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Pilot Plant Processing Studies

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Mississippi State University
AGRICULTURAL EXPERIMENT STATION
HENRY LEVECK, Director
STATE COLLEGE MISSISSIPPI

On Cover:

Pilot plant building at Truck Crops Branch Experiment Station, Crystal Springs.

PILOT PLANT PROCESSING STUDIES

By JOHN A. CAMPBELL, W. O. THOMAS, STEVE L. WINDHAM AND DAN A. AULTMAN

A pilot plant for processing and quick freezing vegetables was installed at the Truck Crops Branch Station and was ready for operation by the spring season of 1962. The plant has been and will be used primarily in studying processing qualities of different varieties, adaptability of varieties to machine harvesting and handling methods, and the effects of various production practices on yield of both fresh and processed product.

The pilot plant was designed to handle the following vegetable crops: snap beans, lima beans, English peas, Southern field peas, broccoli, cauliflower, greens (turnip, mustard, collard and spinach), okra, and squash. With the addition of a few pieces of equipment the plant could handle sweetpotatoes and other root crops.

The plant is equipped with steam and hot water blanchers which are supplied from one of the two 30 H.P. steam boilers. Other machines in the processing lines are of the type used in commercial processing plants.

Packaging and sealing is done by hand and quick freezing is done in a conventional plate freezer at —30° to —40° F. It has a capacity of 320 5½"x4"x1½" packages per 1½ hours. These packages hold from 8 to 12 ounces depending on the crop. The frozen product is stored in a 1000 cu. ft. storage at 0° F.

With present facilities the plant can turn out 1200 to 1500 packages per 8-hour day. This can accommodate larger experimental plots than are normally used to provide a true pilot scale sample.

Results of these studies, which were started in 1962, show the potentials of each crop in terms of yield, quality, and expected income when grown under contract for processing. Findings from these studies have been very useful in feasibility studies for the establishment of vegetable canning and freezing plants in the Central Mississippi area.

Snap Beans

Three varieties of bush snap beans were grown on 1/12 acre plots each in the spring and fall of 1962. Plots were fertilized at the rate of 1,000 pounds 5-10-5 per acre and seed were planted at the rate of 90 pounds per acre on flat prepared seed bed in 20 inch drills. Randox was applied as a spray at the rate of 5 pounds actual material per acre immediately behind seeding as a pre-emerge chemical weed control. Plants were topdressed with 200 pounds of ammonium nitrate per acre when plants were 8 inches tall.

In the spring season the plots were given a once-over harvest simulating the conditions of a machine harvest. Harvesting was done when the greatest percent of pods set on the plants averaged sieve size 4 or below by count. The beans were then put through the processing plant where fresh weight, pod size distribution and processed turn-out determinations were made. They were processed and quick frozen following standard commercial procedures.

Table I shows the results of the spring test. It will be noted that with Wade and Extender varieties there was a considerable break in pod size distribution between sieve 3 or smaller and 5 or larger and that Harvester produced a more favorable pod maturity pattern for mechanical harvest.

Table 1. Yield of fresh and processed beans with pod size distribution of three varieties once-over harvested, Spring 1962.

Variety	Yield fresh weight lbs. sieve size 4 and below per acre	Pounds frozen per acre	Number 10 oz. pkgs. per acre	Pod size distribution percent by weight sieve 3 and Below	4	5 and Above	by count sieve 3 and Below	4	5 and Above
Wade	2050	1275	2440	35.3	21.2	43.5	54.3	17.0	28.7
Extender	1802	1213	2415	22.8	10.4	66.8	45.0	11.0	44.0
Harvester	2313	1606	3200	56.8	24.7	18.5	71.5	15.2	13.3

Table 2. Yield of fresh beans when first harvest is made by hand and the second is once-over with three varieties.

Variety	Yield—lbs. per acre Hand picked first harvest	Yield—lbs. per acre Once-over second harvest Sieve 4 and Below	5 and Above
Harvester	2494	4062	890
Extender	2650	1934	510
Wade	2907	1623	634

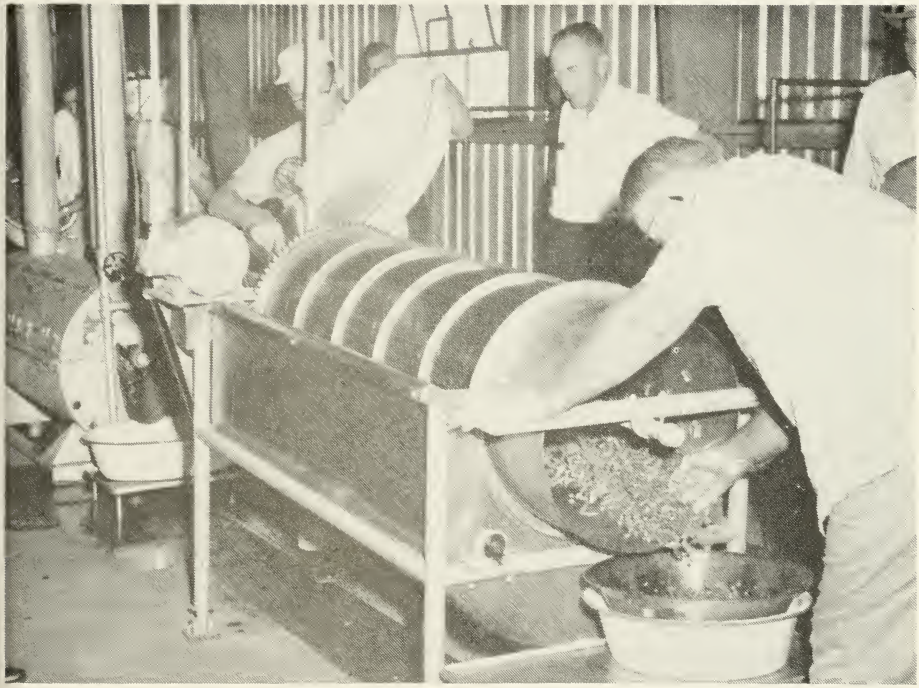
Because of relatively low yields from the once-over harvest in the spring test, two harvests were made in the fall test. The first was made by hand and the second harvest was made as a once-over machine harvest. The same determinations were made as in the spring. Table 2 shows the yield for the two methods of harvesting. The results indicate that a much greater total yield can be obtained with two harvests and that a much more favorable maturity and size distribution of pods can be had in a once-over harvest when it is preceded by one hand picked harvest.

Lima Beans

Four varieties of bush lima beans were planted in the spring and fall of 1962 and 1963 on 1/11 acre plots each. The plots were fertilized with 1600 pounds of 5-10-5 per acre and seeded at the rate of 90 pounds seed per acre in drills 20 inches apart on flat seed beds. Vegedex was applied as a spray behind seeders as a pre-emerge chemical weed control at the rate of 6 pounds of actual material per acre. The varieties were topdressed with 200 pounds of ammonium nitrate per acre when plants were about 8 inches tall.

Each variety was once-over harvested when 3 to 5 percent of pods begin to turn yellow and the highest percent of total set was considered usable. This was done by pulling the vines and picking the pods by hand simulating machine harvest. The beans were then put through the processing plant where fresh weight, shelled weight, percent shell-out and yield of processed product were determined. The beans were processed and quick frozen using standard commercial procedures.

Results of the spring test of 1962 are shown in Table 3. Early Thorogreen produced the greatest yield of fresh pods as well as shelled weight per acre. Jackson Wonder, a speckled seeded variety, had the highest percent shellout and was second highest yielder of shelled beans. This variety apparently had less shrinkage due to blanching than other varieties as it turned out the greatest yield of processed product. This test was repeated in the fall of 1962 with the planting made August 20. The crop grew off well



After blanching beans go through this washer.

but when pods began to mature in October temperatures became progressively cooler thus slowing maturity to the point that yields, when made before the first freeze, were too low to report here. This indicated that fall planting date should be made at an earlier date.

In the Spring of 1963 only three varieties were included in the test. Dixie Butterpea, a plump speckled seeded baby lima was added. Table 4 shows that the Dixie Butterpea produced the greatest yield of fresh, shelled and processed yield. The percentage shellout was excellent on all varieties.

The fall trial was planted August 5 or two weeks earlier than the 1962 fall planting. The same varieties that were used in 1962 were used in the 1963 fall trial with the addition of Dixie Butterpea. Table 4 also gives the results of this trial. It is readily apparent that while yield of fresh pods were high for all varieties, the shellout percentages were low due to immaturity caused by progressively lower temperatures during the period of pod maturation before harvest and the first freeze. Results of the two fall seasons show that for best fall production lima beans should be planted on or about July 20 to 25 to allow sufficient time for proper maturing of beans before the first killing frost.

English Peas

Four English pea varieties of the processing type were grown on 1/8 acre plots each in the spring of 1962. Plots were fertilized with 1500 pounds of 5-10-5 per acre and the peas were seeded in drills 12 inches apart on flat prepared seedbed at the rate of 112 pounds per acre on February 3. No chemical weed control or cultivation was required. All varieties were topdressed with 200 pounds of ammonium nitrate per acre when

Table 3. Once-over harvest yields of four varieties of bush lima beans, Spring 1962.

Variety*	Fresh weight lbs. pods per acre	Pounds shelled beans per acre	Percent shellout	Pounds frozen beans per acre	Number 12 oz. packages per acre
Early Thorogreen	7150	2821	39.4	2689	3586
Clark's Bush	5863	2134	36.3	2021	2695
Thaxter	6682	2586	38.4	2557	3410
Jackson Wonder (speckled)	6468	2706	41.8	2780	3707

*Seed furnished by Asgrow.

Table 4. Once-over harvest studies with varieties of bush lima beans.

Variety	Fresh weight lbs. pods per acre	Pounds shelled beans per acre	Percent shellout	Number 12 oz. packages per acre
		Spring, 1963		
Henderson bush	4146	2007	42.2	2710
Jackson Wonder (speckled)	7102	3010	42.3	4353
Dixie butterpea (speckled)	9100	3993	43.8	5420
		Fall, 1963		
Jackson Wonder (speckled)	7774	2386	30.6	3413
Early Thorogreen	7283	2030	27.8	2923
Clark's Bush	8121	1975	24.3	2678
Thaxter	9259	1793	19.3	2409
Dixie Butterpea (speckled)	9396	2236	23.7	3036

Table 5. Once-over harvest processing study with four varieties of English peas — 1962

Variety*	Fresh Weight pounds of pods per acre	Pounds shelled peas per acre	Percent shellout	Pounds frozen peas per acre	Number 12 oz. packages per acre
Freezer 626	12065	5517	45.7	4995	6660
Freezer 640	6068	2158	35.5	1877	2727
Freezer 69	7145	2853	40.0	2604	3472
Little Marvel	4006	1085	36.9	1075	1365

*Seed furnished by Asgrow.

plants were 8 inches tall. Varieties were once-over harvested when first set pods were at peak maturity—just before turning gray.

Results of these trials are shown in Table 5. It is shown that wide variation exists in productive capacity of varieties and that profitable yields of this crop are possible with certain varieties.

Southern Peas

In preliminary fertility studies for Southern peas large differences were noted for soils which had varying fertility levels. These influences as measured for the variety Pink-eye Purple Hull bus are shown in Table 6. These resul for each location show the average figu for 14 fertilizer treatments replicate four times. The results indicate that u der the conditions of this test the degr of erosion was the factor which seem to cause the greatest variation in yiel With the exception of location No. 1, a soils were approximately equal in s fertility as measured by soil tests.

The results show that yields can be i creased as much as 80 percent by prop selection of location. The assumption th peas produce as well, or prefer erod

Crew working at okra grading and trimming belt.

Table 6. Influence of soil fertility on Southern peas for processing.

ocation	1	2	3	4	5
il Type	Bude	Providence	Providence	Providence	Bude
H	5.6	5.6	5.8	5.6	5.8
level	L—	M	H+	M	H
level	L	M	M	M	M
osion	Med.	Sev.	Med.	Med.	Sli.
elds					
ds and peas	4340	2780	4160	4200	5000
elled peas	1960	1260	1880	1900	2260
. 12 oz. Packages	2482	1596	2381	2407	2863

w fertility soil, is erroneous. These tests o showed that pounds of peas in hull oduced is a good indication of yields of zen peas. Observations made indicat- that in instances where percentage ll increased the loss from over matur- (dry) counteracted this increase. Oth- observations as to color and general earance of peas indicated little or no influence of location on these factors. The yields obtained in these tests when compared to those in other areas where peas are grown for processing are very favorable for production of this crop.

Studies have also been made of many different varieties of Southern peas to determine yield, once-over harvest, and shelling characteristics as well as pro-

Table 7. Effect of plant spacing and number of harvest on yield of fresh and processed broccoli.

Variety	Spacing between plants	Number harvest	Pounds per acre Total yield	Trim loss and cull	Net Wt.	No. 8 oz. packages per acre
Coastal	6 inch	Once-over	3104	672	2432	4592
Coastal	18 inch	4 harvests	2996	340	2656	4250

cessing qualities.

Broccoli

During the fall of 1963 Coastal variety of broccoli was grown with plants spaced 6 inches and 18 inches apart on rows 3½ feet apart. Plots were fertilized with 1200 pounds 6-8-8 per acre and sidedressed with 32 pounds of nitrogen per acre. Plots on which plants were spaced 6 inches apart were harvested as a once-over operation, while those spaced 18 inches apart were harvested 4 times. Results of this study are shown in Table 7. These data indicate that close spacing of plants of a uniform maturing variety might make once-over mechanical harvesting of broccoli feasible.

Other Vegetables

Other vegetables which have been grown and processed to determine yield and freezing qualities of different varieties include cauliflower, okra, squash and turnip greens. Results of these studies show that these crops can be grown in the area at a profit for processing under prevailing contract prices, and that the quality of the processed product compares favorably to that of competitive areas.