

Commercial vegetable production: broccoli

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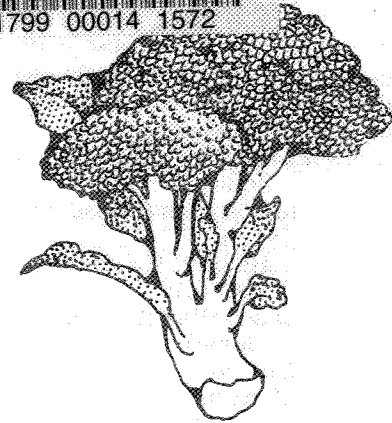
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Ells, James E./Commercial vegetable prod

no. 7.622



Quick Facts

Colorado broccoli production has more than doubled in recent years. Among the hybrid varieties, Packman has performed very well. The best way to obtain a good seed bed on clay dominated soils is to fall plow. Heads may be cut when 3 inches or more in diameter. However, once the flower buds show yellow, the head is unmarketable.



Broccoli acreage has more than doubled in recent years with a present total of 800 acres. This acreage is located in the San Luis Valley, the Western Slope and along the South Platte River Valley north of Denver.

Hybrid varieties suitable for summer and late fall harvest are Futura, Gem, Premium Crop, Bravo, Emperor, Packman, Green Valiant and Rex. Limited experience favors Packman for Colorado production.

Standard varieties also suitable for summer and late fall production are Atlantic, Coastal, DeCicco, Grande and Waltham 29.

Hybrid varieties are favored because they are generally more uniform and yield more with fewer cuttings. Hybrids are usually used for producing transplants; while standard varieties are generally used for direct field seeding because seed cost is much less. However, with improved equipment and increasing production costs, more hybrid varieties are being field seeded.

Transplanting

Transplanting can only be justified when growing for an early summer market since direct field seeding is more economical for late summer and fall markets.

The method chosen to produce transplants will depend upon the number of transplants needed

and whether transplant production is going to be a perennial operation. For small operations it could prove most cost effective to contract out the plant production, allowing six weeks from seeding to field planting.

A protective structure will be required if transplants are to be grown in cold weather. Seed may be sown directly in ground beds, in cellular containers or in flats. The system used will dictate the seeding method used. When grown in ground beds the plants will go to the field as bare root transplants. When seeded in flats, they will be transplanted into pots or cells, then grown out for four weeks before going to the field.

It requires six weeks to produce a transplant. They should be germinated at 75° F, then grown at a night temperature of 55° for five weeks. The final week, the night temperature should be held to just above freezing in order to harden the plants. During the growing period they should be fertilized with 1 ounce of 10-52-17 fertilizer per gallon three times a week. If cold temperatures do not occur during the sixth week, water should be withheld to the point where they are slightly wilted most of the time.

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It is a good idea to pre-irrigate the field then supply each plant with 0.5 pint of water containing two pounds of 10-52-17 per 50 gallons. Transplanting should begin after 12 N to avoid excess wilting. Bare-rooted plants should only be used in cool weather. Irrigation should follow as soon after transplanting as practical.

Field Preparation

If broccoli is to be direct field seeded it is necessary to have a good seed bed to obtain a uniform depth of seeding and loose soil to cover the seed. The best way to obtain such a seed bed on clay dominated soils is to fall plow, mulch (or disk) and list up rough beds to be mellowed by frost action during the winter. This method is also desirable for transplanted broccoli although not as essential. Just before the bed is planted, it should be formed with a bed shaper or smoothed with tillage tools to eliminate the weeds and provide a firm smooth seed bed for either direct seeding or transplanting.

Direct Field Seeding

To obtain a successful crop by direct seeding it is necessary to have control over weeds, crust, insects and diseases. It is best to use a field which has not been planted to broccoli or related crops for four years. If nematodes or disease are known to be present, fumigation should be considered. Chemical weed control and seed protection are standard measures when direct seeding.

Seed should be planted $\frac{3}{4}$ inches deep, 2 to 6 inches apart in 30-inch rows. The distance in the row reflects the confidence of the grower in obtaining a stand. There is three times as much stand insurance at a 2-inch spacing than a 6-inch spacing. An irrigation may be necessary after planting to initiate germination and, at the first sign of crust development, the beds should either be rolled with a cultipacker or irrigated.

As soon as the seedlings emerge, they should be observed for flea beetle damage and protected if evidence is found. Then, as soon as the tractor operator can see the rows, seedlings should be cultivated. The first cultivation usually uses a disk on either side of the row. The disks cut the crust and trash and thereby prevent the seedlings from being uprooted by any shifting of the crust during cultivation. Disks are followed by knives which undercut weeds in their path, and the knives are followed by duck feet to eliminate weeds between rows. Ditches then follow along to re-make the furrows.

Disks are removed after the first cultivation and the knives are moved further apart with each subsequent cultivation to prevent damage to the broccoli.

As soon as the broccoli plants begin to crowd they should be hoed and thinned, leaving a plant every 6 inches. When they begin to crowd at this spacing they are thinned to the final stand which

may be 12 to 24 inches depending on the variety. There is a trend toward closer spacing with two rows on a bed 12 inches apart and 6 inches between plants in the row.

Herbicides

Treflan (trifluralin) is applied pre-plant at 0.5 to 0.75 pounds of active material per acre and incorporated. Dacthal (DCPA) is applied pre-emergence at 10 pounds of active material per acre. Both may be used with transplants. Devrinol (napropamide) is used preplant at one to two pounds per acre and incorporated. It is not labelled for transplants. Consult the label regarding these herbicides, especially with regard to soil types as cole crops have shown marginal tolerance to Treflan at recommended rates.

Insect Control

Flea beetles may infest and seriously damage the crop during seedling stages. Vigorously growing plants can often outgrow flea beetle injury but severe infestations need control. Applications of insecticides rarely persist longer than five to seven days on growing foliage. Edges of fields bordering permanent vegetation are usually most seriously damaged.

Aphids, primarily cabbage aphid and turnip aphid, can infest new growth. This injury may need control if infestations are heavy enough to threaten distortion of growth. As harvest approaches an insecticide with aphid control activity should be applied to prevent contamination of the marketed heads.

Protection against cabbage looper, imported cabbage worm and diamond-back moth will be required by mid-season. Damage done by these insects prior to head formation has little effect on yield. After head formation, control is very important to prevent product contamination by insects.

Use of a wetting agent is often desirable when making applications to improve coverage of waxy leaves.

Diseases

Alternaria leaf spot (caused by *Alternaria brassicae*) causes yellow, concentric spots on foliage which may turn brown and die.

Black rot (caused by *Xanthomonas campestris* pv. *campestris*) produces yellow, angular spots which progress inward from the leaf margin. Leaf veins become dark brown to black, and heads may be deformed.

Club root (caused by *Plasmodiophora brassicae*) causes plant yellowing and wilting, with large spindle-shaped galls on roots.

Damping off and seedling blight (caused by *Pythium*, *Rhizoctonia* and *Fusarium* species) causes a pre- or postemergence wilting and death of seedlings. Roots and hypocotyls are discolored, water-soaked and/or rotted.

Downy mildew (caused by *Peronospora parasitica*) produces yellow spots on the upper surface with bluish to white fungal growth on the lower surface of leaves. Florets may be stunted or exhibit dark streaks.

Nematodes cause poor root development, root galls, root cysts, and/or stunted and yellow plants.

Wirestem (caused by *Rhizoctonia solani*) produces a darkened and girdled stem at the soil line. Plants are stunted and a leaf rot is often present near the soil.

Disease management recommendations rely upon crop rotation, pesticides, clean seed and transplants, good seedbed preparation, and other production guidelines that reduce plant stress.

Harvesting

When the heads reach 3 or more inches in diameter they may be cut. The type of market will

determine the stage and manner in which broccoli is harvested, however, there is no market for heads which show yellow flower petals. Therefore, harvesting is delayed until there is a reasonable yield, but not so long that the heads show any yellow.

For fresh market, heads are cut with 5-inch stems. Leaves are removed and several heads are taped together to make the broccoli bouquets which are hydrocooled, iced and shipped. There is a move to market jumble packs of heads which allow the consumer to select individual heads.

A typical broccoli field is harvested more than once, and during hot weather it should be harvested every day to prevent over maturity losses.

At the present time broccoli is not being processed in Colorado and therefore is not machine harvested nor is it being speared or chopped.

Table 1: Disease control recommendations.

Disease	Pesticide	Rate (acre)	Application frequency (days)	Days before harvest
Alternaria	Bravo 500	2.25 pt	7-10	
	Dithane Z78	4-6 lb	7-14	7
	Dithane FZ	1.2-1.6 qt	7-14	3
	Dithane M22 Sp.	1.5 lb	3-10	7
	Kocide Maneb	1.2-1.6 qt	7-14	3
Club root	Terraclor 75	2-6 lb/100 gal	Transplant solution	
		Apply 1/2-3/4 pt per plant or		
		30 lb/13 100 ft	row	
		40 lb/acre	broadcast	
	Terraclor 10G	200 lb/13000 ft	row	
Damping off		300 lb/acre	broadcast	
	Arasan 70S	5.3 oz/100 lb	seed treatment	
	(Thiram 42S)			
	Captan 30 DD			
	(Captan 400)			
Downy mildew	Captan 50	15 lb	preplant, broadcast	
	Bravo 500	2.25 pt	7-10	
	Bravo W75	1.5 lb	7-10	
	Dithane FZ	1.2-1.6 qt	7-14	3
	Dithane Z78	4-6 lb	7-14	7
	Dithane M22 Sp	1.5 lb	3-10	7
	Kocide 101	0.5-1 lb	7	
	Kocide Maneb	1.2-1.6 qt	7-14	3
	Kocide 606	0.6-1.3 pt	7	
	Manzate D	4 lb	7-14	3
	Top Cop & S	2 qt	7-10	
	Telone II	9-15 gal	preplant, aerate 7-14 days	
Nematodes	Telone C 17	10-17 gal	preplant, aerate 7-14 days	
	Vapam	40-100 gal	preplant, aerate 7 days	
	Vorlex	7-15 gal	preplant, aerate 14 days	
Wirestem	Terraclor 75	15-20 lb in 50 gal or 10-15 lb in 35 gal per 13,100 ft.	broadcast or row drench at seeding	

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Table 2: Insecticide recommendations.

Insect	Insecticide	Rate (lb actual/A)	Days to harvest	Remarks
Flea-Beetle	carbaryl (Sevin, Savit, Sevimol etc.)	1.0	3	
	endosulfan (Thiodan, Tiovel)	0.75-1.0	7	
	Methoxychlor	1.0-2.0	14	
	Disyston	As labelled	42	Restricted use. Planting treatments do not allow granules to contact seed. Microbial insecticide, stops feeding within hours, dies in 2-3 days
Cabbage Looper, Imported Cabbage-worm, Diamond-back Moth and other worms	<i>Bacillus thuringiensis</i> (Dipel, Javelin, Thuricide)	As labelled	0	Restricted
	permethrin (Ambush, Pounce)	0.05-0.2	1	Restricted
	mevinphos (Phosdrin)	0.25-1.0	1-3	Restricted
	Pydrin	0.05-0.2	3	Restricted
	methomyl (Lannate, Nudrin)	0.25-1.0	3	Restricted
	endosulfan (Thiodan, Tiovel)	0.75-1.0	7	
	Guthion	0.5-0.35	21	Restricted
	Monitor	0.5-1.0	35	Restricted
	mevinphos (Phosdrin)	0.25-1.0	1-3	Restricted
	malathion	0.4-0.8	3	
Aphid	diazinon	0.25-0.5	7	
	endosulfan (Thiodan, Tiovel)	0.75-1.0	7	
	dimethoate (Cygon)	0.25-0.5	7	
	Metasystox-R	0.75-1.0	7	
	Guthion	0.5-0.75	21	Restricted
	Monitor	0.5-1.0	14-21	Restricted