

Land and Water Management for Cultivation Under Cover in the Kinki District (II)
— A case study of the investigations of the actual conditions in Shiga, Nara,
and Wakayama prefectures —

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(Received October 31, 1989)

Abstract

Land and water management in the cultivation under cover depend on the crop conditions, the soil conditions, meteorological conditions, and so on. This study was carried out in order to how these managements are maintained in Shiga, Nara, and Wakayama prefectures. They are located around the big cities, for example, Kyoto city, Osaka city, Sakai city, Kobe city and others. The land foundation improvements are found not to be established so much in these prefectures as well as in prefectures which were investigated in the former review. And also they are found to be dependent on the experiences of each farmer who has gained them in course of a long time. On the other hand, main crops planted in the cultivation under cover are vegetables in these places. But cut flowers are abundantly planted too in these places. Again, the culture area of vegetables, cut flowers, and fruit trees is inclined to increase from year to year. Therefore, the actual conditions of the land and water management must be grasped as soon as possible. Furthermore, more appropriate management techniques must be established as well.

Introduction

Main crops planted in the cultivation under cover are vegetables, for example, tomatoes, cucumbers, strawberries, etc. in Shiga, Nara, and Wakayama prefectures. The tomatoes and cucumbers cultures are predominant in Shiga prefecture; the strawberries, tomatoes, cucumbers, and egg-plants cultures in Nara prefecture, and the strawberries and cucumbers cultures in Wakayama prefecture. However, the strawberries cultures of Nara prefecture is greatest of all other prefectures. On the other hand, the culture area of the cut flowers culture is estimated to be about 39 ha in Shiga prefecture, about 41 ha in Nara prefecture, and about 46 ha in Wakayama prefecture. And also, the area of the fruit trees culture amounts to be about 29ha in Nara prefecture and about 13 ha in Wakayama prefecture, but in Shiga prefecture, fruit trees are almost not planted. This study was conducted to clarify how the land and water managements are actually maintained in these prefectures. On the other hand, the results about vegetables cultures on the actual conditions were reviewed at the first part, so the results of fruit trees and cut flowers in the cultivation under cover as well as results on vegetables (except those already reported in the first part) will be investigated and analyzed in this study.

I. Actual conditions of the land and water management in Shiga prefecture

Places where the cultivation under cover is actively developed are the eastern south parts through the eastern north parts of Shiga prefecture. That is, places where the crops

Table 1 The management area of the cultivation under cover in Shiga prefecture (agricultural census, unit: ha)

year	vegetables	cut flower	fruit tree
1970	13.3	11.0	0.2
1980	159.0	39.2	0.4

Table 2 The culture area of different vegetables in Shiga prefecture (agricultural census, unit: ha)

year	tomato	cucumber	egg-plant	green pepper	strawberry
1970	3.0	5.1	0.8	0.2	0.3
1980	22.6	25.1	8.3	0.3	14.0

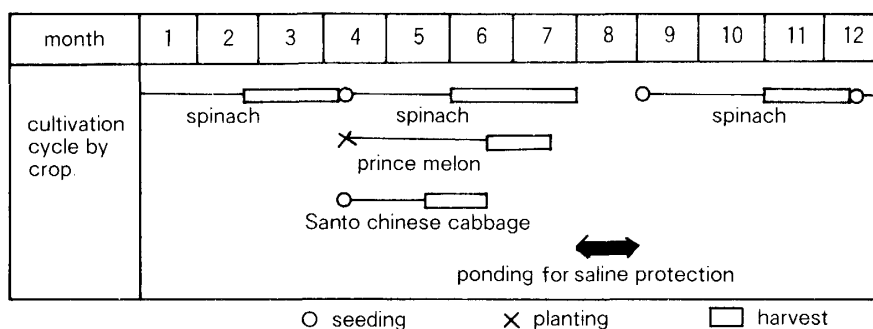


Fig. 1 A case of the culture form in Kusatsu city.

cultures are conducted are Hikone city, Ohmihachiman city, Yokaichi city, Moriyama city, Kusatsu city, Notogawa town, Nakazu town, Azuchi town, Aito town, and other places. Main crops in the cultivation under cover are vegetables and cut flowers. But the area of the cut flowers culture is about one fourth of the area of the vegetables culture. The management area of the cultivation under cover and the different management areas of vegetables are shown in Table 1 and Table 2. At first, the crop culture form forms are shown in Fig. 1. Spinaches, chinese cabbages or prince melons are planted in spring, but spinaches are planted in other seasons as well. In this case, the culture styles are that the furrow width is from about 20 cm to 30 cm, the bed width from about 80 cm to 120 cm, and the bed height about 20 cm. Soil texture is of the sandy soil and its permeability is very high. So the drainage devices are not installed. On the other hand, the saline protection is conducted by the continual irrigation method a day and night after the harvest of the spring crops. Then, agricultural chemicals are mixed into surface layer and soil surface is covered with plastic sheets. After that, the soil pasteurization is conducted by the utilization of the solar radiation for about two weeks. On the other hand, with regard to the water management, as the land foundation improvement was conducted several years ago in this place, the security of irrigation water and the irrigation systems were established. And as the groundwater level is very high in this place, the object of irrigation is said to defend the dry situations of surface layer. And the spray irrigation method is applied by the use of the spray nozzles which are of the semicircle

type or both side direction type. The amount of each irrigation was estimated to be about 2 mm per day. Its value is very small, but as the irrigation time is concentrated, a big problem of the pressure drop is often found to occur at the end of the irrigation system.

II. Actual conditions of the land and water management in Nara prefecture

Places where the cultivation under cover are well developed extend from the centre parts through the north parts in Nara prefecture. The area of the cultivation under cover of Nara prefecture is the largest area in the Kinki district and its area is increasing year by year. That is, the culture area of vegetables amounts to be about 444 ha, that of cut flowers about 100 ha, and that of fruit trees about 30 ha. But the culture area of strawberries is the largest area of all vegetables, and its area amounts to be about 75% of all vegetables, that of tomatoes about 10%, and that of egg-plants about 5%. The management area of the cultivation under cover and the different management area of vegetables are shown in Table 3 and Table 4. The main production places of strawberries are Nara city, Yamatokohriyama city, Tenri city, and others. Again, the main production places of cut flowers are Yamatotakada city, Kashiwara city, Taharamoto town, and others. Also, the main production places of fruit trees are Kawai town, Heguri town, Kasiba town and others. Thus, the cultivations under cover are much developed in Nara prefecture, but the actual conditions of the land and water management are still not clarified.

Table 3 The management area of the cultivation under cover in Nara prefecture (agricultural census, unit: ha)

year	vegetables	cut flower	fruit tree
1970	179.3	9.5	5.6
1980	443.6	41.1	28.9

Table 4 The culture area of different vegetables in Nara prefecture (agricultural census, unit: ha)

year	tomato	cucumber	egg-plant	green pepper	strawberry
1970	8.3	10.3	12.3	0.4	136.7
1980	39.3	19.7	25.0	1.4	322.0

(1) A case of the tomatoes – strawberries culture in Kashiwara city

A case of the tomatoes – strawberries culture was selected in Kashiwara city. Its culture form is shown in Fig. 2. The tomato seedlings are planted at the end of March, and the harvesting is done from the middle of May to the end of June. After that, the soil pasteurization and the ponding for saline protection are conducted for about two weeks. Then, the strawberry seedlings are planted at the middle of September, and its harvesting continues from the first part of December to the end of February. The culture styles are that the furrow width is about 20 cm, the bed width about 60 cm, and the bed height about 30 cm. But in this place, the land foundation improvement is not established

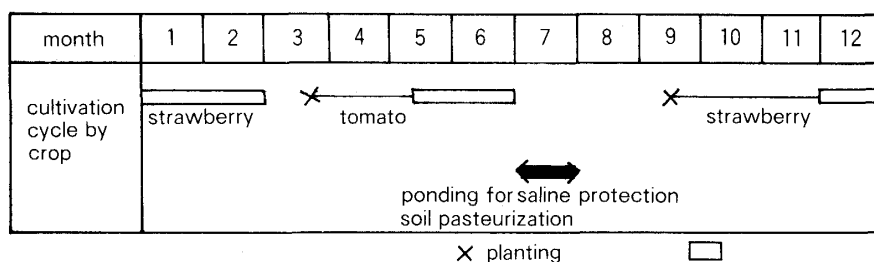


Fig. 2 A case of the culture form in Kashihara city.

yet. However, the desire of establishing it is very strong among the farmers. But the small size of the lands make their grouping almost impossible. The reason may be that the expense is too high to individually conduct the land foundation improvement. Places where were investigated had the diverted fields of sloping lands, and their soil texture was found to be loam soil. The soil pasteurization is conducted by mixing the agricultural chemicals, and at the same time, the ponding for saline protection is conducted. After that, land is covered by vinyl sheets and soil is pasteurized by the utilization of the solar radiation. On the other hand, with regard to the water management, the water source is a well, and irrigation is applied to the crops during the whole growth period. And also, the overhead irrigation method is applied by the spray nozzle system of both side direction type, to the newly planted the seedlings and is continued till they grow roots, and after that, the surface irrigation method is applied by the use of the perforated tubes. The amount of each irrigation is estimated to be about 3 mm everyday. On the other hand, the problem is caused because the groundwater contains the taste of iron.

(2) *A sample of the tomato – strawberry culture in Tenri city*

A case of the strawberry – tomato or strawberry or red pepper culture was investigated in Tenri city. Its culture form is shown in Fig. 3 and Fig. 4. The tomato or red pepper seedlings are planted at the end of March, and the harvesting is done from the end of May to the first part of July. After that, the strawberry seedlings are planted at the first part of September, and the harvesting is done from the middle of December to the end of February. The culture styles are that the furrow width is from about 20 cm to 30 cm, the bed width from about 50 cm to 60 cm, and the bed height about 30 cm. On the other hand, the land foundation is still not improved because the divided land can not be grouped. Furthermore, lands which are located at the sloping land are converted from the ricefields. Soil texture is loam soil. The soil pasteurization and the ponding of the saline protection are conducted for about 2 weeks from the middle of July to the end of August. On the other hand, with regard to the water management, the water source is a

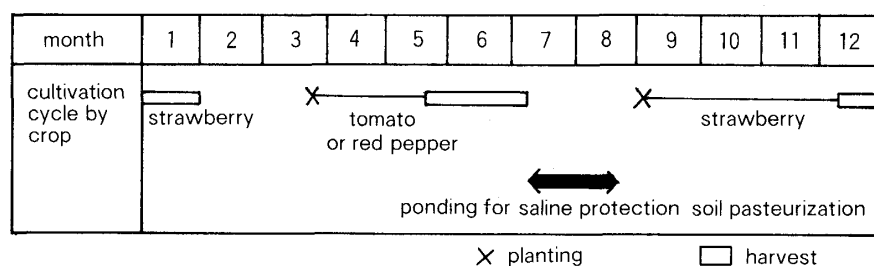


Fig. 3 A case of the culture form in Tenri city (case 1).

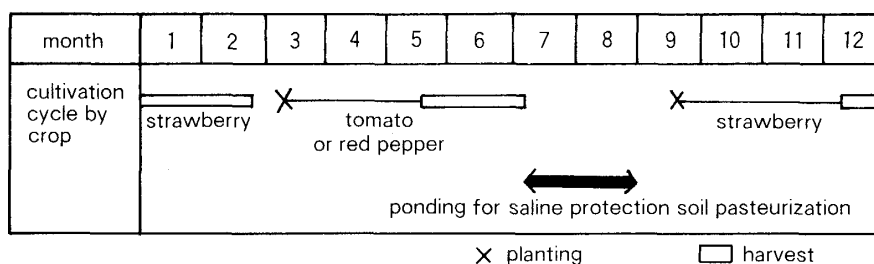


Fig. 4 A case of the culture form in Tenri city (case 2).

well, and the groundwater is pumped up and applied to the crops throughout the whole growth period. The furrow irrigation method are applied at the planting and the taking root period. After that, the spray irrigation method is applied by the spray nozzles or the perforated tubes. The amount of each irrigation is estimated to be about 6 mm to the spray irrigation method of the nozzles type and about 3 mm to that of the perforated tube everyday as a rule. But the control of the amount of irrigation water is supposed to be decided by the crop conditions, growing stage conditions and the soil conditions of the dry or wet situations.

III. Actual conditions of the land and water management in Wakayama prefecture

Places where the culture in the cultivation under cover are very actively developed are located at the northern parts, that is, the Kino river and the area extends from the coastal parts of the mid-region to that of the south parts of Wakayama prefecture. Main crops are vegetables like other prefectures. And the cut flower culture is much developed too, but the fruit tree culture is not developed so much. However, fruit trees which are not observed in other prefectures are planted in the cultivation under cover. That is, Unshu orange trees, lemon trees etc. are same examples of such trees which are planted in Wakayama prefecture. The vegetables and cut flowers cultures are conducted at Wakayama city, Gobo city, Uchida town, Iwade town, Mihama town, Hidaka town, and other places. On the other hand, the fruit tree and cut flower cultures are conducted at Katsuragi town, Hirokawa town, Kibi town, and other places. But only the cut flower cultures are conducted at Kushimoto town, Koza town, and other places. The management area of the cultivation under cover and the different management area of vegetables are shown in Table 5 and Table 6. In Wakayama prefecture, the investigation of the actual conditions were conducted about the Unshu orange culture, the lemon culture, and the carnations and cut rose culture as cut flowers.

(1) A case of the Unshu orange culture in Kibi town

The orchard of Unshu orange trees which was investigated is the upland field con-

Table 5 The management area of the cultivation under cover in Wakayama prefecture (agricultural census, unit: ha)

year	vegetables	cut flower	fruit tree
1970	59.7	7.7	5.6
1980	353.3	45.9	12.6

Table 6 The culture area of different vegetables in Wakayama prefecture
(agricultural census, unit: ha)

year	tomato	cucumber	egg-plant	green pepper	strawberry
1970	4.7	32.9	2.5	1.7	6.9
1980	14.6	26.8	10.7	9.6	54.7

verted from the ricefield. On that account, the conditions of drainage are complicated because the drainage devices were installed in some of the places only and others. Furthermore, the land foundation was not improved. Land is flat and soil texture is loam soil. The culture styles are that the tree interval is about 250 cm, Unshu orange trees were grafted several years ago on the basic trees of old Unshu orange trees. The harvesting is done the first part of September to the first of October. This harvesting time is shorter by 50 days than that of the outdoor culture. On that account, the heating system is set up in order to compensate the fall of temperature in winter season. The soil pasteurization and the ponding of the saline protection are not executed. On the other hand, with regard to the water management, the water source is the river. Irrigation is applied almost the whole year except the period from the first part of June to the first of July which increase the rate of the acidity and that of the sweetness. The spray irrigation method is applied by the use of the sprinkler nozzles. The nozzle installed interval is about 250 cm. The amount of each irrigation is estimated to be about 30 mm at 15 days interval in case of having no drainage system or 10 days interval in case of having drainage system. However, the size of fruit in case of having drainage system is said to be almost same in comparison with the case of no drainage system, but the acidity and the sweetness in the former is said to be inferior to the latter.

(2) *A case of the Unshu orange culture in Hirokawa town*

The orchard of Unshu orange trees which was investigated was initially a ricefield and later converted to the upland field. The land foundation is not improved in this orchard. But land is improved individually by the soil dressing on the original ricefield and then straws are mixed in the soil. On that account, the permeability is considerably improved and is rather high. The tree interval is about 250 cm. And Unshu orange trees are grafted on the basic trees of the Hassaku orange. The harvesting is done from the first part of September to the first part of October. Therefore, the harvest is fastened about 50 days in comparison with the case of the outdoor culture. The soil pasteurization and the ponding of the saline protection are not conducted. On the other hand, with regard to the water management, the water source is a Tameike. Irrigation water is applied a whole growth year except the period during the first part of June to the first part of July which increases the rate of the acidity and the sweetness. The spray irrigation method is applied by the use of the nozzle type sprinkler. The nozzle installed interval is about 200 cm. The amount of each irrigation is estimated to be about 27 mm at 5 days or 6 days interval.

(3) *A case of the lemon culture in Hirokawa town*

The lemon culture in the cultivation under cover is not popular yet, but the possibility of becoming popular seems to be very high in future. The land foundation is not still conducted officially, but only some individual soil dressing have been conducted. This land is indivisually converted from the original ricefield to the orchard. The Hassaku

orange trees were planted there as the open field culture. The soil texture in this orchard is loam soil. The tree interval is about 250 cm. The lemon trees are grafted on the basic trees of the Hassaku orange trees. The fruit harvesting is done from the first part of October to the middle of November. After the fruits harvesting, lemon trees are maintained by allowing the heating system not to drop its temperature more than 0 degree until the first part of March. However the drainage devices were not installed in this orchard. On the other hand, with respect to the water management, the water sources are the storage tank collected rainfall and the groundwater. The spray irrigation method is applied by the perforated tubes a whole year. The amount of each irrigation is estimated to be about 18 mm at 5 days interval in summer season and 7 days interval in other seasons. Therefore, the amount of irrigation water per day is 3.6 mm in summer and about 2.6 mm in other seasons.

(4) *A case of the cut rose culture in Hirokawa town*

The cut rose cultures in the cultivation under cover are not popular yet, but the possibility of becoming popular in future seems to be active because the shipping time can be controlled. The rose plantation which was investigated is improved by soil dressing on the ready-made upland field, and it is devised so as to increase the permeability. The culture styles are that the furrow width is about 40 cm, the bed width about 80 cm, and the bed height about 10 cm. Cut rose flowers are shipped three times a year. The first shipping time is the middle of September, the second shipping time from the first part of October to the end of October, and the third shipping time is at the end of December. The soil pasteurization and the ponding for saline protection are executed at summer season. On the other hand, the water source is a Tameike. The spray irrigation method is applied by the use of the sprinkler nozzles of both side direction. The amount of each irrigation is estimated to be about 30 mm at 2 days interval in summer season, and about 30 mm at 10 days interval in other seasons. Therefore, the amount of irrigation water per day is 15 mm in summer and 3 mm in other seasons. Therefore, its for cut roses the magnitude of irrigation water per day in summer is found to be very higher than that of fruit trees.

(5) *A case of the carnation culture of in Hirokawa town*

The carnation culture in the cultivation under cover is very popularized everywhere in Japan. The land foundation investigated is not officially improved yet. But the improvement of surface layer is individually conducted by the soil dressing of sandy loam. Its thickness amounts to be about 20 cm or 30 cm. The drainage system is not installed. The culture styles are that the furrow width is about 40 cm, the bed width about 100 cm, and the bed height about 10 cm. And the carnation seedlings are planted at the first part of June, and the shippings of cut flowers are continued from the middle of November to the middle of May. The soil pasteurization and the ponding for saline protection are carried out at the end of May. On the other hand, with regard to the water management, the water source is the simplified city water. This water is transported to the storage tank which is installed near the vinyl house and is used as the irrigation water after it has been pressurized. The spray irrigation method is applied by the use of the sprinkler nozzle system of both side directions. And yet, irrigation is found to continue from the plant to the final shipping. The amount of each irrigation is estimated to be about 9 mm everyday in summer, and about 4 mm at 4 days interval or about 9 mm at 5 days interval in other seasons, the amount of irrigation water per day in summer is

seemed to be greater than the peak value of that of vegetables.

Considerations

The actual conditions of the land and water management in the cultivation under cover was investigated to Shiga, Nara, and Wakayama prefectures which are located around big cities. That is, these prefectures are located near the big consuming cities like Kyoto city, Osaka city, Sakai city, Kobe city etc.; and these prefectures originally belonged to the agricultural region. On that account, these prefectures are located at the supply bases from where the products of vegetables, fruits, and cut flowers are shipped to those big cities. On the other hand, the kind of main crops which cultivated is slightly different from place to place. That is, the strawberry cultures are very active in Nara and Wakayama prefecture, and its culture area is the largest of all vegetables. The characteristics of the crops cultivated in these prefectures suggested that the vegetables and the cut flower culture are very active in Shiga and Wakayama prefecture, and the vegetables (especially strawberries), the fruit trees (especially grapes) and the cut flower cultures in Nara prefecture. But in Wakayama prefecture, Unshu orange trees, lemon trees etc. which are not found in other prefectures are cultivated in the cultivation under cover. On the other hand, with regard to the actual conditions of the land and water management, lands which are utilized to the cultivation under cover were clarified to be almost the upland fields converted from the ricefield. Therefore, sandy soil or loam soil is used for dressing on and the rice straws are mixed as the organic matter into the original rice fields in order to improve the land foundation. Furthermore, the soil pasteurization and the ponding of the saline protection are conducted at many places in summer except the case of the fruit trees cultures. The land foundation improvements are clarified not to be at all established in many places officially. Secondary, with regard to the water management, the water source was very different, for example, Tameike, river, groundwater, rainfall, the simplified city water etc. The amount of irrigation water per day or the irrigation interval was clarified to be very different for the same kind of crops when they are planted in different places. This is considered to be dependent on the experiences of each farmer. Therefore, the fact which is found is that the most efficient water use is not necessarily conducted to the crop cultures.

Discussions

The investigations of the actual conditions about the land and water managements in the cultivation under cover were carried out on Shiga, Nara, and Wakayama prefecture. Consequently, main crops of vegetables in these prefectures are slightly different. And also with regard to the land and water management, their manners are found to be slightly different in different places too. As example we can mention, the water sources, the amount of irrigation water per day, the amount of each irrigation, the irrigation interval, etc. Therefore, the land and water managements which now depend on only the experiences of each farmer in the cultivation under cover must be established as soon as possible.

Finally, the authors wish to thank the persons concerned in each prefecture who cooperated with this study. And also, this study has been supported by the general study

(B) of the Scientific Study of the Education Ministry at the 59th year of Showa.

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