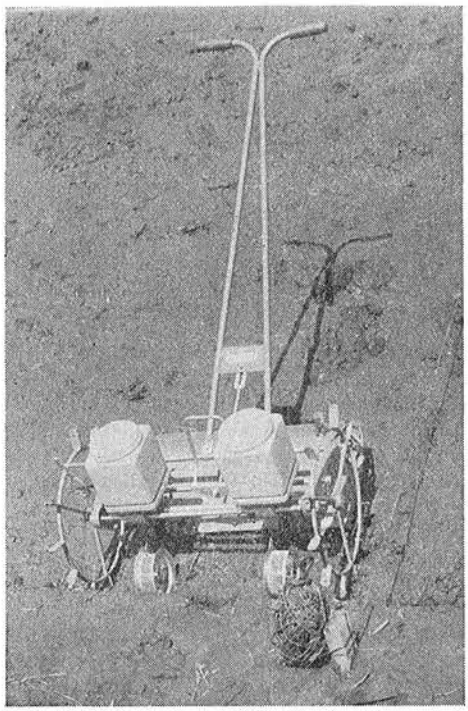

Fig. 4 Direct rowing menual paddy plantir for submerged field

changeable by adjusting the handle. Seed feeding is done in most models through a roll with hole and the rate of feeding is adjusted by an interchange of rolls. Feeding is adjustable both for dotted and continuous (or line) planting. The runner consists of a float, furrow openers, seed-bed makers and presses. The float enables the machine to afloat on the surface of the water and also keeps the surface of paddy field even for furrow openers to work on seed-beds smmoothly. Press puts seeds, which are fed through the hole, into seed-bed by own gravity or by mechanical force by spring. The rate of seeding is almost the same with those of the fertilizer drills described above.

The work efficiency is approximately 60 minutes per 10 ares, though with allowances according to conditions of field. Sometimes the machine is converted to a vegetable seeder by interchanging each rolls.

Other types of fertilizer drills

Besides the above-mentioned, feeding part is now deviced so as to be interchageable among feeding not only wheat but also soybean, corn, rape seed and beet seed. This utility-type fertilizer drill now comes into practical use.

Citrus Breeding through Nucellar Seedling Selection

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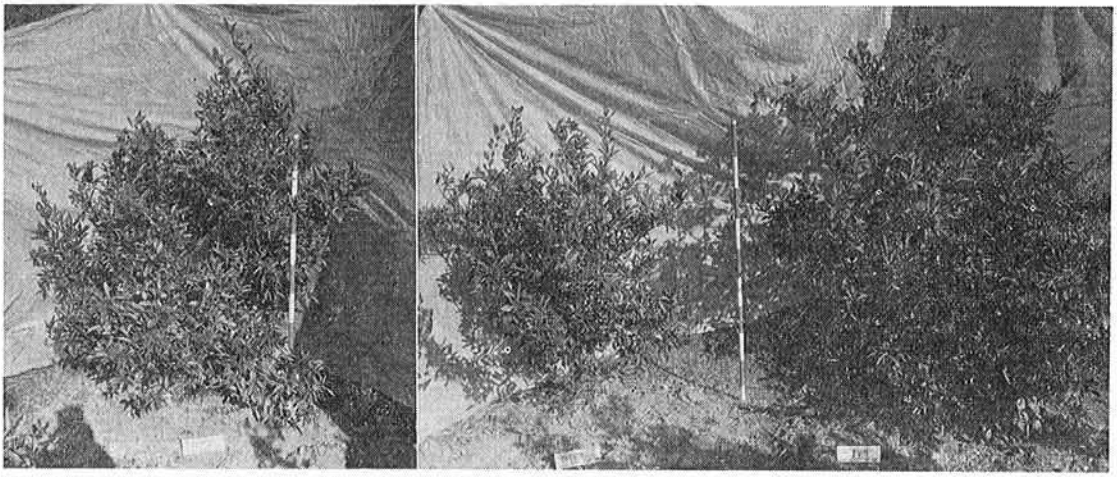
In Japan, many citrus varieties were derived from natural hybridization and spontaneous mutation throughout the citrus regions for the last two or three centuries. Among these are the two most important varieties on which the modern Japanese citrus industry has depended exclusively. One is the well-known Unshu-mikan or Satsuma mandarin, the leading citrus variety in Japan. The other is the Natsudaidai. The former is considered to have originated as a chance seedling derived from citrus fruit brought over from southern China over 300 years ago, and grown on a small island in the southern part of Kyushu. The latter was found also as a chance seedling in Yamaguchi prefecture, in the westernmost part of Honshu island, about 275 years ago. It is the most common late-maturing variety at present, but there are some defects in its quality.

The Satsuma replaced the older varieties about 100 years ago, because it is cold-hardy, early to ripen, easy to peel, seedless and has excellent quality. Through the years, many strains of Satsuma have developed



Comparative growth of Miho-Wase (left), Miyagawa-Wase (centre) and Okitsu-Wase (right) on trifoliate orange stock. Trees nine years old. Note the greater vigor of trees in the nucellar selections.

through limb sports or bud variations, and the superior ones have become the main source of Japanese citriculture today. In these selections which have developed from natural mutation, a very wide variation, including a range of from early to late maturing types, has been obtained. Wase Satsuma ripen in early October, several Satsuma strains ripen in early to middle November, and common Satsuma mature from late November to middle December.

On the other hand, after the establishment of the Horticultural Experiment Station (present Okitsu Branch, Horticultural Research Station, Ministry of Agric. & Forest.) in 1902, many citrus varieties such as the Washington Navel, Valencia and other sweet oranges, lemons, and grapefruit were introduced from foreign countries, and their adaptability was tested for commercial cultivation under our climatic conditions. Unfortunately, sweet oranges, lemons, and grapefruit, the most known world-wide commercial varieties at present, have not shown good results under our climate; namely, the temperature in winter is too low to grow late maturing varieties such as the Valencia and grapefruit, and there is too much rainfall in early summer to produce good yields of the Washington Navel. Thus, Japanese citriculture has had to step back to the original course. Fortunately, the Satsuma has overcome this climatic handicap, and with this variety the modern citrus industry in Japan was built up.

Since 1937, systematic citrus breeding has been conducted in the Horticultural Experiment Station, Okitsu. The principal objective of citrus breeding by hybridization is the production of varieties having such characteristics as more vigorous, hardier, more productive, high-quality, seedless fruits for all seasons of the year, particularly early - and late ripening types, and new varieties for use as citrus rootstock. Besides, in our breeding program, it is emphasized that selection work among nucellar seedling lines has been conducted on a large scale under the leadership by Dr. M. Kajiura, former director of the Horticultural Research Station (Ministry of Agric. & Forest.), in order to improve strains of the Satsuma and other varieties. He has postulated that mutant characteristics may be found more frequently in seedlings from nucellar embryos than in bud mutations. About 30 years ago, he started the work of breeding following this principle. Consequently, many Satsuma nucellar seedlings were produced and closely examined. In some of them, slight or rather distinct genetical changes have been discovered quite frequently and these facts confirmed that the use of nucel-

ar selections is applicable to the improvement of Satsumas.

The Wase Satsuma, early ripening type of Satsuma mandarin, originated from common Satsuma as limb sports, and among the best is the Miyagawa-Wase. However, the lack of tree vigor in comparison with common Satsumas is one of the defects of the Wase Satsuma. Therefore, nucellar seedlings of Wase Satsuma are expected to be more vigorous and earlier ripening. Many nucellar seedlings of Wase Satsuma have been produced, from which three sister nucellar seedlings of the Miyagawa-Wase, pollinated with the trifoliate orange in 1940, were selected as promising strains in 1949. Comparative experiments of the new strains with the parental Miyagawa-Wase have been carried on since 1953 at our station and 22 other prefectural citrus experiment stations under the name of Okitsu No. 1, 2, and 3. Among them, two strains, Okitsu No. 1 and 2, were selected as superior Wase Satsuma strains, and were registered in 1963 and named Miho-Wase and Okitsu-Wase, respectively.

The characteristics of new nucellar selections are summarized as follows: The trees of Miho-Wase and Okitsu-Wase show very vigorous and rapid growth as compared with the parental Miyagawa-Wase, indicating a distinct difference in trunk circumference and tree size as shown in Table 1 and the picture; The yields of Miho-Wase and Okitsu-Wase are very good, being significantly different in comparison with that of Miyagawa-Wase (Table 1); The coloring time of the nucellar lines is earlier and more uniform than the parental line; The shape of fruit is more flattened; The soluble solids of juice of the nucellar selections are significantly high as compared with that of the Miyagawa-Wase and among the highest is Okitsu-Wase; The content of citric acid of Miho-Wase is the lowest, whereas Okitsu-Wase has the highest of all. Consequently, the ratio of solids to acid in the fruit of Miho-Wase is significantly the

Table 1. Tree characters and yield of nucellar selections and parental strain

Strain[a]	Trunk circumference[b]		Tree size in January 1966[c]			Yield[d]	
	April 1956	January 1966	Height	Width	Volume	Number of fruit per tree	Fruit Weight per tree
	cm	cm	m	m	m^3		kg
Nucellar selections:							
Miho-Wase	2.7	28.4y	2.53	2.72	13.10	190y	23.03y
Okitsu-Wase	2.8	29.6y	2.67	2.75	14.37	226y	25.61y
Okitsu No. 3	2.7	25.9xy	2.53	2.67	12.93	174xy	21.01xy
Parental strain:							
Miyagawa-Wase	2.3	21.9x	2.23	2.02	6.41	132x	16.95x

Mean values in a column followed by the same letter are not significantly different at the 5 % level by Duncan's Multiple Range Test.

Each value is the average of 3 replications with single tree plot.

a Each tree was budded on trifoliate orange in September 1954 and planted in May 1956.

b Trunk circumference was measured at 5 cm above the bud union.

c Tree size was expressed in height and width of tree, the width being the average of two measurements taken at a right angle. The volume was calculated by Height $\times$ $(\text{Width})^2$ $\times$ 0.7.

d The average for 5 years period (1961-65).

Table 2. Composition of fruits of nucellar selections and parental strain

Strain	Weight per fruit in g	Per cent of rind	Per cent of juice in fruit	Soluble solids g/100g	Citric acid g/100g	Ratio of solids to acid	Brix degrees
Nucellar selections:							
Miho-Wase	118	19.8	80.9	9.99y	0.93x	11.2y	9.7y
Okitsu-Wase	119	19.3	81.5	10.30y	1.06z	9.9x	10.0y
Okitsu No. 3	129	19.5	80.2	10.05y	0.99y	10.4x	9.9y
Parental strain:							
Miyagawa-Wase	119	19.0	81.5	9.60x	1.02y	9.8x	9.3x

Mean values in a column followed by the same letter are not significantly different at the 5 % level by Duncan's Multiple Range Test.

The values represent the average of analyses on 3 replications with 5 fruit per sample for 5 years period (1961-65).

highest among them (Table 2); Other external or internal characteristics of fruits produced on the nucellar selections closely resemble those of the parental Miyagawa-Wase. It will be concluded that Miho-Wase and Okitsu-Wase, the nucellar selections of Miyagawa-Wase, are very vigorous, heavy cropper, and the earliest in ripening among Wase Satsuma together with superior quality.

The Miho-Wase and Okitsu-Wase are increasing rapidly in the citrus growing regions of Japan and are taking the place of old lines. These facts confirm that this breeding method through nucellar seedling is valuable.

About 1800 nucellar seedlings of the common Satsuma also have been produced. Among them, three strains of Nagahashi and two of Sugiyama have been selected as promising, and are being tested at our station and 25 other prefectural experiment stations. Nagahashi originated as a limb sport from Owari, and it is of the earlier ripening type of the common Satsuma, ripening from early to middle November intermediate between the Wase and the common Satsuma. Sugiyama also originated as a bud variation from Owari. It is one of the most popular strains and ripens in late November. These new strains are being expected to be more vigorous, more rich in sugar content and more productive, than the parental Nagahashi and Sugiyama which have not always had good tree vigor and rich taste. Some other noteworthy nucellar seedling lines have been found and they are being tested now.

In addition, there are two other interesting definite variations observed in the nucellar seedling lines up to the present day. One is the remarkably delayed coloring time of nucellar strains from Suzuki-Wase which is an early maturing type, and most of them seem to reverse to the original common type from which the parental Suzuki-Wase had derived. The other is the change of fruit rind color observed in nucellar seedlings of Dobashibeni Unshu which is a mutant with reddish rind, and two trees of them have not the reddish fruit but an orange-yellow colored fruit. This also seems to be caused by reversional mutation.

Nucellar seedling trials on Washington Navel orange, Natsudaidai, and grapefruit have been carried on since 1944. However, the trees are not bearing fruit sufficiently to investigate further and no promising strain has yet been found.

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Manufacturing Method of Instant Green Tea

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Introduction

In Japan green tea is an integral part of dietary life with rice as the staple food. As a major beverage it has maintained a relatively stable consumption. Meanwhile the recent trend in non-alcholic beverage consumption is toward more convenient way of drinking as illustrated by soluble coffee and soft drinks.

The way of living in Japan has been undergoing rapid modernization. Among others we live less in houses and more in apartments, and less in rural areas and more in cities. Under such situations 'convenient foods' are becoming increasingly important. Convenient foods reach consumers with all wastes having been disposed of at the processing stage.

Green tea also needed a new type of product to keep up with these changes in consumers' mode of living. Instant green tea, soluble in cold water and without wastes, might maintain consumption and develop a new use as a cold drink in addition to the traditional use as a hot drink.

Research[1] on such a product was carried out between 1959 and 1965. Commercial production started in 1962 on a very small scale. At present several kinds of products are on the market. A few more attempts at commercialization are under consideration.

Outline of manufacturing

Dried tea is ground and loaded into a percolator, where soluble solids are extracted under a continuous supply of hot water. Extracted liquid concentrated to contain about 20 percent solids is collected, and then directly vacuum dried or freeze dried into soluble tea powder which has 2 to 3 percent moisture.

Extraction

The batch slurry system[2] extractor produces a highly concentrated (fifty to sixty-fold) extract, which can be sent to the drying process immediately. The concentration of extract is directly proportional to the number of percolators used, but when it has reached a certain degree (about 20 percent for *sencha* and about 25 percent for *hojicha*) the extract becomes difficult to flow due to high viscosity and extraction efficiency is reduced. Therefore the concentration of extract must be regulated by the amount of collection so as to maintain the limit. Generally, the extract of fairly stable concentration can be obtained each time if the weight of extract approximately equivalent to that of materials charged per percolator is collected from an extraction battery consisting of four percolators (for *sencha*) or five (for *hojicha*).

Infinite care must be taken in extraction temperature, as it greatly affects the composition of extract and hence the quality of