Effect of Time of Disbudding on Single-Harvest Yields and Maturity of 'Jade Cross' Brussels Sprouts[1]

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Abstract. **The terminal bud was removed from 'Jade Cross' Brussels sprout plants when sprouts began to develop and at various later stages of sprout development. Total marketable single-harvest yields increased as time of disbudding was delayed and equalled those of normal plants when disbudding was delayed to the 9- whorl stage or later. Thus, terminal bud removal on 'Jade Cross' cannot be justified on the basis of increased single-harvest marketable yields. However, time of removal of the terminal bud affected maturity and the optimum harvest period of disbudded plants was advanced as much as 12 to 14 days. This effect of disbudding can be of assistance to a grower or processor in obtaining earlier production or in scheduling an extended harvesting period.**

Brussels sprout growers in various areas have practiced cutting or pinching out the terminal bud. Few texts on vegetable production discuss terminal bud removal; and those that do fail to provide supporting data (4, 7).

Literature on the technique and value of terminal bud removal is controversial. Metcalf (3) obtained an increase in yield by removing the terminal bud during the first half of August in a 3-year multiple-harvest experiment in Montana. Carter (1), from work in England, stated that sprout yields were increased by disbudding in mid-September, but that disbudding in mid-October tended to increase the yield of 2 of the 3 varieties tested. Studies by MacGillivray et al. (2) indicated that for maximum yields of most varieties grown in California for single harvesting, the terminal bud should be removed when the largest sprouts are three-quarters grown. In contrast, Parker (5) reported from Virginia that while terminal bud removal advanced maturity the practice was of doubtful value. Also, Prest (6), in Australia, suggests that the terminal bud not be removed.

This investigation was conducted to determine the effect of time of terminal bud removal on single-harvest yields and maturity of the cultivar 'Jade Cross', and to define the stage of plant development at which removal would result in maximum single-harvest yields.

Brussels sprouts, *Brassica oleracea* var. *gemmifera* DC., cv. 'Jade Cross', were grown on a fine sandy loam soil. The trials, conducted for 4 years, were composed of 8 treatments arranged in a randomized complete block design with 4 replicates. Plots consisted of single rows containing 20 plants at 0.61 m intervals in rows spaced 0.91 m apart. All data were collected from the 18 central plants of each row.

The terminal bud was removed from the single-harvest treatments, 1 to 6, when 1, 3, 5, 7, 9 and 11 whorls of sprouts formed, respectively. Whorls in which the developing sprouts (about 0.5 cm in diameter) could be detected by touch were included when counts were taken. Disbudding was by manual removal of 3 to 4 cm of the growing tip. Terminal buds were not removed from the control treatments, numbers 7 and 8. These were single- and multiple-harvested, respectively.

The sprouts on the multiple-harvested plots were hand picked 4 times in 1965 and 1968 and 5 times in 1967. In 1966 the sprouts on treatments 6 and 7 were harvested late and the yield data for that year were not included. The single-harvested plots were harvested when 2 or 3 sprouts on the majority of plants exceeded 4 cm in diameter, which was approximately 4 weeks after the terminal bud was removed. The leaves were stripped from the plants 2 to 4 days before the stalks, with sprouts intact, were cut at ground level. The sprouts were cut from the stalks, sized, graded and weighed.

Plants that were disbudded when the sprouts were beginning to form had an "open-topped" appearance at harvest. The sprouts on disbudded plants appeared to be more uniform in size than those on plants that were left intact. Early terminal bud removal reduced plant height. Differences in plant height decreased with later removal of the terminal bud.

The greatest yields were consistently obtained from plants that were multiple-harvested and not disbudded (Table 1). Where the terminal bud was removed when 9 or 11 whorls of sprouts had formed, single-harvest yields were only 83% as much as where normal plants were picked 4 or 5 times over a 48- to 64-day period. Plants that were single-harvested and not disbudded (treatment 7) generally produced slightly less marketable sprouts than those disbudded at the 9- and 11 whorl stage, although differences were not significant (Table 1). Removal of the terminal bud when the sprouts were beginning to form (treatment 1) resulted in the lowest marketable yields; yields increased as the time of disbudding was delayed (Table 1).

Removal of the terminal bud increased yield of smaller sized sprouts more than total marketable yield. For example, removal of the terminal bud when 9 whorls of sprouts had formed increased single-harvest yields of sprouts which were 1.27-2.86 cm (1/2 - 1 1/8 inch) in diameter from 6.70 to 7.55 metric tons /ha, while total marketable yields from the same treatments were increased from 10.35 to 10.75 metric tons /ha (Table 1).

Time of removal of the terminal bud affected maturity. Sprouts on plants that were disbudded when one whorl of sprouts had formed were the first to mature (Table 2), and were ready to harvest about 35 days before those on plants that were not disbudded. Later

Table 1. Effect of time of terminal bud removal on single harvest yields of 'Jade Cross' Brussels sprouts (1965, 1967, 1968).

Treatment No.	No. whorls formed when terminal bud removed	Harvest method	Mean Yield (Metric tons/ha)[1] Sprout diameter (cm) 1.27 - 2.86[2]	1.27 - 4.13[3]
1	1	Single	6.52 d	7.47 e
2	3	Single	7.07 bcd	8.39 d
3	5	Single	7.03 bcd	8.63 d
4	7	Single	7.22 bc	9.33 cd
5	9	Single	7.55 b	10.75 b
6	11	Single	7.20 bc	10.98 b
7	Terminal bud not removed	Single	6.70 cd	10.35 bc
8	Terminal bud not removed	Multiply	10.95 a	13.06 a

[1]Means within a column followed by the same letter are not significantly different at 5% level.
[2]Prime size for processing.
[3]Total marketable size.

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removal of the terminal bud resulted in correspondingly later maturity and plants that were not disbudded were ready for single-harvesting, on the average, 2 days later than those that were disbudded at the 11-whorl stage (Table 2).

The most beneficial effects of termial bud removal were earlier maturity and increased yields of smaller sized sprouts. These results indicate that terminal bud removal from 'Jade Cross' plants after 9 whorls of sprouts have formed does not affect total marketable yields. Therefore, by scheduling terminal bud removal, the optimum harvest period can be extended to approximately 12 to 14 days without affecting total marketable yields and over a considerably longer period if the aim is to produce maximum yields of smaller sized sprouts. Knowledge of the effect of terminal bud removal on the maturity and size of 'Jade Cross' sprouts can be of assistance to a grower or processor in obtaining earlier production, in scheduling an extended harvesting period and in producing desirable product size.

Table 2. Means and standard errors for number of days from transplanting to terminal bud removal and to single-harvest of 'Jade Cross' Brussels sprouts (1965, 1966, 1967, 1968).

Treatment no.	No. whorls formed when terminal bud removed	Days to terminal bud removal	Days to harvest
1	1	43 ± 1.2	69 ± 4.1
2	3	48 ± 1.0	74 ± 3.4
3	5	53 ± 2.4	79 ± 4.5
4	7	58 ± 3.3	84 ± 4.6
5	9	64 ± 3.5	92 ± 3.6
6	11	74 ± 2.6	102 ± 4.5
7	Terminal bud not removed		104 ± 4.2

The application of terminal bud removal on 'Jade Cross' can not be justified exclusively on the basis of increased marketable yields of sprouts within diameter sizes 1.27-4.13 cm (1/2 to 1 5/8 inch).

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Incompatibilities Between Herbicides and Insecticides in Direct-Seeded Brassica Crops[1]

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Abstract. **The compatibility of 5 preemergence herbicides and 3 insecticides applied in silt loam was assessed in 4 brassica crops by comparing their effects on germination, plant stand, and yield. Several combinations were deleterious. The herbicides CDEC and DCPA in combination with the insecticide thionazin reduced plant stand in cabbage and cauliflower. Herbicide C-7019 in combination with the insecticide fensulfothion was incompatible for cabbage and broccoli. Cabbage germination was reduced; while with broccoli both the germination and crop yield were affected. C-7019 alone reduced the germination of cauliflower and in combination with fensulfothion the damage was increased. This herbicide was phytotoxic to rutabaga. When nitrofen was combined with the insecticides, plant stands of cauliflower and rutabaga were affected. Nitrofen and thionazin together reduced the plant stand of cabbage. Propachlor at 4 lb./acre was compatible with any of the three insecticides for the four crops. However, the plant stand and yields of all four crops were reduced in plots treated with propachlor at 6 lb./acre in combination with thionazin. Propachlor with the insecticide carbofuran injured only broccoli. The herbicides did not affect the efficacy of the insecticides.**

In coastal British Columbia stem brassica crops are normally transplanted and harvested over a long period. With ever-increasing labor costs this has become uneconomic, and the industry requires a method for direct seeding and mechanical harvesting. It follows that selective herbicides must be available for weed control. In addition, the cabbage maggot *(Hylemya brassicae* Bouche), a serious pest of these crops, must be controlled. Since recommendations for chemical control of weeds and root maggots are needed, information is essential on the compatibility of herbicides and insecticides applied to field-seeded brassica crops. Compatibility, as defined by Sharvelle (9) is the ability of the plant-protective materials to be used together without loss of effectiveness or damage to the host.

In 1967 a study was initiated to examine the actions of herbicides and insecticides and their interactions in combinations applied to field-seeded brassica crops. Preliminary results (5) revealed that the herbicide C-7019 used as a preemergence treatment on field-seeded cabbage was incompatible with the insecticides fensulfothion (Dasanit) and thionazin (Zinophos). The investigation was broadened in 1968 to include 5 herbicides, 3 insecticides and 4 brassica crops.

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