1992 ANNUAL REPORT OF NC-140 COOPERATIVE REGIONAL PROJECT

PROJECT: **NC-140, California**

COOPERATING AGENCIES AND PRINCIPAL LEADERS:

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PROGRESS OF WORK AND PRINCIPAL ACCOMPLISHMENTS:

Objective 1. To evaluate rootstocks in different environments.

1984 Apple Rootstock Planting

Trees of both pollenizing cultivars on M.26 EMLA continue to be lost, presumably from fireblight (Erwinia amylovora), although this has not been confirmed. Just over half of the pollenizers have now died. Pollination continues to be satisfactory, however, (see 1992 yield data below) because of cross-compatible cultivars planted around the plot's periphery. None of the 'Starkspur Supreme Delicious', also on M.26 EMLA, have been lost. Several 'Starkspur Supreme Delicious' trees have been lost on P.22 (2), P.16 (1) and MAC 39 (1); and some have been eliminated because they were off-type including all trees on CG-10, Bud.491 and own roots; 2 trees on P.22; and one each on M.26 EMLA, P.2 and P.16. Data continues to be collected for CG-24 in California since at least some of these trees appear to be true-to-type.

The following comments and table 1 summarize the 1992 data from this plot. Based on trunk circumference the largest 'Starkspur Supreme Delicious' trees in this plot continued to be those on P.18, M.4, Ant.313 and domestic seedling, while the smallest were on P.22, P.16, Bud.9 and P.2. These very small trees do not have sufficient canopy to protect the tree in the very hot San Joaquin Valley of California. This has resulted in sunburn damage to the trunk and major limbs on some of these small trees which were then attacked by borers.

Trees on M.7 EMLA, MAC 39, P.2, P.16, Bud.9, P.1 and M.26 EMLA rootstocks all had yield efficiencies (fruit weight per trunk cross sectional area) of 1.0 kg/cm^2 or higher. The 1992 yield efficiencies in this plot were generally the highest of any year so far. However, both pollenizers on M.26 EMLA had low yield efficiencies. Of the 'Starkspur Supreme Delicious' trees those on domestic seedling had the lowest yield efficiencies followed by trees on Bud.490, MAC 1 and P.18.

Based on total yield per tree, the rootstocks producing the highest yields were M.4, P.18 and Ant.313, the same as in 1989, 1990 and 1991. Average yields for trees on these rootstocks ranged from 165 to 205 kilograms per tree, considerably more than in previous years. Using the existing spacing in this plot, trees on these three rootstocks produced approximately 2000 bushels per acre, while the average production for all trees in the planting was over 900 bushels per acre. On a per tree basis the lowest yielding trees were again on P.22, P.16, Bud.9 and P.2. These were also the smallest trees in the planting, and certainly the planting distance in this plot was much too far apart for these rootstocks, at least with a spur-type cultivar.

Trees on M.4, Ant.313, Bud.490, M.7 EMLA and P.18 produced the largest fruit, all averaging 200 grams fruit of larger. For 'Starkspur Supreme Delicious' Bud.9, P.22, and P.16 gave the smallest fruit. In 1992 there was considerable variability in fruit size between trees for a number of the rootstocks.

In an area where fruit color of red cultivars generally tends to be poor, P.22, MAC 39, Bud.9 and P.16 gave the best color and trees on Bud.490, P.18 and P.1 produced the poorest fruit color. Percent soluble solids was highest with P.16, P.22, CG-24 and MAC 39 and lowest with Ant.313, P.1, M.4, domestic seedling, M.7

EMLA, Bud.490 and P.18. rootstocks. However, rootstock had little effect on fruit firmness.

In reviewing this years and some previous year's data it appears that there are some data trees that may not be true-to-type. Three of the ten trees on P.1 were much larger than the other seven, and in 1991 and 1992 these three had considerably higher yields. Three of the ten trees on CG-24 were considerably smaller with much lower yields and generally smaller fruit than the other seven in both of these years. Two of the nine 'Starkspur Supreme Delicious' on M.26 EMLA trees were much larger and had greater yields than the other seven (the tenth tree had already been eliminate from data collection because of scion rooting).

Objective 2. To evaluate different apple orchard management systems.

1989 Orchard Systems Trial (not an NC-140 cooperative trial)

A trial to evaluate four apple orchard systems (vertical axis, slender spindle, central leader and perpendicular Y) was set out in 1989. Modifications in some training systems, including more heading cuts, were made to provide a denser canopy for protection of fruit from sunburn. 'Granny Smith' and 'Fuji', both on M.26 rootstock, were used as the test cultivars.

Table 2 shows trunk circumference, total yield, yield efficiency and percent sunburnt fruit for 1992, the fourth growing season. A large difference was obtained between cultivars. 'Granny Smith' gave much lower yields and yield efficiencies and a greater percentage of sunburnt fruit than did 'Fuji'. 'Granny Smith' has not always grown well on M.26, and tree performance of this combination in this trial has been less than desirable.

With both cultivars, the vertical axis and slender spindle gave the highest production followed by the central leader. The perpendicular Y, which requires substantial training, had the lowest production and yield efficiency. There was little effect of orchard system on sunburn of fruit with damage on 'Granny Smith' ranging from 47 to 59% and on 'Fuji' from 23 to 34%.

USEFULNESS OF FINDINGS:

Objective 1. (Same as above.)

Three rootstocks, P.18, M.4 and Ant.313, in this planting are larger than domestic seedling and even though they have been very productive on a per tree basis, they are not particularly yield efficient. They also produce trees that are too large for most high density plantings, and with a non-spur-type cultivar they would have even less potential.

On the other hand P.22, P.16, Bud.9 and P.2 are making very small trees. Under the conditions in this planting and with a spur-type cultivar, trees on these rootstocks appear to be too small even for very high density plantings. Under the hot growing conditions of the San Joaquin Valley, trees on these rootstocks tend to sunburn and then be attacked by borers, probably because of too little canopy to shade the trunks and major limbs. Also under the conditions in this valley, these rootstocks probably would not produce sufficient tree canopy to protect fruit of susceptible cultivars from sun damage.

So far no rootstock has performed much if any better than M.7 EMLA. This rootstock makes a moderate sized tree that is highly yield efficient, but has a tendency to sucker. Several rootstocks in this planting continue to show some promise for Central Valley conditions in California and should be studied further. These include P.1, MAC 39 and possibly CG-24 and C.6.

Objective 2 (Same as above.)

There has been concern that orchard systems utilizing very high densities with dwarfing rootstocks may provide too little canopy to protect fruit from sunburn in California's interior central valleys. Early results from this trial indicate that, at least with certain cultivars, these systems may be successful with modifications in tree training and good orchard management.

WORK PLANNED FOR NEXT YEAR:

Objective 1. (Same as above.)

Continue data collection and rootstock evaluations from this 1984 apple planting as recommended by the NC-140 Technical Committee.

Objective 2. (Same as above.)

Continue training systems as modified and collect data on production, fruit sunburn and tree growth.

PUBLICATIONS ISSUED OR MANUSCRIPTS APPROVED DURING THE YEAR:

Micke, W. C., J. T. Yeager, P. M. Vossen, R. S. Bethell, J. H. Foott and R. H. Tyler. 1992. Apple rootstocks evaluated for California. California Grower 16(6):33-34.

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Table 1. 1992 summary for 1984 planted NC-140 apple rootstock plot U.C. Kearney Agricultural Center, Parlier, CA.

Cultivar/Rootstock[1]	Trunk Circ. (mm)	Total Yield (Kg/tree)[2]	Total Yield per T.C.A. (Kg/cm^2)	Average Fruit Weight (g)	Fruit at Harvest		
					Red color index[3]	% Soluble Solids	Fresh Firmness (lbs)
2 SS/Bud 9	143	17	1.02	163	2.28	13.0	14.2
3 SS/MAC 1	435	104	0.70	189	2.15	13.0	15.2
4 SS/MAC 39	226	45	1.11	190	2.31	13.5	14.5
5 SS/P1	323	85	1.02	189	1.50	11.9	14.4
6 SS/P22	118	11	0.97	166	2.58	13.8	14.0
7 SS/Dom. Sdlg.	505	131	0.64	199	1.70	12.0	14.5
9 SS/CG-24	279	57	0.91	190	2.05	13.7	15.1
10 SS/M4	569	205	0.79	212	1.60	11.9	14.5
11 SS/M7 EMLA	307	86	1.14	205	1.95	12.0	14.9
12 SS/M26 EMLA	317	80	1.00	198	2.00	12.8	14.6
13 SS/Bud 490	486	130	0.69	206	1.45	12.0	14.3
14 SS/P 2	145	17	1.04	185	1.88	13.0	14.7
15 SS/P 16	127	13	1.04	177	2.21	14.0	14.8
16 SS/P 18	587	193	0.70	202	1.45	12.0	14.1
18 SS/C 6	210	33	0.95	195	1.94	12.3	14.0
19 SS/Ant. 313	523	165	0.76	209	1.77	11.8	14.4
20 Macspur/M26 EMLA	475	50	0.28	145			
21 S. Golden/M 26 EMLA	513	79	0.38	173			

[1]SS = Starkspur Supreme Delicious
[2]Total Yield = Harvested fruit + ground fruit
[3]Red Skin Color Index (visual rating):
1 = 0-25% of surface with red color
2 = 25-50% of surface with red color
3 = 50-75% of surface with red color
4 = 75-100% of surface with red color

Table 2. 1992 Yield and Fruit Sunburn summary for 1989 Apple Systems Trial, University of California, Davis.

Cultivar*	Treatment**	Yield/Acre (Tons)	Trunk Circ. (cm)	Yield Efficiency (lbs/cm^2)	% Sunburnt Fruit
Granny Smith	Vertical Axis	4.3	15.0	0.65	51
	Slender Spindle	3.6	16.2	0.47	47
	Central Leader	2.5	14.8	0.59	59
	Perpendicular Y	1.2	14.4	0.25	59
Fuji	Vertical Axis	14.5	17.5	1.64	23
	Slender Spindle	15.3	17.4	1.75	30
	Central Leader	10.3	18.2	1.61	34
	Perpendicular Y	2.0	16.1	0.33	24

*Rootstock: M26
**Spacing: Vertical Axis and Slender Spindle -- 726 Trees/Acre; Perpendicular Y -- 581 Trees/Acre; Central leader -- 484 Trees/Acre.

1992 SUMMARY
Sweet Cherry
Rootstock and Tree Training

S.M. Southwick, J. Grant, and J.T. Yeager

Six-year-old 'Bing' (B) growing on GM 61/1 and 79 were approximately 35% while GM 9 was 60% smaller than B/mahaleb (MH) in Stockton, CA. All trees were growing well and produced a crop of cherries. The crop on GM 9 was the poorest and best on GM 79. More work needs to be done with these stocks because GM 61/1 does not impart precocity to B trees if left to grow naturally without training. However, orchards in the Lodi area have consistently produced fruit in the 2nd and 3rd leaf with cherries in the 9 to 11 row size with proper training and growing procedures being employed. GM 79 has tended toward overcropping, but that problem could be resolved as well. Determining how to best grow each of these stocks is needed because the stocks are dwarfing and may not be as costly as other dwarfing rootstocks available in the future. It seems that crown gall can be managed on these GM rootstocks so that good nursery and grower orchard stands can be achieved.

Five-year-old B trees growing on varying rootstocks in Stockton, CA and trained to an open center were again evaluated in 1992 for horticultural performance. 'Colt' and MxM 60 were the 2 imparting most vigor to B trees. While other rootstocks in the test were less vigorous with Giessen (Gi) selection 148/2 showing a reduction in trunk cross sectional area (TCSA, indicative of tree size) of about 70% of B/'Colt'. Yield of fruit per tree was lowest with 'Colt', MH, and the MxM series of rootstocks while higher yields were recorded with Gi 148/1, 148/9, 169/15, 195/1, 195/2, and 196/4. Lowest yield efficiencies (yield per tree/TCSA) were measured on 'Colt', MH, and the MxM rootstocks while the highest yield efficiencies were measured on Gi 148/1, 148/2, 148/9, 173/9, 195/1, 195/2, and 196/4. The highest yields per tree for the 1991 and 1992 seasons were found on rootstocks Gi 148/1, 195/1, 195/2, and 196/4. Fruit size was similar for B on most of the tested rootstocks however, with large crops borne on Gi 195/1 fruit size was smaller than many other tested rootstocks. A different pruning style could overcome that finding. No rootstock through the 1991 and 1992 season's produced consistently larger or smaller fruit size, except possibly Gi 173/9 which had slightly larger fruit than those found on either 'Colt' or MH. Several of the Gi rootstocks were able to produce fruit of adequate size with crops that were 3 to 5-fold higher than found on 'Colt' or MH. As a consequence, even though crop load or yield per tree was higher than 'Colt' or MH fruit size did not generally decrease on several Gi rootstocks.

More B fruit were dark red (indicator of fruit maturity) from trees growing on Gi 148/1, 148/9, 154/4, 195/1, and 195/2 than the more vigorous rootstocks of 'Colt', MH or the MxM series when all trees were harvested on a single date. The production of "spurred" and "doubled" fruit were greater with Gi selection 148/2 than other tested rootstocks. There were no other consistent differences among rootstocks with regard to deep suture formation. The Gi rootstock selections 148/1 148/2, 148/9, 169/15, 195/1, 195/2, and 196/4 certainly warrant further testing by growers and researchers.

California Peach Rootstock Evaluation - 1992

R. Scott Johnson, Ted M. DeJong, and Dave Ramming

In 1987 a collection of over 80 potential peach rootstocks were lined out in a nursery and budded to O'Henry peach. These items included numerous *Prunus* species, and many interspecific hybrids such as peach-plum, peach-almond, apricot-almond and plum-apricot. In 1988, 5 trees of each were planted at the Kearney Agricultural Center together with several standard rootstocks. Over the past 5 years, these trees have been evaluated for compatibility, suckering, tree size, yield, fruit size, and disease and nematode susceptibility. The top 10 showing promise as semi-dwarfing rootstocks are listed in Table 1.

Citation, which has been inconsistent in other trials, has performed very well in this study. P30-135 is a plum-peach hybrid which has had good production and fruit size. Both of these rootstocks produce trees substantially less vigorous than Nemaguard. Leaf calcium levels from 'O'Henry' on P30-135 are much higher than O'Henry on Nemaguard, so there might be potential for improved fruit quality. However, fruit calcium levels have not been measured. Plans are being made to further evaluate these items in additional trials.

In a separate study, further evaluations were made of GF655-2 as a dwarfing rootstock. Results from the 1984 NC-140 peach planting indicated this rootstock was compatible with peach and produced an ideal sized dwarf tree. The major problem was a reduction in fruit size. Since the field was flood irrigated, we felt more frequent irrigations provided by a low volume irrigation system might overcome the problem of fruit size. Therefore, in 1988 nine trees budded to O'Henry peach were planted in a field irrigated by microsprinklers. The rest of the field is the same cultivar on Nemaguard rootstock.

Over the last several years, trees on GF655-2 rootstock have had reduced fruit size, but only by about 10% compared to the rest of the field. Therefore, fruit size would probably not be a serious drawback with this rootstock under good irrigation management. However, root suckering has been very extensive with GF655-2 even though the field has not been cultivated since planting. This is probably a much more serious concern for commercial plantings of this rootstock.

Table 1. Potential Dwarfing Peach Rootstocks

Name	Type	Yield (kg/tree) 1989	1990	1991	1992	Fruit Weight (g) 1989	1990	1991	1992	Trunk Circumference Nov., 1991 (cm)
Nemaguard	Peach	.6	28.3	57.3	65.2	194	204	226	226	38.6
Alace	Plum	.8	28.1	41.4	29.9	228	225	169	190	30.0
Citation	PeachxPlum	2.0	20.6	53.2	53.0	222	199	217	222	28.8
Hiawatha	Plum	4.5	24.7	46.0	49.9	184	190	184	207	31.7
K119-50	PlumxAlmond	1.2	21.7	52.3	50.7	199	220	192	205	28.7
K144-100	PlumxPeach	.8	21.1	39.5	46.1	169	202	174	160	25.9
K145-5	PlumxPeach	.8	14.4	44.5	46.1	182	193	194	187	28.8
K146-43	PlumxPeach	.7	21.3	38.0	48.2	187	179	184	183	26.0
K62-68	Peach	1.9	27.9	65.6	58.4	219	206	186	193	36.0
P30-135	PlumxPeach	.2	17.3	43.4	50.9	202	250	201	195	30.5
Sapalta	Plum	3.5	26.2	39.3	32.4	208	219	175	198	31.4