State University Agricultural Center, 21549 Old Covington Highway, Hammond, LA, 70403.

[2]Associate professor, Hammond Research Station, Louisiana Agricultural Experiment Station, Louisiana State University Agricultural Center, 21549 Old Covington Highway, Hammond, LA, 70403.

[3]Head, Agricultural Chemistry Department, Louisiana Agricultural Experiment Station, Louisiana State University Agricultural Center, P.O. Box 25055, Baton Rouge, LA, 70894.

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grid pattern across the beds showed that the location of the fertilizer after the broadcast-and-bed treatment was similar to the placement of the banded fertilizer. Since broadcasting can be done with a faster, wider applicator, growers could reduce costs by broadcasting fertilizer and obtain yields that are at least equivalent to the yields obtained by banding the fertilizer.

There are two primary ways of applying granular fertilizer to vegetable crops: broadcast and banding. Each of these operations can be performed at different stages in the tillage, planting, and growth process. Broadcast applications are generally easier and faster, since the fertilizer can be thrown in a wide swath by a high-speed machine. Banding fertilizer requires a narrower, more controlled applicator. If equivalent results can be obtained from broadcast applications, this method would be attractive to commercial vegetable growers as a way of saving time in field operations.

Many prior studies (see Sidebar) involved banding phosphorus, and many, but not all, reported improved fertilizer efficiency resulting in yield increases from banding compared with broadcast application. Most of the studies compared equal rates per acre, broadcast or banded.

The objective of this study was to compare preplant and sidedress broadcast and band applications of granular fertilizer on three vegetable crops to determine the yield advantage of application methods. Timing of preplant broadcast applications relative to the bedding operation was also a variable.

Materials and methods

A series of field tests was conducted at the Hammond Research Station, Hammond, La., in 1996. The soil type was Cahaba fine sandy loam. Three preplant application methods were combined with two sidedress application methods for a total of six treatments. Each treatment was replicated four times in a randomized block design. All plots were planted on shaped beds 40 inches (1 m) on center. The preplant fertilizer application methods were a) broadcast fertilizer then bed with disk bedders, b) bed with disk bedders then broadcast fertilizer, and c) bed with disk bedders then band fertilizer ≈2 inches (5 cm) deep in the center of the beds.

All preplant treatments were applied before shaping the beds. The sidedress fertilizer application methods were a) broadcast fertilizer over the entire plot and b) band fertilizer on the surface of the soil between twin drills or beside single drills.

All fertilizer treatments were applied with one fertilizer metering hopper using one calibration for all preplant treatments on each date and another calibration for all sidedress treatments on each date. The hopper had four discharge outlets. For broadcast application, baffles were mounted under the outlets to achieve a broadcast pattern over the 80-inch (2-m) plot width. For band application, hoses from two outlets were routed into each of two fertilizer injection knives. This procedure guaranteed that the same rate was applied to each treatment in the test while allowing broadcast application to small plots without overlap on adjacent plots. The large rotary spreaders often used for broadcast application in commercial fields rely on overlap to achieve a uniform pattern; our procedure eliminated overlap and the need for overlap.

Crops planted were turnip, cabbage, and sweetcorn. Turnip and cabbage were planted in twin drills 10 inches (25 cm) apart. Sweetcorn was planted in a single drill per bed. The turnip cultivar was 'AllTop'. The spring cabbage cultivar was Asgrow 'XPH 5957', and the fall cabbage cultivar was 'Blue Bayou'. The sweetcorn cultivar was 'Crisp and Sweet 711'.

The preplant fertilizer was 5–20–20 applied at a nominal rate of 600 lb/acre (672 $kg \cdot ha^{-1}$) for the turnip and cabbage and a nominal 700 lb/acre (784 $kg \cdot ha^{-1}$) for the sweetcorn. The initial soil test results and pH before planting are shown in Table 1. Sidedress applications at a nominal rate of 110 lb/acre (123 $kg \cdot ha^{-1}$) of ammonium nitrate were applied to each crop. The rates actually applied and the number of sidedress applications are shown in Tables 2 through 5.

All crops were planted with a precision seeder mounted on the back of a spool-type bed shaper. Planting dates are shown in Tables 2 through 5. All crops were grown using the Precision Cultural System (PCS) developed by the Louisiana Agricultural Experiment Station (Parish and Bracy, 1992). Louisiana Cooperative Extension Service recommendations (Boudreaux, 1991) were followed. Crops were furrow irrigated as needed.

A separate study was conducted to determine the final location of the fertilizer in the shaped beds after potassium chloride at a rate of 200 lb/acre (224 $kg \cdot ha^{-1}$) was applied using the three preplant fertilizer methods. After the beds were shaped, soil samples were collected in a grid pattern at four depths and eight locations across the bed top, four times for each treatment. The samples were analyzed for chloride content by the Agricultural Chemistry Laboratory of the Louisiana State University Agricultural Center. The background level of chloride content was determined from random soil samples just outside the treated area. The mean background level was subtracted from the sample data, and the data were averaged and plotted to show the locations of granular fertilizer resulting from the three treatments.

Results

Graphs of fertilizer distribution in the shaped beds at planting time are shown in Figs. 1 through 4. With the broadcast-and-bed treatment, the fertilizer was fairly evenly distributed at depths to 2 inches (50 mm) but peaked in two bands at a depth of 2 to 3 (76 mm) inches. This is because disk bedders pick up fertilizer broadcast in the furrows between beds and deposit this soil on the sides of the beds under a layer of soil. With the bed-and-broadcast treatment, the broadcast fertilizer rolled off the rough beds into the

Table 1. Results of initial soil tests before applying fertilizer treatments.

Crop	P	K	Ca	Mg	pH
			$mg \cdot kg^{-1}$		
Turnip, spring	27	45	892	146	6.5
Cabbage, spring	27	45	892	146	6.5
Sweetcorn, summer	49	99	1017	184	6.7
Turnip, fall	141	50	770	100	6.6
Cabbage, fall	197	131	440	79	6.4

Literature review

Nettles (1938) compared broadcast, banding beside the row, and banding in the row furrow on six vegetables: tomato (*Lycopersicon esculentum* Mill.), lettuce (*Lactuca sativa* L.), potato (*Solanum tuberosum* L.), snapbean (*Phaseolus vulgaris* L.), bell pepper (*Capsicum annuum* var. *annuum* L.), and cucumber (*Cucumis sativus* L.). He found that short-season vegetables such as cucumber produced greater yields when the fertilizer was banded. Broadcast fertilizer was more completely used by long-season crops such as pepper and tomato.

Jones and Warren (1954) evaluated several broadcast and band applications of phosphorus to tomatoes. They concluded that deep band placement under transplants was more efficient than shallow band or broadcast application.

Locascio et al. (1960) compared coating tomato seed with phosphorus with banding phosphorus beside the row. They found that lower rates of phosphorus applied as a seed coating gave yield responses equivalent to conventional banding.

Cook and Sanders (1990) evaluated the effect of fertilizer rate and placement on drip-irrigated and plastic-mulched tomatoes. They found that broadcast, as compared with band, application had no effect on fruit size, fruit number, or total yield.

Mortley et al. (1991) compared band and broadcast applications of N, P, and K, as well as minor nutrients on tomatoes. They found that at least double the rate of fertilizer was needed when broadcasting to realize the same yield response obtained with banding.

Kemble and Guertal (1996) compared band and broadcast application of phosphorus for production of sweet corn (*Zea mays* var. *rugosa* Bonaf.). They noted a yield response due to phosphorus rate but none due to application method.

Sanchez et al. (1991) compared band with broadcast phosphorus application for sweet corn and found that band placement reduced the amount of phosphorus required to achieve a specific yield. Equal amounts of phosphorus resulted in higher total yields if banded. Depending on soil test results, the relative efficiency of band:broadcast ranged from a high of 3:1 to a low of 1:1.

Fox and Kang (1978) compared banding of phosphorus with broadcast application on corn. Banding was advantageous only with suboptimal rates of phosphorus. With an adequate rate of fertilization, the best results were obtained from incorporating P in the entire cultivated soil volume. This study did not support the hypothesis that major economies in fertilizer use can be achieved from band application of phosphate fertilizer.

Nettles and Hulburt (1966) conducted fertilizer rate and placement trials on cabbage, pepper, cucumber, and beans. Although yield responses were attained with some fertilizer placement methods, no method was found superior for all of the crops grown, nor was any method consistently outstanding for any one crop. Often, no placement response was found.

Locascio and Fiskell (1976) evaluated the response of bell pepper to fertilizer placement. Results varied by year. In 2 years of the study, broadcast application resulted in the highest yields; in the other 2 years, there were no significant differences in yield due to placement.

Guzman et al. (1987) studied the response of crisphead lettuce to banding phosphorus and mixed fertilizers in combination with various rates of broadcast fertilization. Overall, treatments that included banded phosphorus fertilizer improved the yield of lettuce over treatments where comparable phosphorus rates were applied broadcast. Banding nitrogen and phosphorus together appeared to improve lettuce yields further. They concluded that banding part of the fertilizer would reduce the rate required by improving fertilizer efficiency.

Sanchez et al. (1990) evaluated different phosphorus rates of band and broadcast applications on lettuce. Response of lettuce to phosphorus varied by placement. Lettuce yields were generally optimized with a band phosphorus rate one-third of that required with broadcast placement.

Espinoza et al. (1993) compared banding with broadcast application of phosphorus on celery [*Apium graveolens* L. var. *dulce* (Mill.) Pers.]. Band placement did not improve fertilizer efficiency.

Fiskell et al. (1967) and Locascio et al. (1972) studied the effect of fertilizer placement on watermelon [*Citrullus lanatus* (Thunb.) Matsum. & Nakai] grown on sandy soils in Florida. They compared broadcasting over the bed top with different band arrangements. Fertilizer broadcast over the bed top and incorporated before planting gave higher yields than banding. Increased rates of micronutrients resulted in increased fruit yields when broadcast, but decreases when banded due to toxicity from the concentrated band(s). Broad band placement was more detrimental to crop yield than concentrated bands.

Locascio (1987) reviewed the history of and current recommendations for vegetable nutrition in Florida. With low fertilizer rates, banding was generally more efficient than broadcasting, while at higher rates, broadcast application resulted in higher yields. With very high rates, a combination of broadcast and band application was recommended.

Sogaard and Kierkegaard (1994) made theoretical calculations to determine the increase in net profit possible by increasing the uniformity of fertilizer application. Based on laboratory tests of spreader patterns, they found a potential increase in net profit but recommended more study of external influences such as field irregularities and wind on application.

Bracy et al. (1994) studied the actual placement of fertilizer in planting beds resulting from banding with three fertilizer knife configurations. They found that careful placement of the preplant fertilizer bands did not result in precise band location in the shaped beds.

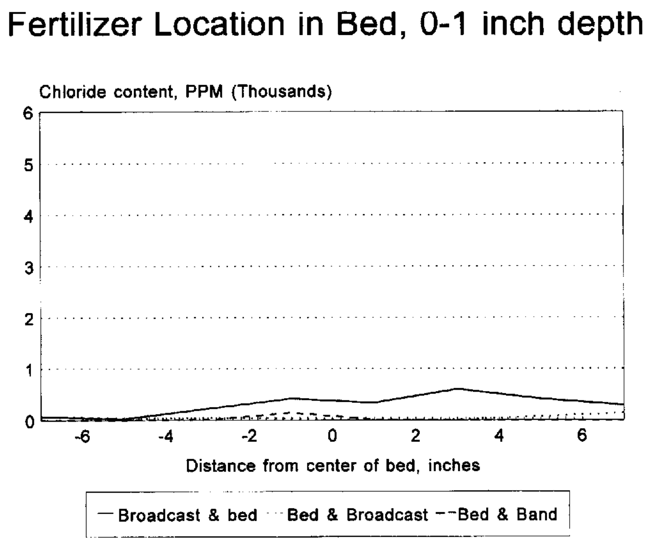

Fig. 1. Fertilizer distribution in shaped planting bed at 0- to 1-inch depth.

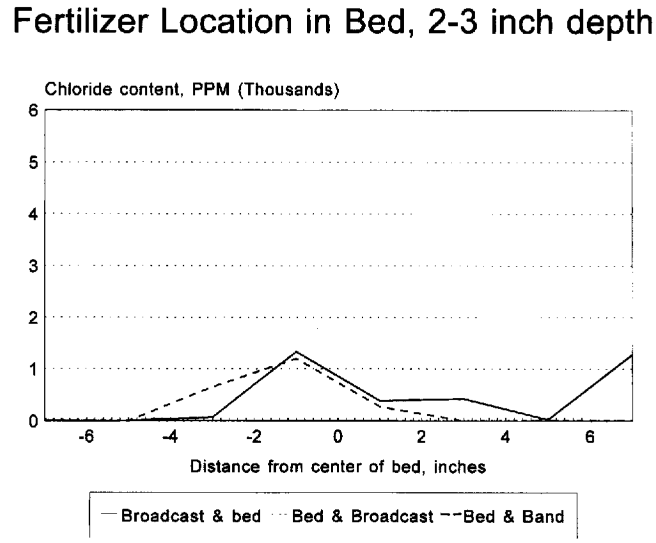

Fig. 3. Fertilizer distribution in shaped planting bed at 2- to 3-inch depth.

furrows, and very little fertilizer was left in the center of the beds after shaping. With the bed-and-band treatment, the fertilizer was knifed ≈2 inches deep into the rough beds and was retained near the center of the beds at a depth of 1 (26 mm) to 2 inches. This result is consistent with the results obtained by Bracy et al. (1994), where the fertilizer distribution graphs from a single knifed band into rough beds showed a strong but slightly off-center peak in the shaped beds. There is similarity in fertilizer placement in the shaped planting beds between the broadcast-and-bed and the bed-and-band treatments, although the band treatment gave a higher peak at the 2- to 3-inch depth.

The yield data from the crop tests are shown in Tables 2 to 5. The mustard and turnip were harvested by cutting the leaves at a 4-inch (10-cm) height and manually removing the cut leaves. Since no differences in maturity were noted, all plots were harvested at the same time. Tables 2 and 3 show the data for turnip in spring and fall. The broadcast-and-bed treatments and the bed-and-band treatments had higher yields at the first harvest. There was a very visible difference in growth between those treatments and the bed-and-broadcast treatments early in the season. When broadcasting fertilizer after bedding, much of the fertilizer rolled off the beds into the furrows and thus was not available to the crop. This preplant effect was partially masked by sidedressing. The stem percentage was unacceptable (not >20% stems for cutleaf product and not >27% stems for chopped product, Pictsweet Frozen Foods) for all fall harvests of turnip, regardless of treatment. The stem percentage at first spring harvest was unacceptable, but was acceptable at second harvest.

Table 4 shows data for cabbage in spring and fall. Cabbage was hand harvested based on firmness of heads. Although yield varied considerably, the differences were not significant due to variations among replications.

Table 5 shows data for sweetcorn, which was harvested by hand. There were no significant differences in yield or ear weight although there was a trend toward higher early and total

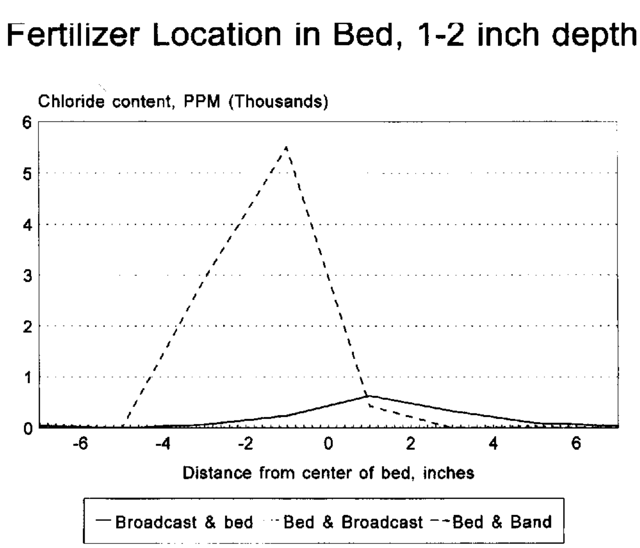

Fig. 2. Fertilizer distribution in shaped planting bed at 1- to 2-inch depth.

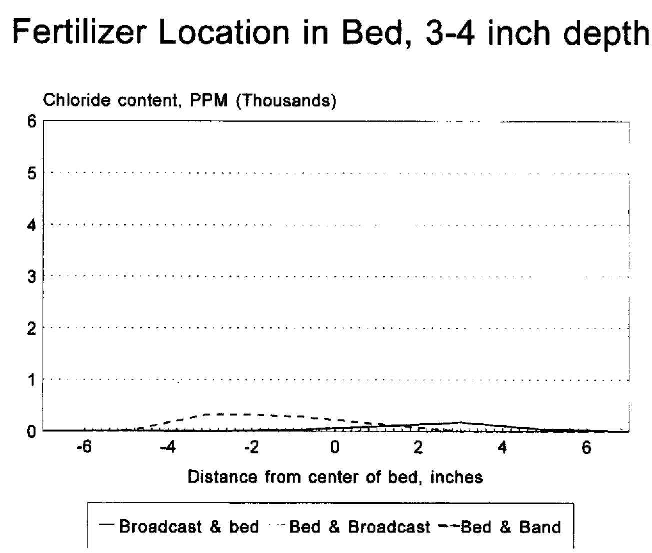

Fig. 4. Fertilizer distribution in shaped planting bed at 3- to 4-inch depth.

Table 2. Yield of 'AllTop' turnip in fertilizer application methods study, Spring 1996. Plants were cut at a 4-inch (10-cm) height (above the bed top). Soil type was a Cahaba fine sandy loam. Fields were planted 22 Feb. 1996. Trifluralin herbicide was used at 1.5 pt/acre. Stand (from plant counts 2 weeks after planting) was 309,000 plants/acre. Fertilizer used was 600 lb/acre 5–20–20 plus two sidedress applications of ammonium nitrate at 110 lb/acre.

	Harvest							
	26 Apr. 1996				10 May 1996			
Application method	Yield (lb/acre)	Stem %	Leaf %	Yellow %	Yield ($kg\cdot ha^{-1}$)	Stem %	Leaf %	Yellow %
Preplant								
Broadcast-and-bed	17,500 a[z]	38.3	62.1	3.1	4,900	19.0	80.9	2.0
Bed-and-broadcast	17,200 a	38.1	59.5	2.4	4,700	18.2	80.0	1.8
Bed-and-band	12,300b	36.8	58.6	1.0	4,200	18.1	79.1	1.0
Significance	0.05	NS	NS	NS	NS	NS	NS	NS
Sidedress								
Broadcast	16,100	38.1	60.2	2.4	4,700	19.4	81.4	2.1
Band	15,300	37.4	59.9	2.0	4,500	17.5	78.6	1.2
Significance	NS	NS	NS	NS	NS	NS	NS	NS
Interactions								
Preplant × sidedress	NS	NS	NS	NS	NS	NS	NS	NS

[z]Means in each column followed by the same letter are not significantly different at $P = 0.05$, Duncan's multiple range test.
[NS]Nonsignificant at $P = 0.05$.

yields and higher ear weight with the broadcast-and-bed preplant treatments.

There were no differences in yield between band and broadcast sidedress application methods for any crop except the first harvest of fall turnip (Table 3), where higher yields were obtained with broadcast application. In no case was the yield from banded sidedress application superior to broadcast sidedress application.

Conclusions

Band application was expected to be more efficient than broadcast application at the same rate of fertilizer, since banding would theoretically provide more fertilizer in the plants' root zone. This did not prove to be the case. Broadcasting fertilizer before bedding gave fertilizer placement in the shaped beds similar to banding, and yields were maintained with the broadcast-and-bed treatment. Broadcast sidedress applications gave results that equalled or exceeded banding.

The effects of preplant fertilizer placement were more pronounced with a short-season crop (turnip) than with a long-season crop (cabbage, sweetcorn). Broadcasting after bedding can reduce fertilizer efficiency because fertilizer falls off the sides of the beds into the middles between beds. Broadcast and band application gave equivalent results when the broadcast application was made before bedding so that the subsequent bedding operation concentrated the broadcast fertilizer in the crop area of the bed profile.

Since broadcast applications can be made with equipment that is faster and wider, broadcast-and-bed preplant applications and broadcast sidedress applications could be less expensive for the grower than traditional band ap-

Table 3. Yield of 'AllTop' turnip in fertilizer application methods study, Fall 1996. Plants cut at a 4-inch (10-cm) height above the bed top. Soil type was a Cahaba fine sandy loam. Fields were planted 5 Sept. 1996. Trifluralin herbicide was used at 1.5 pt/acre. Stand (from plant counts 2 weeks after planting) was 322,000 plants/acre. Fertilizer used was 600 lb/acre 5–20–20 plus two sidedress applications of ammonium nitrate at 110 lb/acre.

	Harvest							
	21 Oct. 1996				22 Nov. 1996			
Application method	Yield ($kg\cdot ha^{-1}$)	Stem %	Leaf %	Yellow %	Yield ($kg\cdot ha^{-1}$)	Stem %	Leaf %	Yellow %
Preplant								
Broadcast-and-bed	19,300	40.1	61.1	6.1	19,500	33.0	63.6	5.8
Bed-and-broadcast	19,200	37.4	56.6	3.4	19,500	32.2	63.0	5.7
Bed-and-band	18,900	35.5	56.6	3.3	18,600	31.3	62.0	3.5
Significance	NS	NS	NS	NS	NS	NS	NS	NS
Sidedress								
Broadcast	21,500 a[z]	37.9	59.2	5.1	19,600	32.4	63.7	6.2
Band	16,800b	37.7	56.9	3.4	18,800	31.9	62.0	3.8
Significance	0.05	NS	NS	NS	NS	NS	NS	NS
Interactions								
Preplant × sidedress	NS	NS	NS	**	NS	NS	NS	NS

[z]Means in each column followed by the same letter are not significantly different at $P = 0.05$, Duncan's multiple range test.
[NS],**Nonsignificant at $P = 0.05$ or significant at $P = 0.01$.

Table 4. Yield of Asgrow 'XPH 5957' cabbage (Spring 1996) and 'Blue Bayou' cabbage (Fall 1996) in fertilizer application methods study. For the Spring 1996 planting, soil type was a Cahaba fine sandy loam. Fields were planted 13 Mar. 1996. Trifluralin herbicide was used at 1.5 pt/acre. Stand (before thinning) was 62,700 plants/acre. Fertilizer used was 582 lb/acre 5–20–20 plus three sidedress applications of ammonium nitrate at 121, 101, and 112 lb/acre. For the Fall 1996 planting, soil type was a Cahaba fine sandy loam. Fields were planted 5 Sept. 1996. Trifluralin herbicide was used at 1.5 pt/acre. Stand (before thinning) was 34,800 plants/acre. Fertilizer used was 582 lb/acre 5–20–20 plus three sidedress applications of ammonium nitrate at 121, 111, and 111 lb/acre.

	Harvest				
	19 June 1996		20 Dec. 1996 and 3 Jan. 1997		
Application method	Yield (lb/acre)	Head wt (lb)	Early yield (lb/acre)	Total yield (lb/acre)	Head wt (lb)
Preplant					
Broadcast-and-bed	7,700	1.41 a[z]	16,400	22,400	2.62
Bed-and-broadcast	6,000	1.17b	11,800	18,500	2.43
Bed-and-band	5,500	1.17b	16,400	20,700	2.95
Significance	NS	0.05	NS	NS	NS
Sidedress					
Broadcast	6,500	1.30	16,800	22,200	2.58
Band	6,300	1.21	13,000	18,800	2.76
Significance	NS	NS	NS	NS	NS
Interactions					
Preplant × sidedress	NS	NS	NS	NS	NS

[z]No significant differences among means at $P = 0.05$.
[NS]Nonsignificant at $P = 0.05$.

plications with yield results that are equivalent to banding fertilizer.

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Table 5. Yield of 'Crisp and Sweet 711' sweetcorn in fertilizer application methods study, Summer 1996. Soil type was a Cahaba fine sandy loam. Fields were planted 3 May 1996. Metolachlor herbicide was used at 1.5 pt/acre. Stand (from plant counts 2 weeks after planting) was 13,700 plants/acre. Fertilizer used was 696 lb/acre 5–20–20 plus two sidedress applications of ammonium nitrate at 112 and 118 lb/acre.

Application	Incremental yield (doz/acre)			Total yield		Ear wt
method	3 July 1996	5 July 1996	8 July 1996	(doz/acre)	(lb/acre)	(lb)
Preplant						
Broadcast-and-bed	272	299	340	850	6,500	0.64
Bed-and-broadcast	231	252	252	735	5,200	0.60
Bed-and-band	191	238	191	681	4,800	0.60
Significance	NS	NS	NS	NS	NS	NS
Sidedress						
Broadcast	250	304	295	767	5,500	0.62
Band	213	222	227	744	5,500	0.60
Significance	NS	NS	NS	NS	NS	NS
Interactions						
Preplant × sidedress	NS	NS	NS	NS	NS	NS

[NS]Nonsignificant at $P = 0.05$.

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Applications of Endothalic Acid, Pelargonic Acid, and Hydrogen Cyanamide for Blossom Thinning in Apple and Peach

Esmaeil Fallahi[1]

ADDITIONAL INDEX WORDS. Dormex, 1-naphthyl-*N*-methylcarbamate, carbaryl, Sevin, NAA, Thinex, Endothal, NAA, *Malus domestica*, *Prunus persica*

SUMMARY. Blossom thinning of 'Early Spur Rome' apple (*Malus domestica* Borkh.) and 'Redhaven' peach (*Prunus persica* L.) with hydrogen cyanamide (Dormex, 50% a.i.), endothalic acid [(Endothal, 0.4 lb a.i./gal (47.93 g a.i./L)], and pelargonic acid (Thinex, 60% a.i.) was studied in 1995 and 1996. Full-bloom applications of hydrogen cyanamide at 2 pt formulation/100 gal (1288 mg a.i./L) and 2.5 pt formulation /100 gal (1610 mg a.i./L) or endothalic acid at 1 pt formulation/100 gal (59.9 mg a.i./L), once at 70% bloom and again at full bloom, reduced apple fruit set. Pelargonic acid was only effective in thinning apple blossoms when applied twice—at 40% bloom and again at full bloom—at 1.5 pt formulation/100 gal (1.12 mL a.i./L) per application. Pelargonic acid marked apples in 1995 but not 1996. Neither hydrogen cyanamide nor endothalic acid marked apples. A single full-bloom application of hydrogen cyanamide, endothalic acid, or pelargonic acid effectively thinned peach blossoms in 1995; however, in 1996, only hydrogen cyanamide at 2.5 pt formulation/100 gal effectively thinned peach blossoms. Peaches did not show fruit marks with any of the peach blossom thinners.

[1]Associate professor, Tree Fruit Physiologist University of Idaho, Department of Plant, Soil and Entomological Sciences, Parma Research and Extension Center, 29603 U of I Lane, Parma Idaho 83660.

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Early thinning of apples is important because of its impact on fruit size and the next season's flower bud initiation. In the past, apple cultivars were often sprayed with the blossom thinner sodium dinitro-ortho-cresol (Elgetol, 19% a.i.) during full bloom, followed by a postbloom application of a fruit thinner such as 1-naphthyl-*N*-methylcarbamate (carbaryl) with or without naphthalene acetic acid (NAA) (Williams and Edgerton, 1981). Carbaryl and NAA are effective postbloom fruit thinners for 4 to 5 weeks after full bloom (Byers et al., 1990; Byers and Carbaugh, 1991; Williams and Edgerton, 1981). Gibberellin A_{4+7} and 6-benzylamino purine are also effective postbloom fruit thinners for 'Delicious' apples (Byers and Carbaugh, 1991; Ferree, 1996; Greene, 1984; Greene and Lord, 1985). Elgetol was removed from the market in 1989 because of the high cost of reregistration. Full-bloom sprays of sulfcarbamide (Wilthin, 79% a.i.), pelargonic acid (Thinex), and endothalic acid (Endothal) or petal fall applications of carbaryl (Sevin XLR Plus) were developed as replacements for Elgetol and were reported to result in a satisfactory thinning and fruit set in 'Delicious' apple (Williams, 1993, 1994).

Hydrogen cyanamide and other chemicals have been used to eliminate or to reduce chilling requirements of peaches grown under the warm desert conditions of southwestern Arizona (Fallahi et al., 1990). Hydrogen cyanamide applied at "pink bloom" stage reduced the number of open blooms. Based on this observation, hydrogen cyanamide at different concentrations was sprayed at prebloom and full bloom on 'Florda Prince' peach in southwestern Arizona (Fallahi et al., 1990). Under the climatic conditions of that experiment, applying hydrogen cyanamide at 8 pt formulation/100 gal (5152 mg a.i./L) at full bloom signifi-