QUANDONG

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Newsletter of WANS the West Australian Nutgrowing Society

NEXT MEETING WEDNESDAY MAY 27 , 1981

SUBIACO LIBRARY MEETING ROOM
(Cnr Rokeby Road and Bagot Road, Subiaco)

AT 7.30 P.M.

Talk on Tissue Culture

The next meeting of the Society will feature a talk on "TISSUE CULTURE PROPAGATION OF NUT, FRUIT AND TIMBER TREES" given by Dr Jennie McComb of Murdoch University. This is an extremely important topic.

Tissue Culture propagation is going to revolutionise the horticultural world. It is especially important for nut and fruit crops. The method depends on culturing or growing a small piece of plant in a sterile medium such as agar gel to form a complete plant. Only a small clump of cells is needed, so a piece of a selected plant can be rapidly multiplied into an enormous number of similar ones, if the right culture conditions can be established.

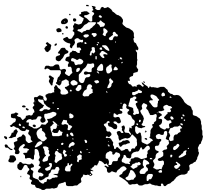
Each of the new plants is genetically identical to the original, and so is the equivalent of a cutting-grown plant or a grafted variey. The method can also be used to propagate plants which cannot be grafted or grown from cuttings, like the coconut, and so have not previously had any clonal selections.

The method is also very important for imported selected varieties of nuts and fruits. Trees or budwood from overseas is subject to extended quarantine and is only permitted in the absolute minimun amount for further propagation. Sterile tissue cultures of the same plants are allowed in in quantity for growing on and distribution, as they do not have the same dangers of importing diseases and pests.

The method is essentially a low-cost one, which for the first time may also economic clonal propagation of timber trees, for which grafting is far too expensive. It also allows re-establishment of rare and threatened species which may seldom set seed.

David Noel

MEETING DATES: August 26, 1981
November 25, 1981



West Australian Nutgrowing Society

WANS

Mail Address: P.O. Box 27, Subiaco, W.A. 6008, Australia.

BOARD OF DIRECTORS

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Nutrition	Alex Sas, 52 Croydon Road, Roleystone, 6111 397 5628
Seed & Tree Supply	Milan Mirkovic, P.O. Box 69, West Perth, 6005
Walnut	Tom Speer, P.O. Box 71, Bridgetown,6225 (097)61 1713

SOCIETY PUBLICATIONS

WANS publishes its newsletter QUANDONG four times a year. This is devoted to news of meetings and events, details of tree and seed sources, notes about books and pamphlets dealing with nuts,reprinted short articles, notes from members, and other items of interest.The major publication is the annual WANS YEARBOOK, which contains articles drawn from Australia and overseas, covering any aspect of nut horticulture and production, and is regarded as an important research journal in this area. Members receive one copy of each WANS publication as a subscription benefit. YEARBOOK EDITOR, Mr Peter Good. QUANDONG EDITOR Mr Tony Bryant, P.O. Box 98, Gosnells, W.A. 6110, 459 2449. BACK NUMBERS, WANS began publishing in 1975. Back numbers of publications are still available. Some issues of QUANDONG are available only in photocopy form. Cost of each YEARBOOK is $6.00; cost of one year set of QUANDONG(3 or4 issues) is $2.00. Contact the Secretary for back numbers.

MEMBERSHIP

Any person or organisation interested in growing or production of nuts may subscribe for membership. Members are welcomed from outside Western Australia and overseas, as well as in W.A. Write to P.O. Box 27, Subiaco, W.A. ,6008. The current membership subscription rate, which runs for a calender year and covers all publications issued in that year is $10.00.

IMPORTANT CHANGES IN THE OFFING: FORMAL RESOLUTION

At the last meeting, following on suggestions from a number of members, I raised the proposal of extending the scope of the Society to cover other useful fruits and tree crops such as the avocado, honey locust and cherimoer, and at the same time amend the name of our organisation. Members present were generally in favour.

Accordingly, a formal motion will be presented at the next meeting, in two parts:

1. That the scope of our activities be extended to include tree crops generally, with the emphasis remaining, however, on nut plants;
2. That the name of our organisation be amended to

THE WEST AUSTRALIAN NUT AND TREE CROP ASSOCIATION

A simple majority of members present at the meeting is sufficient to enable either of these resolutions to take effect. Therefore, if you feel strongly about either of these changes, and cannot be present at the meeting, you should write immediately to the Secretary so that your views can be taken into account.

It is hoped that the first change will foster a renewed growth in our membership, which has recently become static or even declined, in marked contrast to earlier years. We need to maintain a membership level of around 400-500 to cover the continually increasing costs of our publications, and we are currently below this level. The costs of assembling,editing, setting up, and printing the Yearbook, for example, aremuch the same whether 10 or 1000 copies are made.

It is hoped that the record change, and in particular, the use of the word "Association" in our title, will enable us to attract much more official and professional support, so that we can truly begin to represent the industry in the eyes of Government and others and qualify for such things as fruit-growers assistance and levies. It has been suggested that the word "Society" has too academic a ring to outsiders, and could discourage active producers of tree crops. The word "Association" is more neutral and more generally acceptable for a body of people representing an activity in the agricultural area.

DAVID NOEL

SUBSCRIPTIONS ARE ALSO NOW OVERDUE.

TO RECEIVE THE NEXT ISSUE OF QUANDONG THESE MUST BE PAID NOW

TO B BRYANT
SECRETARY
P.O Box 98,
GOSNELLS WA 6110.

REPEAT OF NURSERY NOTES.

by
DAVID NOEL*

(Reprint from West Australian Nutgrowing Society Yearbook 1976)

Anyone interested, as I am, in a wide range of exotic and little-known nut plants, will soon find that most of the more interesting plants cannot be bought from any local nurseryman perhaps not from any commercial source in Australia. Their only course then is to obtain seed or other propagation material, and grow from that.

During the past eight years I have gained a fair amount of experience in the nursery production of nut plants. My nursery was originally started for my own use exclusively, but in recognition of the difficulty in obtaining nut plants, in recent years I have sold quite a lot to WANS members and others.

The raising of nut plants is frequently quite different to the raising of other plants commonly sold in garden centres. I have no desire to compete with the commercial nurserymen, but it has been my experience that very few of these have the incentive or inclination to master these differences, in view of the small market compared with decorative plants, and the considerable skill and difficulties invloved.

In what follows I describe current practices in my nursery, evolved through experience of every sort, from blind trial and error through to testing of techniques described elsewhere. Most relates to raising nut plants from seed.

CONTAINERS. One obvious factor with nuts is that the seeds are much larger than the general run of seeds. A consequence of this is that the seed has within it enough food to develop a considerable root and stem system before leaves appear. Conventional small plastic seed trays and pots are comparatively useless with nuts. A pecan nut, for example, may have a root 50cm down in the ground before anything appears above surface.

My practice is to sow almost all nuts in sections of black plastic tubing, about 30cm deep and the same across, secured atthe bottom with a piece of packaging tape. This tubing or sleeving is sold by weight by a number of plastics firms, and is used to make the conventional plant bags in which bigger items are sold at nurseries. It is usually gussetted, that is with the sides folded in like two letter M's joined at their feet, and must be black- any other colour deteriorates too quickly in the sunlight.

In these large plastic tubes I plant 10 to 50 seeds, depending on their size and germination percentage expected, and grow on the resulting plants for as long as a year or more. The plants are then potted out into individual plastic tubes of similar depth, but only about 15cm across. The plants grow on in these until ready for their final planting.

These tubes have many advantages for nut trees. The tube bottom discourages formation of very long tap roots, and what roots do grow out can be trimmed of easily. Both these factors encourage side root formation, an essential for later transplanting success. Nut trees for many years had a bad reputation for transplanting, because they were field-grown and had long tap roots and no fibrous side roots. When these trees were dug for sale, most of the active root system was cut off, and the trees had a low survival rate.

The actual planting operation is very easy with these tubes. The hole is dug and prepared to the correct depth. The piece of securing tape is pulled off the bottom of the tube (if not already rotted) and the tree and tube put in the hole. If the soil in the tube is wetted, it is then possible to pull the tube up, over the top of the tree, without exposing the roots or disturbing them at all. The tube has no drainage holes for the roots to get caught in, as happens with ordinary plastic plant bags. The one disadvantage is that the tube must be supported underneath if it is moved, or it may decide to do its own transplanting before you are ready!

SOIL MIX. I usually make my own soil mix, consisting of one part by volume of red eucalypt (jarrah) sawdust, one part of sewage farm sludge, and two parts of yellow sand. This has proved very successful, apparently having the right combination of drainage characteristics, moisture retention, nutrient value, and low cost. Drainage is very important with container-grown stock, and for this reason the securing tape at the bottom of the tube must be short enough (about 6cm) to permit drainage through the folds of the plastic.

GERMINATION. Another special characteristic of nut seeds is that they often have thick shells and require special treatment for good germination. Even under ideal conditions, germination can take a long time, in some cases several years! Moreover, each sort of nut tends to have its own special conditions, so it is difficult to generalise. The following rules are therefore only guidelines.

OILY TEMPERATE NUTS (walnut, pecan. hazel, stone-pine): these are usually much improved by stratification (see below) for 4-12 weeks, normally in a dry sealed plastic bag.

STARCHY TEMPERATE NUTS (chestnuts, bunya pine, acorns): these must not be allowed to dry out. Either plant immediately, or stratify in damp peatmoss or sawdust in a plastic bag.

TROPICAL NUTS (brazil, pili, coconut, kenari): pack in individual clear plastic bags, in damp peat moss, and keep in a warm place. Check periodically and plant out as soon as they shoot, else they tend to rot.

ARID-ORIGIN NUTS. (pistachio, jojoba, almond): very liable to fungal attack. Containers must have good drainage. Dust seeds with fungicide. Sow in spring or summer, so plants get established before cold weather arrive.

RAIN-FOREST NUTS (macadamia, hicksbeachia): sow in container filled with moisture-retaining mix (much saedust,peat,etc.), leave container in shallow tray so it is usually standing in some water.

STRATIFICATIONOriginally meant conditioning layers of seeds in a pit or cellar, covered with soil or straw, througha frosty or snowy winter. Now usually means storing in the refrigerator in a plastic bag, but not usually in the freezer compartment.

SHADE. In the hot dry West Australian summers, some shading is essential for raising most nut plants. Most are naturally forest plants, and would be shaded by mature trees when young. I have a large shade area with a wire roof which I cover with hessian in thesummer. This only lasts one summer. Plastic shadecloth, e.g. Sarlon, would be a more permanent, if dearer, alternative.

OSMOCOTE. I have had good results from almost all plants by adding a teaspoon of 280-day Osmocote to each plant at the time of potting into individual plastic bags.

OTHER PLANT METHODS. Very few nut plants can be grown from stem or leaf cuttings except under highly specialised conditions (intermittent mist, rooting agents). However, some (pecan, chestnut) can be grown from root cuttings. Hazel and chestnut can be grown from layers (bending branches over into the ground and pegging down till they root). Many difficult tropicals (macadamia,cashew) can be reproduced by marcotting or air-layering (holding peat or soil around a branch till roots form). All these methods have the advantage that they are vegetative,so that the parent variety is retained in the new plant (with root cuttings, it is the root variety which is propagated,of course).

BUDDING AND GRAFTING. This is a very comples business. For more detail, consult one of the books listed below. Nut trees are often difficult graft subjects.Almonds are easy. Macadamias and some others require highly specialized techniques. Grafting is a very satisfying techniques to master, but it comes only through practice.

LITERATURE CITED

1. Hartmann, H.T.:- "Plant propagation, principles and practices". Prentice-Hall, Englewood Cliffs, N.J.:1968
2. Garner, R.J.:- "The grafter's handbook". Faber; London 1967

Here is an interesting letter from a new member.

West Australian Nut Growing Society
SUBIACO - Western Australia

Dear Sir,

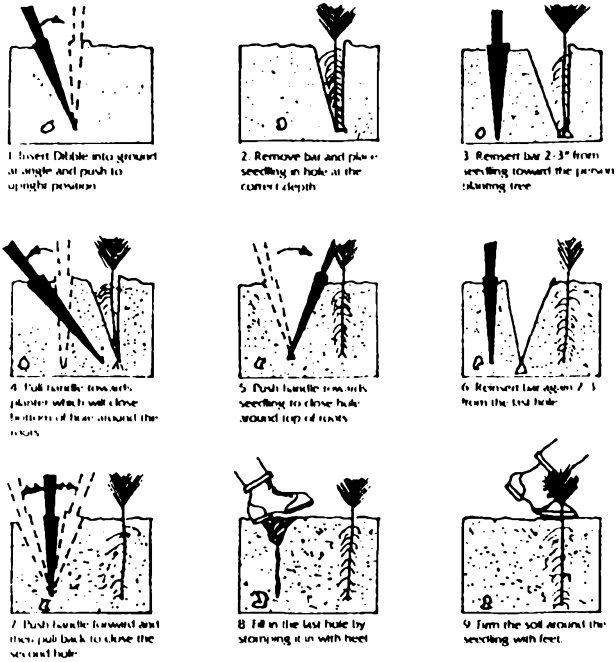
Having read your excellent yearbook and magazine for some time at our departmental library, I thought it about time to apply for membership myself. As a Horticultural Research Officer of the Department of Agriculture, Victoria I have in recent tears been concerned with nut trees and am now in charge of our nut tree planting (walnuts, chestnuts, hazelnuts, macadamias and pecans) at the Knoxfield H R I as well as a newly established nut arboretum at Toolangi. In my capacity as horticultural advisor I give advice to many prospective nut growers and am currently running three fertiliser experiments on nut trees.

One of these trials, on walnuts and chestnuts has been established for 5 years and is now yielding useful results.

Be assured that your pioneering work in this field is appreciated here.

Yours Sincerely
Paul Baxter, M. Agric. Sc.

PLANTING WITH A DIBBLE BAR



1. Insert Dibble into ground at angle and push to upright position

2. Remove bar and place seedling in hole at the correct depth

3. Reinsert bar 2-3" from seedling toward the nearest planting tree

4. Pull handle towards planter which will close bottom of hole around the roots

5. Push handle towards seedling to close hole around top of roots

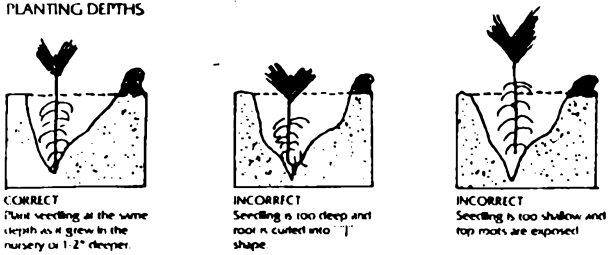
6. Reinsert bar again 2-3 from the last hole

7. Push handle forward and then pull back to close the second hole

8. Fill in the last hole by stomping it in with heel

9. Firm the soil around the seedling with feet.

CORRECT AND INCORRECT PLANTING DEPTHS



CORRECT
Plant seedling at the same depth as it grew in the nursery or 1-2" deeper.

INCORRECT
Seedling is too deep and root is curled into "J" shape

INCORRECT
Seedling is too shallow and top roots are exposed

GENERAL GUIDE FOR PLANTING BAREFOOT TREES AND SHRUBS

(1) Keep plant roots moist at all times. Store in cool place until you are ready to plant

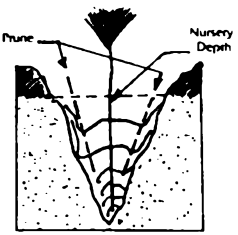
(2) The plant should be planted at the same depth as it grew in the nursery. Look for ground line coloration change above the root collar. This could be several inches above where the side roots start, depending on tree species.

(3) The hole must be dug larger and deeper than the roots stick out so the roots can go down and out without curling. Very long roots should be pruned rather than curled.

(4) Fill dirt loosely around roots. Then add water to the hole until it is about ¾ filled.

(5) Finish filling the hole with soil and pack firmly to eliminate air pockets.

In Forestry plantings, where water is not readily available, make a special effort to ensure that no air pockets remain around the roots by firmly pressing the soil around the tree.



MEMBERS CORNER

FIELD DAY APRIL 12, 1981

Though attendance was small a most interesting day was had by all. Caroline Clark showed us trees which had all been planted five to six years. They had just been placed in the ground and given no special treatment at all. Some had progressed very slowly, others such as a hazelnut and bunya pine are doing very well.

After lunch we went to Alex Sas' where besides showing us his trees which as Alex stated he has planted more to obtain scion wood than nuts, we were given an excellent demonstration on green budding and saw the successful results of Alex' work.

Our thanks to both members for their time given in providing a most informative day.

RESIGNATIONS

Mr Paul Sinclair has resigned as Vice President and Mr Alex Sas has been co-opted to serve the remainder of his term.

Mr Tim Lynn-Robinson has resigned as tree supply officer and Milan Mirkovic has agreed to fill this position.

We would like to thank both these Officers for the time they have given to the Society over the years in filling these important positions. A great deal of excellent work has been carried out for our Society by you both.

PLEASE NOTE THE FOLLOWING:

PLANTING AT SUBIACO NUT CARYETUM ----------BUSY BEE

SATURDAY MAY 9, 1981 at 10.00 a.m.

The Subiaco City Council has donated 100 trees for shade and shelter to the caryetum. They will dig the holes for us however we have to plant them. These trees will be quick growing and will be vital to the successful establishment of our nut trees at a later date.

In order to put thesein the groud a BUSY BEE has been arranged for Saturday May 9, 1981. The more people who can assist the less time it will take. ALL YOU NEED BRING IS A SPADE.

Meeting Time:- 10.00 a.m. Saturday May 9, 1981
Meeting Place:- Cliff Sadlier V.C. Memorial Park (Daglish Basin)
Cnr Chubb Ave and Northmore St, Daglish

CONFERENCE

More in later issues however work is also being carried out towards organising a Conference in May 1982.

RECIPES

HONEY WALNUTS

(Source:- The Australian Women's Weekly Chinese Cooking Class Cookbook)

250g (8oz) walnut halves
3/4 cup honey
1 tablespoon lemon juice
1 teaspoon soy sauce
Castor sugar

1. Combine honey, lemon juice and soy sauce, add walnuts, mix well. Allow to stand two hours, stirring occasionally.
2. Drain walnuts, toss in castor sugar, coating well
3. Put walnuts in enough hot oil to just cover, cook until just golden. Remove walnuts from pan, drain well. These are delicious to serve with drinks or after dinner coffee.

PACIFIC COAST TUNA SALAD

(Source:- A Treasury of Prize Winning Filbert Recipes)

(Makes 4-6 servings)

½ cup lime juice
½ cup salad or olive oil
1 tsp chopped parsley
1 tsp salt
Dash white pepper
1 medium head lettuce
2 cans (about 7oz each) solid-packed tuna drained
2 fully ripe* avocadoes, peeled and sliced
2 medium oranges, peeled and sectioned
Chopped filberts.

Combine lime juice, oil, parsley, salt and pepper; refrigerate. Line salad bowl with lettuce leaves. Place tuna in centre; arrange avocadoes and oranges around tuna. Sprinkle with nuts and serve with lime dressing.

*Buy fully ripe or ripen at room temperature until soft to the touch.

W.A.N.S.C.O.

ANNUAL GENERAL MEETING HELD ON FEBRUARY 25, 1981

Points from Meeting

1. As per notice of meeting resolutions 1 and 2 were passed unanimously.

2. At present Co-operative has cash as Building Society of $673.00.

3. Co-operative has been placed in hibernation. Should any member have any ideas how the Co-operative could be utilised please contact the Chairman, Mr David Noel.

Nut Harvester for Small Orchards[1]

DONALD L. PETERSON and GORDON E. MONROE,
Agricultural Engineers, USDA-SEA-AR Southern Region,
Fruit and Tree Nut Research Laboratory, Byron, Georgia

A pecan pick-up harvester was developed that will be economical for use in many of the 6600 farms which have 5 to 25 acres of pecans. With only slight modification it should also work in small orchards of Chinese chestnuts, filberts, hickory nuts, walnuts, and other nuts the size of pecans or larger. Nut growers with small acreages cannot afford existing commercial harvesters and must resort to hand labor for harvest. A harvester for small farm operators was developed in Israel (Sarig, 1973), but will only pick up nuts that are in a windrow or pile. A small fruit and nut harvester was developed in California (Fridley et al. 1959) but required extensive land preparation and had no cleaning ability.

Objective and Design Requirements

The objective of our research was to develop a mechanical ground pick-up harvester that would be economical for a small-pecan-farm operator. Specific design requirements were:

1) The harvester be mounted on and operated by a small garden size tractor (10 to 16 hp).
2) A simple principle be used for pick-up of pecans distributed over a 40 inch width.
3) A trash removal system be incorporated for removal of dirt, leaves, and other trash.
4) A containerizing system be mounted on the tractor.
5) The harvester be able to be used on either individual trees or tree rows.

Machine Design

Any harvester costs more if it is designed to be self-propelled. To reduce cost, our harvester was designed to be mounted, with a minimum amount of time and effort, on a garden size tractor (10 to 16 hp), (Figures 1 and 2). Many small growers already own such tractors. Those that do not could justify the initial investment for the tractor not only for harvesting, but also for orchard maintenance.

The pick-up principle used was a rubber-fingered screw (Figure 2) that would sweep the nuts and other material along the ground to the end of the screw and then up an inclined surface to an elevating conveyor (Figure 3). The rubber-fingered screw has been used successfully in a sweeper-windrower and a pick-up unit for tung fruits (Jezek et al., 1969) and in a pecan sweeper-windrower (Sarig et al., 1974). Rubber fingers had been used in an earlier pecan harvester (Whitney et al., 1966), but only to give initial acceleration into a conveying air stream.

[1]From an article entitled "Pecan Harvester for Small-Farm Operators", in the Transactions of ASAE (Vol. 20, No. 5, pp. 833-835, 1977).

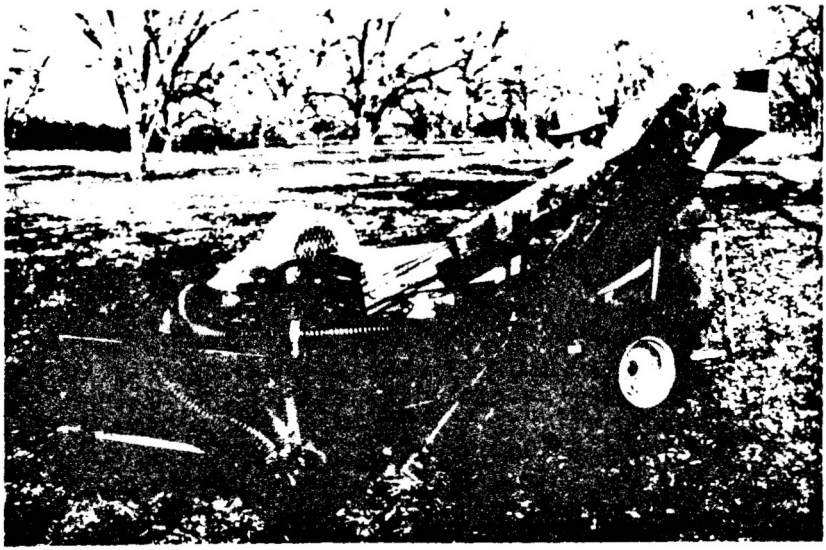


FIGURE 1.—Tractor-mounted pecan harvester.

The support framework for the screw and elevator of our harvester was attached to a piece of 1.9 inch pipe which was free to pivot in two support bearings (Figure 2). The support bearings were bolted to the underframe of the tractor. A counterbalancing spring was linked

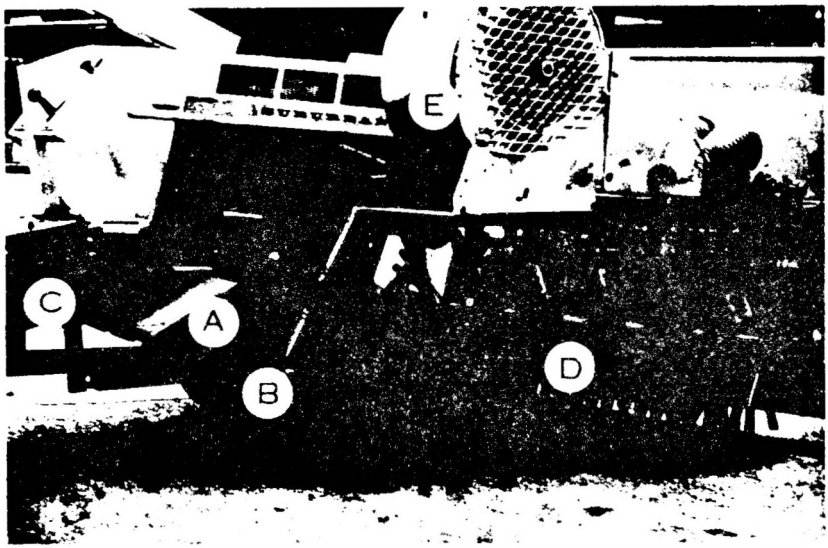


FIGURE 2.—Components of pick-up harvester. A) Mounting brackets with support bearing. B) Frame support pipe. C) Lift linkage. D) Rubber finger screw. E) Trash removal fan.

to the pipe to allow the screw and the shoe under the elevator to float on the ground. This type of mounting could easily be adapted to any model garden tractor.

Power to drive the harvester was transmitted by a v-belt from the engine drive shaft to a jackshaft on the screw support framework. The jackshaft then supplied power to the fan, screw, and elevator. Special linkage that enabled the screw and elevator to be raised to a transport position also automatically disengaged power to the jackshaft as the screw was raised. Transmitting power to the jackshaft would require design changes for different model tractors.

The rubber-fingered screw was 4 feet long and had an outside diameter of 22 inches. This screw had a 28 inch pitch and four spirals with 48 fingers per spiral. Each rubber finger was 5 inches long and was ⅞ inch in diameter at one end and 1 inch in diameter at the base. Longer, more flexible fingers were tried, but were not aggressive enough to sweep nuts along the ground. The end of the screw was tapered for 6 inches to transfer material up the incline from the ground onto the elevator.

Preliminary testing showed that the angle formed by the screw and the line of direction of travel should be between 65 and 70 degrees to allow for good material movement to the left and to still maximize the effective sweep width. A 69-degree angle was selected since it gave an effective sweep width of 40 inches.

After the nuts and trash were swept along the ground they were augered up an inclined surface onto an elevator (Figure 3). Initially, rubber fingers were used on this tapered section of the screw to make the transfer up the incline, but a continuous tapered piece of ⅜ inch thick rubber belting proved to be more effective. The transfer surface was basically a flat inclined plane with an additional curved sheetmetal surface fitted to match the shape of the tapered screw.

As the picked-up material is swept off the transfer area onto the elevator, air is forced through this material to initially separate light trash from the nuts. Flights attached to the roller chain carry the nuts upward. One-quarter inch holes in the steel under the flights allow soil to fall to the ground. At the top of the elevator, the nuts pass through an additional airstream before dropping into a burlap bag mounted at the rear of the tractor. A stick removal device was not incorporated into the harvester because of cost and weight limitations.

Tests conducted during the 1975 pecan harvest season revealed two problems when operations were conducted in heavy trash conditions: (a) some leaves and nuts were carried over the top of the screw as trash built up in front of the screw, and (b) sticks and leaves piled up and plugged the lower elevator section. A row of 10-inch long flexible rubber fingers was positioned along the screw to help minimize the material being carried over the top of the screw (Figure 3). The fingers extended about 6 inches into the screw and were perpendicular to its center axis. A device was also designed and incorporated on the harvester to prevent build-up of trash in the lower ele-

vator section. It consisted of two rubber hoses, 180 degrees apart, that were rotated at 1 revolution per second (Figure 3). A sweeping action resulted that cleared out any piling of trash and sticks.

Field Evaluation

Preliminary field testing during 1975 gave encouraging signs that the harvester, with some modifications, could be an effective unit for gathering pecans from the ground. Modifications, as described above, were incorporated into the harvester, and field tests were conducted in 1976 to find optimum harvest parameters. Two ground speeds of ¾ and 1½ mph, and two screw rotational speeds, 1.17 and 0.88 revolutions per second were tested. Trees were harvested both individually and in rows of three. Before ground harvest, trees were shaken with a commercial tree shaker. An area approximately 3 feet wide was raked clean around the tree trunk and limbs larger than 10 inches long were removed.

For individual tree harvest, the harvester was driven from outside in, around the tree until the radius of travel became too small to maintain an effective sweep width. Then the final harvest pattern near the center of the tree became either a rectangle or triangle. This portion of the harvest required much unproductive time for turnarounds.

The harvest pattern for the three-tree-row runs was basically a rectangle with a semicircle at each end. Only one turnaround was re-

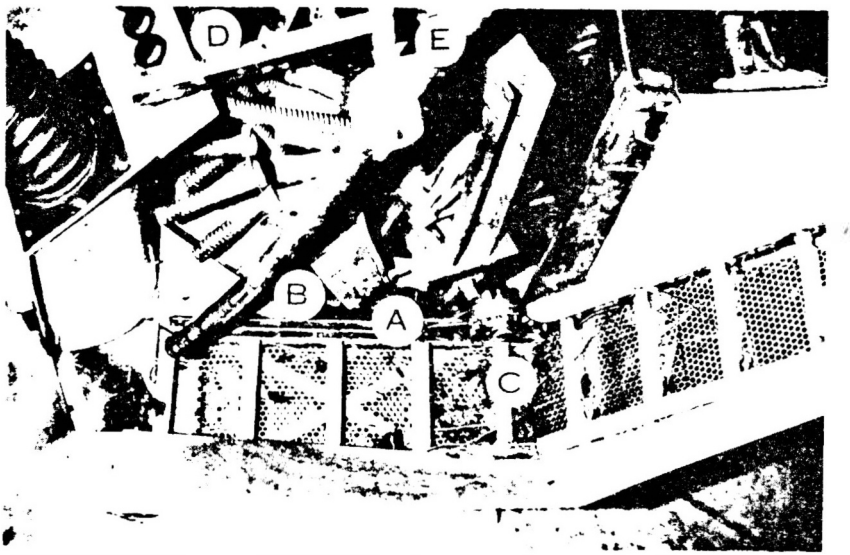


FIGURE 3.—Transfer area. A) Inclined surface swept by tapered rubber belt. B) Air outlet for initial trash removal. C) Elevator. D) Brush that prevents carry-over. E) Trash deplugger.

quired at each end as the width of the rectangle narrowed. This pattern made for more effective use of harvester width.

Ground cover was mainly a grass sod 2 to 5 inches high. Some bare spots and ruts were present.

Harvest time did not include time to change bags, which averaged about 45 seconds per change. After machine harvest, all remaining nuts were hand-harvested from the ground in order to determine harvest efficiency. The machine-harvested material was run through a field cleaner that separated nuts from trash. All weights were recorded.

Results and Discussion

The results of the harvest trials are summarized in Table 1. Maximum recovery occurred with a screw speed of 1.17 revolutions per second and a ground speed of $^{3}/_{4}$ mph; trash content was 45.1 percent. Trash consisted of mainly small sticks the size of pecans and some dirt due to damp ground conditions at harvest time. This was the first time the trees were harvested mechanically. We expect trash content to decrease as trees are mechanically harvested year after year since trash is removed from the orchard in the harvested material. Trash content for commercial harvesters is usually between 33 and 50 percent, depending on harvest conditions (Monroe, 1970).

TABLE 1.—Summary of averages of harvest data.

Number of trees harvested	Screw speed rps	Ground speed mi hr	Nut recovery %	Trash content %	Harvest rate A hr
5 a	0.88	0.75	85.5	51.1	0.20
5 a	0.88	1.40	73.6	52.1	0.35
5 a	1.17	1.40	82.8	44.5	0.32
6 b	0.88	0.75	88.5	59.6	0.30
3 b	1.17	0.75	91.2	45.1	0.25

a—Harvested individually.
b—Harvested as 3-tree rows.

Ninety-one percent nut recovery compares favorably with nut recovery from commercial harvesting equipment and is probably better than recovery from hand harvesting. One area of nut loss was at the point where the nuts leave the ground and are augered up the incline. The bottom shoe of the incline did not always stay flat on the ground and nuts were lost under this shoe. A flexible piece of rubber belting material glued to the incline surface and extending about 1 inch toward the ground should close this area of loss. Trash build-up in the elevator was not a problem, but in heavy trash areas some material was still carried over the screw. In areas where there was no ground cover and the soil surface was smooth, nut recovery was nearly 100 percent. A closely mowed sod would also be very good.

When the same ground speed was maintained, harvesting three trees at a time rather than harvesting them individually increased

harvest rates by 25 to 50 percent by decreasing the turnaround time and better utilizing sweeping width.

The 12-hp tractor had ample power to run the harvester; the ease of operation indicated that a 10-hp tractor might also furnish ample power. The harvester mounted easily on the tractor, and by adding three 35-pound weights to the right rear tire, the tractor was kept in its normal upright position. The tractor and harvester handled satisfactorily in the orchard, but could not maintain an effective harvest width on sharp turns.

Cost of Ownership and Operation

Annual overhead cost of the pick-up harvester was calculated as follows by assuming that the pick-up unit would cost $1500 and that 50 percent of the cost of a $1200 tractor would be attributed to the harvesting operation:

Pick-up harvester depreciation (10 percent salvage 10-yr straight line)	$135.00
50 percent tractor depreciation (10 percent salvage 10-yr straight line)	54.00
Interest (8 percent on average of $1249.50)	99.96
Repair and maintenance (4 percent of new cost)	84.00
Annual overhead cost	$372.96
Operating cost as follows:	
Fuel (1 gal hr at $0.50 gal)	.50
Labor (1 operator at $2.50 hr)	2.50
Total hourly operating cost	$ 3.00

Table 2 shows the unit cost (cents/lb) of harvesting pecans by use of the pick-up harvester for different size farms with varying yields at two different harvest rates (A/hr). The unit cost of hand harvesting is 5 to 8 cents/lb. Adding 1 cent/lb for cleaning the harvested nuts to the figures in Table 2 will give a direct comparison between machine and hand harvesting costs for marketable nuts. If a farmer already owns a small tractor the harvesting cost will be substantially lower than the cost presented in Table 2.

Conclusion

The small tractor-mounted harvester can do an effective job of harvesting pecans and can be economical for many small pecan

TABLE 2.—Unit costs (cents/lb) of harvesting with the pecan pick-up harvester.

Harvested area	Harvesting rates A/hr									
	0.25					0.35				
(A)	Yields lbs/A									
	1500	1250	1000	750	500	1500	1250	1000	750	500
25	1.8	2.2	2.7	3.6	5.4	1.6	1.9	2.4	3.2	4.8
20	2.1	2.5	3.1	4.1	6.2	1.8	2.2	2.8	3.7	5.5
15	2.5	3.0	3.7	5.0	7.5	2.8	2.7	3.4	4.5	6.8
10	3.3	4.0	5.0	6.7	10.0	3.1	3.7	4.6	6.2	9.3
5	5.9	7.0	8.8	11.7	17.5	5.6	6.8	8.4	11.2	16.8

growers to own and operate. Trash content is comparable to that from commercial machines. Optimum nut recovery depends on orchard conditions. To aid nut recovery and reduce trash content in harvested material, leaves and ground cover should be dry. The orchard floor should be either a closely clipped sod or a smooth, packed surface devoid of ground cover. Sticks and limbs should be removed before harvest time.

In properly conditioned orchards the small harvester should, with minor modifications, also be effective in harvesting other nuts the size of pecans or larger.

References

Agricultural Statistics, 1973.

Bureau of the Census, Agriculture Division of U. S. Department of Commerce, Unpublished Data, 1969 Census of Agriculture.

Fridley, R. B., and P. A. Adrian. 1959. Development of a fruit and nut harvester. Agr. Engr. 40(7): 386-387 and 391.

Jezek, R. E., W. W. Kilby, and J. L. Butler. 1969. Windrower and harvester for tung fruit. USDA, ARS Production Research Report No. 123.

Monroe, G. E. Unpublished data from 1970 pecan harvest season. FY 1972 Annual Report of Fruit Harvesting and Handling Studies. AERD-USDA, Byron, Georgia.

Sarig, Y., E. Emek, and R. Orny. 1974. The development of a side-delivery pecan sweeper. Transactions of the ASAE 17(3): 474-476.

Sarig, Y. 1973. Mechanized harvesting a must. Pecan Quarterly. Vol. 7, No. 4. pp. 12-13.

Whitney, R. W., L. O. Roth, and J. G. Porterfield. 1966. Pecan harvester pick-up and separator development. Transactions of ASAE 9(3): 333-337.