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Increase of Piñon Nut Size by Basal Pruning[1]

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Additional index words. Pinus edulis, edible nuts

Abstract. **Basal pruning of piñon pine (*Pinus edulis* Engelm.) stems to a 1.5 m. height markedly increased nut size and percent full nuts but not percent kernel (weight of kernel/weight of nut x 100).**

Piñon pine occurs upon about 23 million ha in the "Four Corner" states of New Mexico, Colorado, Utah and Arizona (1). A principal species in piñon-juniper woodlands, piñon provides multiple products including fuel wood, Christmas trees and edible nuts (3). The value of these products continues to rise, especially fuel wood. Past reference to piñon-juniper woodlands as "non-commercial" has been justly criticized (4) and many scientists are concerned with imprudent woodland removal. Coordination of operations to optimize multiple product outputs has been recommended (3) and there is a growing interest in simple methods that can be imposed over large areas to increase amounts and values of products. The purpose of this study was to evaluate basal pruning as a technique for stimulating nut production.

Yields of piñon nuts have been estimated at 336 kg per ha. Nuts are rich in protein, fat, and carbohydrates and (2, 6) and retail for $10 per kg. Commercial exploitation and marketing are highly unorganized since crops are erratic and little is known about production processes that might stabilize yields.

It may be possible to artificially stimulate nut production through insect control or cultural practices such as irrigation, fertilization or pruning. Fertilization (5, 7), especially with nitrogen and irrigation have stimulated seed production in tree improvement seed orchards. Branch pruning, widely used in horticultural crops, increased ovulate cone production in slash pine (9) but has received limited application in forestry. We are unaware of attempts to stimulate cone production through basal pruning on piñon, although this has been prescribed for reduction of disease and insect injury (8).

Piñon trees are usually scattered and widely spaced in orchard-like, multi-aged stands. Nut bearing may begin at about 25 years, but does not become reliably abundant until 75 to 100 years. Cones are generally borne laterally in the axil of a scale leaf near branch tips.

Ovulate cone primordia can be seen in winter buds in September and emerge from buds the following May or June when pollination occurs. Cone enlargement ceases in late August, resumes in May and is completed by July. Cones are mature in September and seeds begin to fall in October marking the end of a seed development process lasting more than two years.

In this study, basal branches of 70 to 80-year old piñon were pruned up to 1.5 m (Fig. 1) in October to determine pruning effects on seed development. Ovulate primordia development was completed in September prior to pruning. The study included 10 randomly selected pruned trees paired with 10 adjacent control trees. The study was conducted in northern New Mexico on a site with a gently to moderate southwest slope and deep clay loam soil.

Nuts were harvested 2 years following treatment and were air-dried at 20°C for 15 days. Three 50-g samples were taken from nuts collected from pruned and control trees to determine the size and number. Fifty-nut samples were taken to determine the percentage of nuts containing kernels. Percent kernel (weight of kernel/weight of nut x 100) was calculated from this data. Data were analyzed according to Students *t*-test for paired observations.

Fig. 1. Basal pruned (left) and unpruned (right) trees of piñon pine.

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Pruned trees consistently produced larger and heavier nuts (Table 1 and Fig. 2). Average nut volumes from pruned and unpruned trees were 0.40 and 0.32 cm^3, and the average nut weights were 0.33 and 0.20 g respectively. Percent kernel was nearly the same and percent full nuts was much greater for nuts coming from pruned trees as compared to nuts from unpruned trees. Unauthorized harvesting precluded accurate determination of seed yield. However, it is doubtful that seed number was affected since primodia were initiated prior to pruning.

Basal pruning may prove to be a valuable technique for stimulating quality of piñon nut production due to an increase in nut size and decreased percentage of poor nuts. Fewer empty nuts and increased weight will reduce labor investment per unit weight of harvested seed.

Basal pruning will spare cone bearing branches in the upper crown and will remove lower branches likely to be net consumers rather than producers of energy. Pruning can be easily combined with other operations such as Christmas tree harvest and thinning or fuel wood cutting.

Table 1. Effect of pruning treatment on weight, percentage kernel and percentage filling of piñon nuts.

Treatment	Avg nut wt (g/nut)	Kernel[z] (%)	Full nuts[z] (%)
Unpruned	0.20	55	84
Pruned	0.33**	54	99**

[z]Based on 50 nut sample.

**Significantly different from unpruned at 1% level.

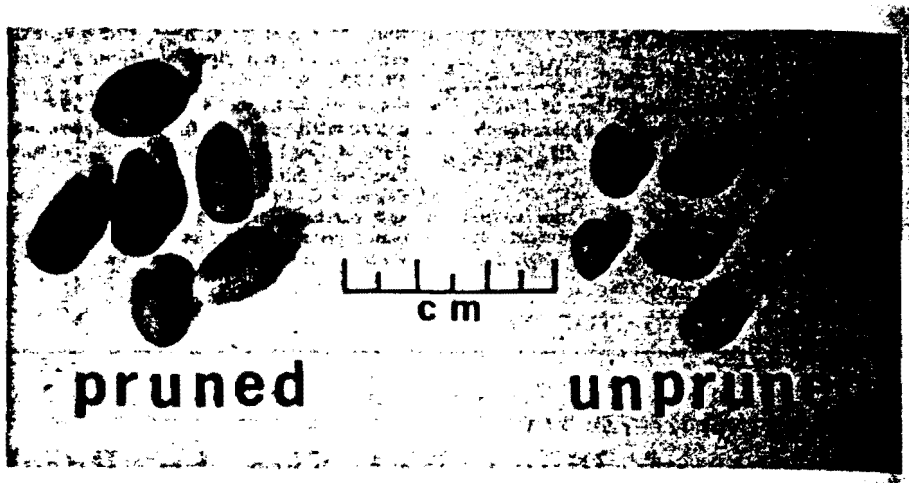

Fig. 2. Nut sizes from purned and unpruned piñon trees.

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Identification of Nucellar and Zygotic Seedlings of *Citrus* with Leaf Isozymes[1]

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Abstract. **The distinction between apomictic nucellar and zygotic 5-month-old seedlings of *Citrus* was made using two genetically defined isozyme markers: phosphoglucose isomerase and phosphoglucose mutase. Of 123 seedlings of attempted crosses of 'King' (seed parent) x 'Parsons Special', 18 had the 'King' genotype and were therefore nucellars. Segregation ratios for both markers were as expected among the zygotics.**

Several economically important species of *Citrus* either produce asexual nucellar embryos exclusively or a polyembryonic mixture of nucellar and recombinant sexual embryos (3). One of the major problems in citrus breeding is to distinguish between these while the seedlings are young (ca. 2 months). Nucellar gene combinations are already available in the seed parent and resources spent growing plants with them could be saved with early identification. Other workers (1, 2, 4, 5) have examined various biochemical characteristics in attempts to determine the genetic origin of seedling populations prior to fruiting (ca. 5 years).

Torres et al. (6) proposed that some isozymes would provide excellent single gene markers because they are colinear with the gene, codominant, little affected by the environment and are identical in leaves of young and mature plants of the same cultivated variety. The rationale for using isozymes for addressing the problem and the electrophoretic techniques were noted. The genetic control of 3 enzyme systems coded by 4 genes with 12 codominant alleles was analyzed in citrus and near relatives. Among the variable isozyme systems were phosphoglucose isomerase (PGI) and phosphoglucose mutase (PGM). The former is specified by the gene *Pgi-1* and the latter by *Pgm*. For each enzyme, *F* is used to specify a fast migrating subunit, *S* a slow migrating subunit and *I* an intermediate one. The *W* subunit for *Pgi-1* was named for the cultivar 'Willial' in which it was first

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