are both pistil and pollen sterile as previously observed (3, 6).

Our results confirm the feasibility of the sublethal screen afforded by intergeneric hybridization to obtain chromosome reduction in strawberry. *P. anserina* is a useful choice as a pollen parent with cultivated strawberry because all intergeneric hybrids are lethal at an early stage. Results from *P. fruticosa* indicate that this species and undoubtedly others may be used. Tetrahaploids may have been previously overlooked from earlier *P. fruticosa* intergeneric crosses because of the difficulties in distinguishing them from intergeneric hybrids which survive at a much greater frequency. Our results suggest that tetrahaploids occur at an approximate frequency of 1 per 1000 seed in crosses of cultivated strawberry by *Potentilla anserina* and *P. fruticosa*. Further tetrahaploids will have to be produced to determine if fertility can be found in these types.

The octoploids derived from Md-US 3699 are very likely naturally-doubled tetrahaploids, and if so, suggest this technique may be useful for obtaining inbred lines directly in strawberry. Of the 3 octoploids derived from Md–US 3699 × *Potentilla,* 2 survived to flowering with one (derived from *P. anserina*) pistillate and the other (derived from *P. fruticosa*) hermaphroditic.

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Ethephon-induced Flowering in Apple Seedlings[1]

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Abstract. **(2-Chloroethyl) phosphonic acid (ethephon) applied as a foliar spray at 1000 and 2000 ppm to 3-, 4-, and 5-yr old nonbearing seedlings of apple (*Malus pumila* Miller) significantly increased the percentage of trees flowering for the first time and the total number of flower clusters per tree.**

Seedling apple trees generally retain their juvenile character for several years (2). These experiments were designed to determine if ethephon which stimulates flower bud initiation in mature apple trees (3) could also induce flowering in young seedling apple trees.

In 1969 and 1970 ethephon was applied as a foliar spray to 3-, 4-, and 5-yr old apple trees which had not yet flowered. Treatments consisted of ethephon at 0, 50, 100, 500, and 1000 ppm as single and repeat applications in 1969. Single sprays were applied June 10 and double sprays June 10 and June 30. The repeat applications were not made to 5-yr old trees. In 1970, ethephon was applied to previously untreated trees at 1000 and 2000 ppm as a single spray on May 26 and June 11, 2 and 5 weeks after normal full bloom respectively. Treatments were applied to 3-tree blocks and replicated 3 times, once in each of 3 age classes, making a total of 207 trees studied in 1969 and 90 trees in 1970. Trees from the same cross constituted a single replication. Treatments were applied to run off using a hand gun. Polyoxyethylene sorbitan (Tween 20) at 0.1% was used as a surfactant.

Ethephon, at 1000 ppm as a single application in 1969, significantly increased the % apple seedlings that flowered for the first time, at all ages the following year (Table 1). The mean no. of flower clusters per tree also increased with ethephon treatment (Table 2). Although 1000 ppm had the greatest influence on flowering response, there was no consistent pattern of response from concn or no. of sprays. In some cases less flowering occurred with the repeat applications.

Table 1. Effect of ethephon on the % flowering of young apple seedlings, 1970.

Ethephon Treatment (ppm)	Date of Application (June, 1969)	Trees Flowering (%) z/ — Age of seedlings in 1969: 3 yr	4 yr	5 yr	Mean
0	–	11	22	17	17
50	10	0	44	22	22
50	10 + 30	0	44	–	22
100	10	0	22	28	17
100	10 + 30	11	22	–	17
500	10	11	11	39	20
500	10 + 30	11	11	–	11
1000	10	56**	56**	50**	54
1000	10 + 30	11	44	–	28

* Statistical significance, P = 5%.
** Statistical significance, P = 1%.
z/ Data are means for 9 trees of each age class per treatment.

Table 2. Effect of ethephon on the number of flower clusters per tree on young apple seedlings, 1970.

Ethephon Treatment (ppm)	Date of Application (June, 1969)	No. flower clusters per tree z/ — Age of seedlings in 1969: 3 yr	4 yr	5 yr	Mean
0	–	7	11	8	9
50	10	0	42**	29**	24
50	10 + 30	0	28**	–	14
100	10	0	3	69**	24
100	10 + 30	14	5	–	10
500	10	15	10	55**	27
500	10 + 30	7	3	–	5
1000	10	56**	49**	148**	84
1000	10 + 30	18	12	–	15

* Statistical significance, P = 5%.
** Statistical significance, P = 1%.
z/ Data are means for 9 trees of each age class per treatment.

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In 1970 all ethephon treatments increased the % seedlings flowering for the first time over unsprayed controls (Table 3). There were no statistically significant differences in % of seedlings flowering among concn or timings. Ethephon increased the no. of flower clusters on the 4-yr old trees more than the 5-yr old trees. Ethephon at 1000 and 2000 ppm significantly reduced shoot growth below control trees (Table 4).

Table 3. Effect of ethephon on the % trees flowering and number of flower clusters per tree of young apple seedlings, 1971.[z]

Ethephon (ppm)	Date of Application (1970)	Age of Seedlings in 1970			
		4 years		5 years	
		Flowering (%)	No. flower clusters	Flowering (%)	No. flower clusters
0	--	40	8	11	6
1000	May 26	89**	122**	22**	31*
1000	June 11	67**	42*	56**	11
2000	May 26	100**	96**	44*	12
2000	June 11	78**	41*	67**	40*

* Statistical significance, P = 5%.
** Statistical significance, P = 1%.
z/ Data are means for 9 trees of each age class per treatment.

Table 4. Effect of ethephon on the mean shoot growth of apple seedlings, 1970.

Ethephon Treatment (ppm)	Date of application (1970)	Mean shoot growth (cm) Age of seedlings in 1970	
		4 years	5 years
0	–	29.8	35.1
1000	May 26	24.9*	28.7*
1000	June 11	25.2*	30.9
2000	May 26	21.9**	23.6**
2000	June 11	21.9**	24.4**

* Statistical significance, P = 5%.
** Statistical significance, P = 1%.

Since gibberellins inhibit flower bud initiation in fruit plants, it may be likely that ethephon in stimulating flowering in these studies acted as a gibberellin antagonist as suggested by Monselise (1). Zimmerman (4) has proposed that factors influencing the flowering of young seedlings may be acting not on a juvenile tree but rather on one in a post-juvenile, transitional stage. If ethephon acted as an anti-gibberellin it is not likely that the juvenile stage was influenced but a postjuvenile period prior to first flowering (readiness to flower). Unfortunately it was not possible to distinguish between these 2 phases. Nevertheless, ethephon shows promise as a means to reduce the time from seed germination to the first flowering of apple seedlings. If combined with other techniques (2) it may also further enchance the efficiency in apple breeding programs.

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Cultural Management of Pine Voles in Apple Orchards[1]

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Abstract. **Pine vole, *Microtus pinetorum* LeConte, activity in an apple orchard was reduced by cultivation of a 4 m-wide strip down the tree row. Bare-ground-culture using a single annual application of Simazine plus Amitrol (1964-71) or Paraquat (1972-73) herbicide for 10 years reduced pine vole activity.**

Pine vole damage to apple tree stems and large roots is a major cultural problem in orchards of the central-eastern U.S. The pine vole is adapted to a wide range of habitats covering at least 22 eastern states and Ontario. The animal is subterranean and exists in a tunnel system horizontally beneath that of other species. The ideal pine vole habitat includes a diversity of ground cover plant material, ground cover height 20-30 cm, grass density of 60-100%, adequate soil moisture for burrowing, thick litter, uniform soil temp and sparse or adjoining deciduous shrub or tree stands (1, 4). This study was initiated to determine if the orchard habitat could be sufficiently altered to have a marked influence on pine vole activity.

The experiment was conducted in a 14 year-old orchard near Batesville, Virginia planted 5 x 8 m. The Smitty Tree Hoe was used to cultivate 3 replicate plots of 40-45 trees each (approx 6 rows wide and 7 trees long). Comparison was made to 3 replicates of an uncultivated control where normal orchard practices were followed. Cultivations were performed May 8, July 2, and Nov. 21, 1973. The treatment effect was monitored using techniques developed by Horsfall (2). One activity site was established 5-15 cm below the soil surface in a pine vole tunnel at each of the interior 20-24 trees of each replicate. An apple with 2.5 cm sector removed from the cheek was placed at each site. All sites were covered with a rubber mat approx 0.15 m^2 weighing 2-3 kg. Twenty to 24 hr after placement, the apples were observed for characteristic vole tooth marks. The site was designated as highly active if a semi-sphere of 2.5 cm was removed from the apple in 24 hr. Apple consumption less than this was recorded as slightly active. The sum of slightly and highly active sites is presented as active sites per tree (Table 1). Sites in the cultivated area became progressively more difficult to find because of the destruction of the surface tunnel system and the collapse of abandoned tunnels in the undisturbed areas adjacent to the trunk. The no. of active sites per tree in the cultivated area rose to .21 to .30 during October and November 1973, respectively. Cultivation Nov. 21, 1973 reduced the activity to .08 by Dec. 4 and good control remained throughout the winter months.

Simazine at 4.5 kg ai/ha (4 lb./acre)

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