# Field Evaluation of Almond Varieties

**Project No.:** **10-HORT2-Lampinen**

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**Objectives:**

The objective of this project is to evaluate performance of pollenizers and Nonpareil clones in a replicated field trial in McFarland, California. Assessment includes relative yield performance as well as bloom dates, maturity dates, disease/insect susceptibility, and other factors like any development of bud failure in the Nonpareil clones.

A secondary objective is to use the replicated data on light interception and yield to assess the relative productivity per unit of light intercepted for the Nonpareil clones, varieties and selections.

**Interpretive Summary:**

Yields at the McFarland trial continue to be high compared to the 1993 regional almond variety trials. The McFarland trial reached an average production of 3000 kernel pounds per acre in the 5$^{th}$ growing season which was six years earlier than the 1993 Kern RAVT while neither the 1993 Butte or 1993 Delta trials ever reached this level of production. In order to develop the canopy this quickly, water and other inputs need to be quite high and this has resulted in high disease pressure (especially hullrot). Because this trial is replicated, unlike the earlier regional almond variety trials, we have the opportunity to more accurately assess yield differences among the Nonpareil clones, varieties and selections. In addition, because we have detailed light interception data, we can assess whether differences in productivity among varieties and selections are due to faster canopy growth or higher productivity per unit light intercepted. Yields in 2010 were down slightly from 2009 but this was expected since 2009 yields were very high for the canopy size of the orchard. Hull rot continued to be the major disease related problem

with the highest levels in Kochi and Winters with the Nonpareil clones having intermediate hull rot pressure.

## Materials and Methods:

This report will concentrate on a replicated variety trial of eight varieties and eight Nonpareil clones that was planted in 2004 in Kern County near McFarland. Soils at the site consist of McFarland loam and Wasco sandy loam (both Class I soils). The irrigation system is double line drip. Tree spacing is 20 feet between tree rows and 18 feet between trees for a density of 121 trees per acre. Varieties planted included Chips, Kahl, Kochi, Marcona, Selection 2-19e, Sweetheart and Winters, Nonpareil clones planted include Nonpareil 3-8-2-70, Nonpareil 5, Nonpareil 6, Nonpareil 7, Nonpareil Dr., Nonpareil-J, Nonpareil-Newell and Nonpareil-Nico. There are six replications of each variety and Nonpareil clone with 34 trees per replication. Pollenizer and Nonpareil rows alternate in the orchard.

In 2010, data was collecting on bloom and maturity timing, disease pressure (scab, *Alternaria* and hull rot), yield and midday canopy light interception in mid-summer.

## Results and Discussion:

Weather during bloom was generally good at the McFarland trial site. Bloom was generally advanced by 1-3 days in 2010 compared to 2009 and 2008 (**Table 1**). Sweetheart and Marcona were the varieties to reach full bloom the earliest and Kochi and Selection 2-19e were the latest. Bloom overlap was very good in 2009 and 2010.

Initiation of hullsplit was late in 2010. Nonpareil hullsplit began from between July 20-22 (**Table 2**). Hullsplit for Winters did not start until Aug. 22 and for Marcona on Aug. 31 (**Table 2**).

In 2010, scab was only observed on Winters and Nonpareil while Alternaria was not a problem at the McFarland trial (**Table 3**). There was substantial hullrot in all varieties and selections with the most severe disease pressure in Kochi and Winters (**Table 3**). Kochi also displayed severe hullrot in 2008 and 2009. There was also substantial hull rot in all the Nonpareil clones in 2010 (**Table 3**).

The grower started ripping every other row center in 2009 and this has resulted in significant improvements in water penetration in the orchard.

Yield data for the McFarland trial from the 2006 through 2010 seasons are shown in **Table 4**. Nonpareil-Nico, Nonpareil-Newell, Nonpareil 3-8-2-70, Nonpareil-Driver, Nonpareil-5 and Nonpareil-7 have had significantly higher cumulative yields than all of the other varieties and selections (**Table 4**). Selection 2-19e, which had some of the highest yields in the early years of the trial had significantly lower cumulative yield compared to all of the Nonpareil clones except Nonpareil 6 and Nonpareil 7 in 2010 (**Table 4**). The replication provided in this trial adds much value to the data compared

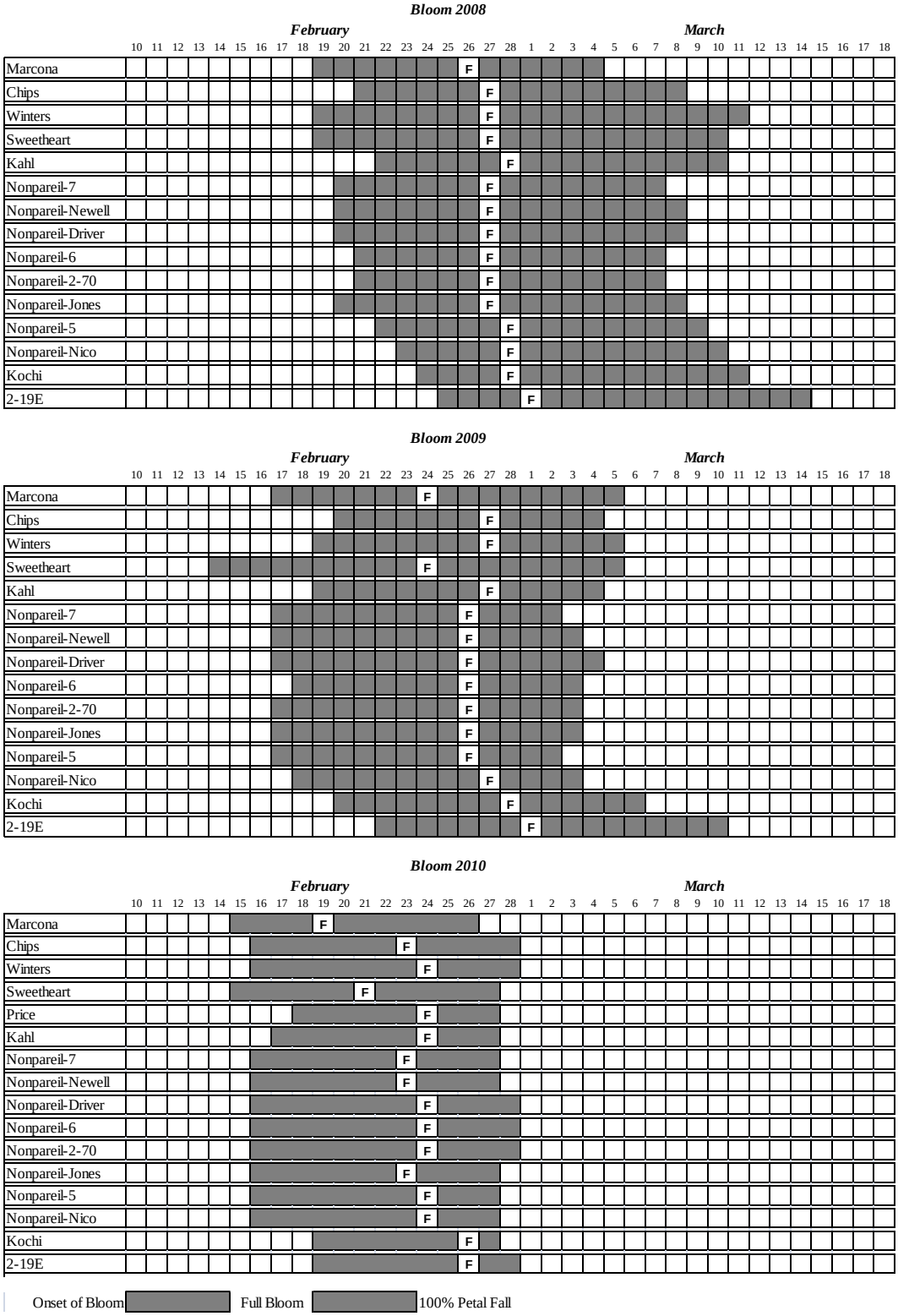
to earlier unreplicated variety trials but it comes at a cost in terms of the time required for maintaining, rating and harvesting the plots.

The yields from this trial continue to be high for the age of the orchard. **Figure 1** shows average yield by orchard age for all varieties, selections and Nonpareil sources for the Butte, Delta and Kern trials planted in 1993 compared to the McFarland trial planted in 2004. The McFarland trial reached an average production of 3000 kernel pounds per acre six years earlier than the 1993 Kern RAVT while neither the Butte nor Delta trials ever reached this level of production (**Figure 1**).

The mobile platform light bar (described in report for Almond Board project titled "Development and Testing of a Mobile Platform for Measuring Canopy Light Interception and Stress in Almond") was used to measure midday canopy light interception in the McFarland trial on July 28-30, 2010. **Table 4** shows the photosythetically active (PAR) interception, yield and yield per unit PAR intercepted (2020 column labeled "unit PAR int.") by variety for the 2010 season. The productivity per unit canopy light interception was quite high for the size of the tree in 2009 (ranging from 52 to 85 kernel pounds per unit light intercepted – data not shown) and was still fairly high in 2010 (ranging from 23 to 51 kernel pounds per unit light intercepted - **Table 4**) since our previous data has suggested somewhere around 50 pounds per unit light intercepted is near the normal maximum for almond. In general, varieties or selections that produced high yield per unit PAR intercepted also produced high yields overall (**Figure 2**). Perhaps this is because the same factors that result in more rapid growth in the tree canopy (as measured by PAR interception) also result in more productivity per unit light intercepted. An additional factor is canopy loss due to hull rot which was particularly pronounced in Kochi.

Acknowledgements
The authors wish to thank the Almond Board of California for their continued support of this project. We also want to thank the Billings Ranches for their excellent cooperation in managing and maintaining this trial.

**Table 1**. Bloom data for the McFarland Trial for the 2008, 2009 and 2010 seasons. Crosshatched area indicates period from onset of bloom to 100% petalfall.




. Chilling hours from November 1, 2009 to February 28, 2010 **1039**

**Table 2.** Onset of hullsplit in 2010 at the McFarland trial.

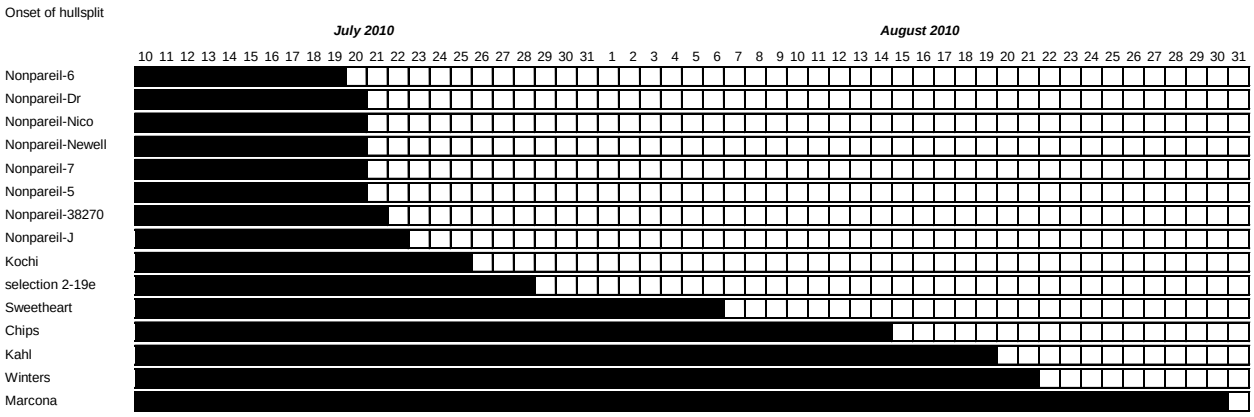



**Table 3.** Scab rating, *Alternaria* rating, and hull rot strikes per tree for the 2010 season at the McFarland trial. Letters indicate significant difference at the 5% level of significance

| | ***Scab Rating*** | | ***Alternaria rating*** | | ***Hull Rot Strikes*** | |
|---|---|---|---|---|---|---|
| selection 2-19e | 0.00 a | Chips | 0.00 a | Kahl | 8.33 a | |
| Chips | 0.00 a | Kahl | 0.00 a | Sweetheart | 11.00 a | |
| Kahl | 0.00 a | Kochi | 0.00 a | Marcona | 13.33 a | |
| Kochi | 0.00 a | Marcona | 0.00 a | selection 2-19e | 18.83 a | |
| Marcona | 0.00 a | Nonpareil 3-8-2-70 | 0.00 a | Price | 23.01 a | |
| Nonpareil 3-8-2-70 | 0.00 a | Nonpareil-5 | 0.00 a | Chips | 24.00 a | |
| Nonpareil-6 | 0.00 a | Nonpareil-6 | 0.00 a | Nonpareil-Nico | 30.67 a | |
| Nonpareil-7 | 0.00 a | Nonpareil-7 | 0.00 a | Nonpareil 3-8-2-70 | 61.33 a | |
| Nonpareil-DR | 0.00 a | Nonpareil-DR | 0.00 a | Nonpareil-J | 62.67 a | |
| Nonpareil-J | 0.00 a | Nonpareil-J | 0.00 a | Nonpareil-5 | 65.17 a | |
| Nonpareil-Newell | 0.00 a | Nonpareil-Newell | 0.00 a | Nonpareil-7 | 72.67 a | |
| Nonpareil-Nico | 0.00 a | Nonpareil-Nico | 0.00 a | Nonpareil-6 | 82.83 a | |
| Price | 0.00 a | Price | 0.00 a | Nonpareil-Newell | 83.67 a | |
| Sweetheart | 0.00 a | selection 2-19e | 0.00 a | Nonpareil-DR | 98.17 a | |
| Nonpareil-5 | 1.00 a | Sweetheart | 0.00 a | Kochi | 262.00 b | |
| Winters | 2.00 b | Winters | 0.00 a | Winters | 539.67 c | |

**Table 4**. Number of nuts per tree, average kernel weight, shelling percentage, kernel pound per acre, cumulative kernel pounds per acre for the 2006 through 2010 seasons at McFarland trial. Data for each year is sorted by cumulative yield.

| 2007 | | | | Kernel pounds per | | Cumulative kernel yield |
|---|---|---|---|---|---|---|
| Variety | No. of nuts/tree | Average kernel wt (g) | Shelling percentage | Tree | Acre | (lbs/acre) |
| 2-19e | 13149 a | 0.78 e | 54.3 d | 22.8 a | 2756 a | 4474 a |
| Winters | 11972 ab | 0.83 de | 60.2 b | 21.8 ab | 2634 ab | 4173 a |
| Nonpareil-Newell | 10659 bc | 0.90 bc | 67.3 a | 20.9 abc | 2536 abc | 3626 b |
| Nonpareil-Nico | 9260 cde | 0.92 bc | 66.0 a | 18.8 abcde | 2279 abcde | 3511 b |
| Nonpareil-Driver | 9793 cd | 0.91 bc | 65.6 a | 19.6 abcd | 2370 abcd | 3474 b |
| Nonpareil-3-8-2-70 | 9340 cde | 0.92 bc | 66.3 a | 18.9 abcde | 2291 abcde | 3393 b |
| Nonpareil-5 | 8905 cdef | 0.95 b | 67.0 a | 18.6 abcde | 2251 bcde | 3323 bc |
| Marcona | 6938 fg | 1.08 a | 29.8 f | 16.5 defg | 1995 defg | 3252 bcd |
| Kahl | 9594 cd | 0.91 bc | 47.6 e | 19.3 abcd | 2332 abcd | 3222 bcd |
| Nonpareil-J | 9137 cde | 0.89 bcd | 65.5 a | 17.8 bcde | 2152 bcdef | 3218 bcd |
| Nonpareil-6 | 8396 def | 0.94 b | 67.1 a | 17.4 def | 2103 def | 3178 bcd |
| Nonpareil-7 | 9517 cd | 0.92 bc | 67.9 a | 19.3 abcd | 2332 abcd | 3140 bcd |
| Chips | 7681 defg | 0.87 cd | 54.4 d | 14.7 efg | 1780 efg | 2766 bcd |
| Kochi | 6006 g | 1.08 a | 59.4 bc | 14.3 fg | 1729 fg | 2694 de |
| Sweetheart | 6767 fg | 0.89 bcd | 66.6 a | 13.1 g | 1588 g | 2165 e |

| 2008 | | | | Kernel pounds per | | Cumulative kernel yield |
|---|---|---|---|---|---|---|
| Variety | No. of nuts/tree | Average kernel wt (g) | Shelling percentage | Tree | Acre | (lbs/acre) |
| 2-19e | 13472 a | 0.93 g | 54.3 d | 27.5 cd | 3321 cd | 7795 a |
| Nonpareil-Nico | 13879 a | 1.10 cd | 66.0 a | 33.5 a | 4056 a | 7567 ab |
| Nonpareil-Newell | 11916 bcd | 1.09 de | 67.3 a | 28.6 cd | 3456 cd | 7110 bc |
| Nonpareil-3-8-2-70 | 12506 bcd | 1.17 cd | 66.3 a | 30.7 b | 3714 b | 7106 bc |
| Nonpareil-Driver | 12729 abc | 1.07 de | 65.6 a | 29.8 bc | 3611 bc | 7085 bc |
| Nonpareil-5 | 12883 ab | 1.08 de | 67.0 a | 30.5 b | 3692 b | 7001 bc |
| Winters | 9872 e | 1.02 | 60.2 b | 22.1 fg | 2670 fg | 6843 c |
| Nonpareil-7 | 13250 ab | 1.06 de | 67.9 a | 31.1 ab | 3763 ab | 6802 c |
| Nonpareil-6 | 10707 de | 1.16 c | 67.1 a | 27.3 cd | 3300 cd | 6478 cd |
| Nonpareil-J | 11071 d | 1.09 cde | 65.5 a | 26.6 de | 3224 de | 6442 cd |
| Kahl | 10720 de | 0.96 fg | 47.6 e | 22.6 fg | 2733 fg | 5954 de |
| Chips | 11465 cd | 0.97 fg | 54.4 d | 24.4 ef | 2956 ef | 5722 e |
| Sweetheart | 13149 ab | 0.82 g | 66.6 a | 23.9 ef | 2893 ef | 5059 f |
| Marcona | 4721 f | 1.39 a | 29.8 f | 14.4 h | 1748 h | 5001 f |
| Kochi | 5882 f | 1.28 b | 59.5 bc | 16.5 h | 2002 h | 4996 f |

| 2009 | | | | Kernel pounds per | | Cumulative kernel yield |
|---|---|---|---|---|---|---|
| Variety | No. of nuts/tree | Average kernel wt (g) | Shelling percentage | Tree | Acre | (lbs/acre) |
| Nonpareil-Nico | 13773 ab | 1.05 bcd | 74.7 ab | 32.9 a | 3977 a | 11417 a |
| Nonpareil-Newell | 14513 a | 1.03 bcd | 74.8 ab | 33.1 a | 4004 a | 11145 ab |
| 2-19e | 14706 a | 0.84 f | 65.6 f | 27.1 c | 3285 c | 11080 ab |
| Nonpareil-Driver | 13856 ab | 1.08 ab | 75.8 a | 32.9 a | 3977 a | 11062 ab |
| Nonpareil-3-8-2-70 | 13756 ab | 1.04 bcd | 74.6 ab | 31.4 ab | 3798 ab | 10905 abc |
| Nonpareil-5 | 12070 bcd | 1.08 ab | 74.2 ab | 28.7 bc | 3476 bc | 10494 bcd |
| Nonpareil-7 | 13051 ab | 1.03 bcd | 72.6 abc | 29.5 bc | 3571 bc | 10393 bcd |
| Nonpareil-6 | 13505 ab | 1.02 bcd | 71.2 cd | 30.3 abc | 3661 abc | 10139 cd |
| Nonpareil-J | 12803 abc | 1.04 bcd | 71.6 bcd | 29.0 bc | 3513 bc | 9955 de |
| Winters | 9434 ef | 0.96 bcde | 61.6 g | 20.0 e | 2415 e | 9258 ef |
| Kahl | 11035 cde | 0.87 ef | 59.1 g | 21.1 de | 2559 de | 8513 fg |
| Chips | 9771 ef | 0.93 def | 58.6 g | 20.0 e | 2422 e | 8144 gh |
| Sweetheart | 12798 abc | 0.85 ef | 73.3 abc | 24.0 d | 2906 d | 7965 gh |
| Marcona | 8977 fg | 1.07 abc | 32.5 | 21.2 de | 2562 de | 7563 hi |
| Kochi | 7252 g | 1.17 a | 68.9 de | 18.7 e | 2259 e | 6955 i |

| 2010 | | | Shelling | Kernel pounds per | | | Cumulative kernel |
|---|---|---|---|---|---|---|---|
| Variety | No. of nuts/tree | Average kernel wt (g) | percentage | unit PAR int. | Tree | Acre | yield (lbs/acre) |
| Nonpareil-Nico | 9521.8 abc | 1.24 abcdef | 72.5 ab | 49.7 ab | 25.9 ab | 3141 ab | 14558 a |
| Nonpareil-Newell | 8429.4 cde | 1.31 ab | 73.6 a | 45.2 abc | 24.2 ab | 2931 ab | 14099 ab |
| Nonpareil-3-8-2-70 | 8823.4 bcd | 1.28 abcd | 72.3 ab | 47.0 ab | 24.8 ab | 3011 ab | 13915 abc |
| Nonpareil-Driver | 8368.2 cde | 1.28 abcd | 71.0 ab | 46.2 abc | 23.5 ab | 2849 ab | 13910 abc |
| Nonpareil-5 | 9410.2 abc | 1.24 abcde | 72.3 ab | 50.8 a | 25.8 ab | 3130 ab | 13579 abc |
| Nonpareil-7 | 10611.8 ab | 1.16 bcdef | 69.8 ab | 49.4 ab | 27.1 a | 3282 a | 13510 abc |
| Nonpareil-6 | 9498.9 abc | 1.21 abcdef | 71.8 ab | 48.7 ab | 25.4 ab | 3081 ab | 13219 bc |
| 2-19e | 6832.8 efg | 1.10 bcdef | 56.1 e | 33.7 e | 16.6 cd | 2020 cd | 13100 bc |
| Nonpareil-Jones | 8314.7 cde | 1.23 abcdef | 70.9 ab | 43.8 abcd | 22.6 b | 2737 b | 12691 c |
| Winters | 6601.3 efg | 1.11 bcdef | 60.7 cde | 38.5 cde | 16.0 de | 1945 cd | 11203 d |
| Chips | 9089.0 abc | 1.15 bcdef | 65.9 abc | 48.4 ab | 23.0 b | 2789 b | 10933 d |
| Sweetheart | 10915.5 a | 0.80 g | 71.8 ab | 42.1 bcd | 19.3 ab | 2803 ab | 10768 de |
| Kahl | 7587.0 cde | 1.01 f | 56.5 de | 43.4 abcd | 16.9 c | 2048 c | 10561 de |
| Marcona | 5072.7 gh | 1.28 abc | 26.2 | 36.7 de | 14.4 cde | 1745 cde | 9307 fg |
| Kochi | 3902.2 h | 1.40 a | 64.4 bcd | 23.5 f | 12.1 e | 1466 e | 8421 g |

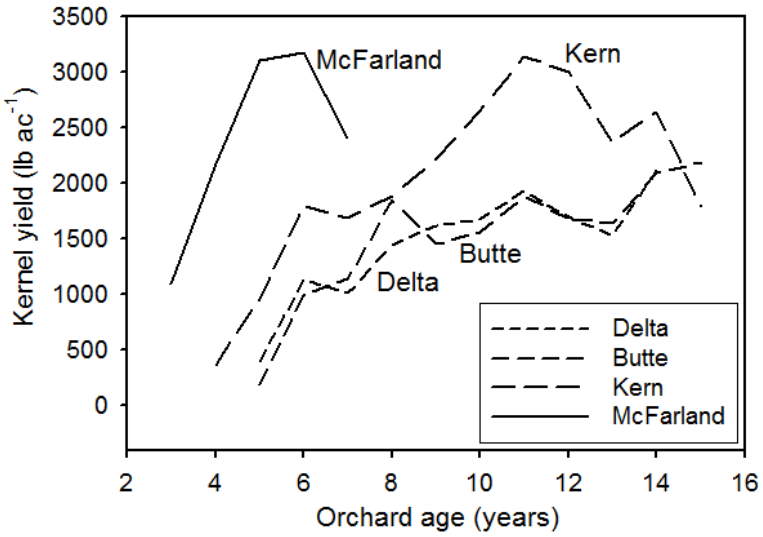



**Figure 1.** Average yield for all varieties, selections and Nonpareil sources by orchard age for the 1993 Butte, Delta and Kern Regional Variety Trials as well as the McFarland variety trial that was planted in 2004.

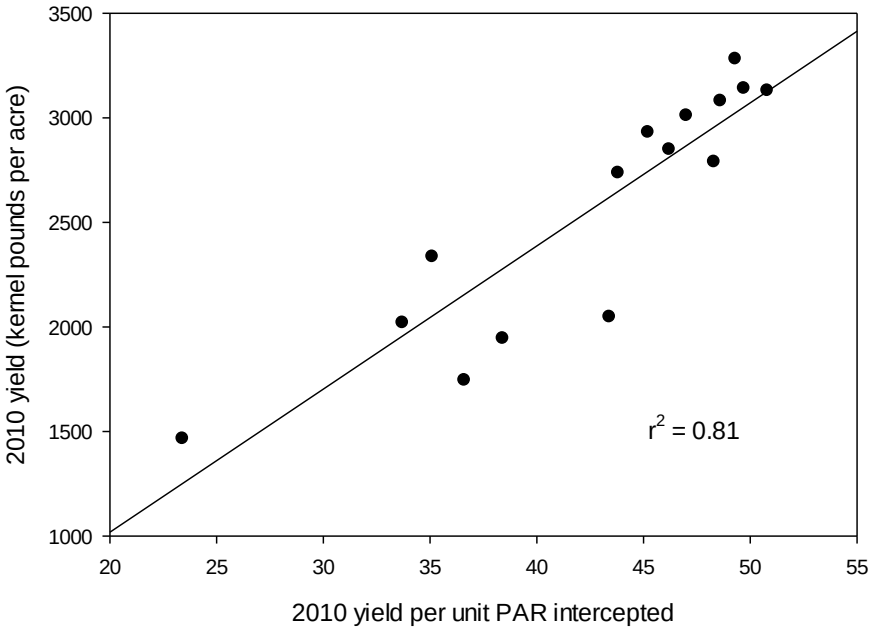



**Figure 2.** Yield per unit photosynthetically active radiation intercepted versus variety yield at McFarland trial.