# A Study on the Relationship between Images of Colors Derived from Plants and Color Names

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## ABSTRACT

The colors have a close to our life and there are many color names derived from plants in Japan. This study aimed to analyze relationship people and plants and investigated what the images of colors derived from plants related to the color names. Surveys on color images of abstract and concrete were conducted with adults who lived in the metropolitan area and in urban areas. The subjects were surveyed about images of similar colors derived from plants(3 type of similar two colors; pink, green and yellow) and asked to select a pair of color names(*momo* or pink, *midori* or *green*, *yamabuki* or *lemon*) corresponding to the color. The subjects were simultaneously presented with two similar colors and asked to give their perceptions of each color against 13 polar opposite pairs of terms or phrases using a Semantic Differential Scale, and asked to select the number of the 16 items concerned with life such as clothes and food. With the pink colors, many subjects did not feel opposite abstract images between these two similar colors and felt the same concrete images such as 'cosmetics' and 'clothes', and these color names such as momo and pink are confused. With the green colors and the yellow colors, many subjects felt opposite abstract images between these two similar colors such as 'natural - artificial' and 'rural - urban' and different concrete images such as 'plants' and 'plastics', and these two similar colors are distinguished by the color names such as 'midori - green' and 'yamabuki - lemon'. The results revealed that there are two patterns in the relationship colors derived from plants, color images and color names. In the pattern which images of colors derived from plants are connected with artificial things irrelevant to plants, the color names corresponding to the two similar colors are confused. On the other hand, in the pattern which images of colors derived from plants are connected with plants and artificial things, the two similar colors are distinguished by their color names. So demographics influenced the images of color, younger subjects compared with older tend to obviously distinguish images of colors derived from plants, and there are images of color influenced by the environment as a child. In both patterns, images of colors derived from plants are influenced by artificial things and natural colors are limited among many people. These results indicate that there are a few opportunities to see colors of plants which are full of variety. These results suggest that it is necessary to recognize colors derived from plants in relation to plants and to educate regarding the nature of plants, therefore landscape architecture focused on colors of plants is required.

*Key Words: Colors Derived from Plants, Color Names, Color Images, Relationship between People and Plants, Artificial*

## I. Introduction

For example, red colors are sensed as warm and blue colors are sensed as cold(Kaneko, 1990), and colors inspire various images(Takei, 1995). Figure 1 shows the relationship between color, color image and color name. The survey(Kanazawa, 2003) examined the relationship between color and color image suggested that demographics influenced the color images
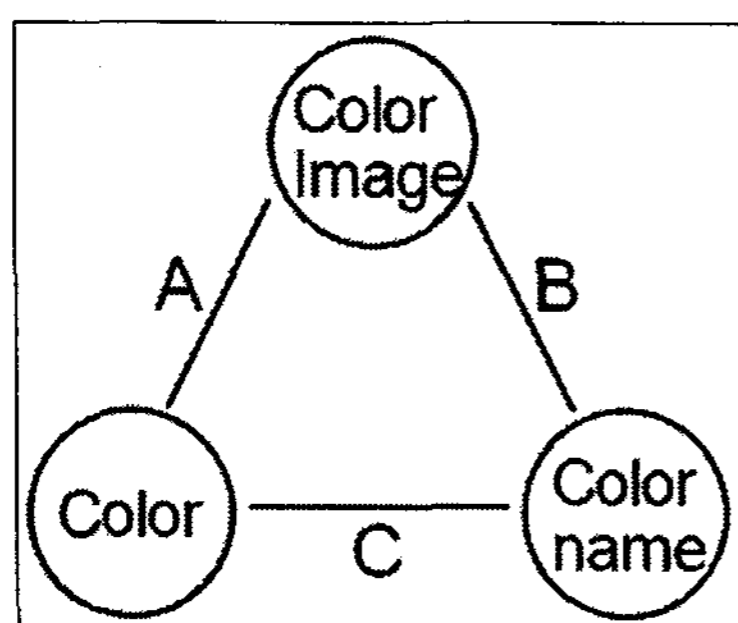
Figure 1. Relationship between color, color image and color name

(Figure 1, line A). On the other hand, words are connected with concrete images and abstract images, respectively(Mizushima and Uesugi, 1983). For example, *midori* means the color between blue and yellow, leaves of trees and grasses in spring or summer(Matsumura, 1988), and *midori* inspires various images. Such as *midori*, there are many color names derived from plants in Japan(Fukuda, 2001). The survey (Masuda and Iwasaki, 2006) reported images of color names derived from plants examined the relationship between color name and color image(Figure 1, line B). The survey suggest that images of these color names are reflected by the decline of the relationship between people and plants, such as the destruction of customs using plants, conversion to chemicals from plants and reduction of familiar plants. Besides these surveys, cross-cultural studies(Lin *et al.*, 2001a, 2001b) examined the relationship between color and color name are also reported(Figure 1, line C).

As mentioned above, images of color names derived from plants reflect the relationship between people and plants, so this study aimed to examine the relationship between images of colors derived from plants and color names(Figure 1, line A, B and C).

# II. Methods

## 1. Selection of Colors and Color Names for the Survey on Images of Color

The selected color were pink colors, green colors, and yellow colors in reference to the rate of flower colors of angiosperm(Yasuda, 1986), leaf colors and "JIS Z 8102" (Japan Standards Association Committee of JIS Note of Color Name, 2002). The selected color names were *momo* and pink for the pink colors, *midori* and *green* for the green colors, and *lemon* and *yamabuki* for the yellow colors, and two similar colors were distinguished by the value, and L(Light) or D(Dark) was added as an initial of the color colors name in this paper(Table 1).

## 2. Survey on Abstract Images of Color and Relationship between Abstract Images of Color and Color Name

From June to July 2006, the survey was conducted among 137 adults(45 males and 92 females) who lived in the metropolitan area and in urban areas. The questionnaires were handed out to the subjects and collected after they had responded. A total of 186 questionnaires was handed out and 137 questionnaires were returned.

The subjects were simultaneously presented with two similar colors and asked to give their perceptions of each color against 13 polar opposite pairs of terms or phrases, using a Semantic Differential Scale and each pair was scored from 1 to 5. The 13 polar opposite pairs were selected in reference to study on the effects of color schemes(Ito, 2004) and the

Table 1. Color sample and character of the sample

| Sample | Color group | | Munsell system* of sample | Color name by "JIS Z 8102" | Munsell system by "JIS Z 8102" |
|---|---|---|---|---|---|
| A | Pink | Dark Pink (DP) | 1.0R 6.0/12.0 | *momo* | 2.5R 6.5/8.0 |
| B | | Light Pink (LP) | 4.0R 7.0/9.5 | *pink* | 2.5R 7.0/7.0 |
| C | Green | Dark Green (DG) | 3.0G 4.0/8.0 | *green* | 2.5G 5.5/10.0 |
| D | | Light Green (LG) | 3.0G 5.0/10.0 | *midori* | 2.5G 6.5/10.0 |
| E | Yellow | Light Yellow (LY) | 7.0Y 8.5/11.0 | *lemon* | 8.0Y 8.0/12.0 |
| F | | Dark Yellow (DY) | 9.0YR 7.0/11.0 | *yamabuki* | 10.0YR 7.5/13.0 |
| mount | — | | N 9.5 | — | — |

*Munsell system: hue, value, chroma

psychological effects of plants(Lour and Pearson-Mims, 2000; Nakamoto *et al.*, 2001). Then, the subjects were asked to select the color name that corresponded to the color. Each sample was two similar color tips(30×30 mm) at intervals of 80 mm and was mounted on white matte card(128×182 mm), and each color was marked alphabetically. The subjects were asked to judge the color and select the color name in alphabetical order.

A demographic questionnaire was developed to obtain information from the subjects about factors such as their sex, age group, location of childhood residence, and current location of residence. Answers to questions on sex(male, female), age group(under 20s, 30s, 40s, 50s, over 60s), location of residence(urban area, farming village, fishing village, mountain village) were entered respectively. Because there were few subjects who had lived or now lived in fishing villages or mountain villages, they were associated with farming villages, and these groups were called rural group(Table 2).

A Wilcoxon signed-rank test was used to decide whether a mean difference between two similar colors was statistically significant. A Wilcoxon rank-sum test was used to decide whether a mean respective difference between the demographic characteristics of the subjects was statistically significant.

## 3. Survey on Concrete Images of Color and Relationship between Concrete Images of Color and Color Name

In August 2006, the survey was conducted among 87

Table 2. Demographic characteristics of subjects of survey on abstract images of color

| age | sex | location of childhood residence | | | | total |
| | | urban | | rural | | |
| | | current location of residence | | | | |
| | | urban | rural | urban | rural | |
| under 20s | male | 13 | 0 | 5 | 4 | 22 |
| | female | 14 | 0 | 6 | 14 | 34 |
| 30s | male | 0 | 0 | 0 | 4 | 4 |
| | female | 9 | 1 | 1 | 11 | 22 |
| 40s | male | 2 | 0 | 0 | 3 | 5 |
| | female | 1 | 0 | 3 | 9 | 13 |
| 50s | male | 2 | 1 | 1 | 4 | 8 |
| | female | 7 | 0 | 1 | 4 | 12 |
| over 60s | male | 4 | 0 | 1 | 1 | 6 |
| | female | 7 | 0 | 3 | 1 | 11 |
| all | male | 21 | 1 | 7 | 16 | 45 |
| | female | 38 | 1 | 14 | 39 | 92 |
| | total | 59 | 2 | 21 | 55 | 137 |

Table 3. Demographic characteristics of subjects of survey on abstract images of color

| age | sex | location of childhood residence | | | | total |
| | | urban | | rural | | |
| | | current location of residence | | | | |
| | | urban | rural | urban | rural | |
| under 20s | male | 12 | 1 | 3 | 1 | 17 |
| | female | 10 | 0 | 6 | 3 | 19 |
| 30s | male | 2 | 0 | 0 | 2 | 4 |
| | female | 8 | 0 | 1 | 2 | 11 |
| 40s | male | 3 | 0 | 0 | 0 | 3 |
| | female | 1 | 0 | 0 | 0 | 1 |
| 50s | male | 1 | 0 | 1 | 0 | 2 |
| | female | 1 | 0 | 7 | 0 | 8 |
| over 60s | male | 3 | 0 | 3 | 3 | 9 |
| | female | 8 | 1 | 3 | 1 | 13 |
| all | male | 21 | 1 | 7 | 6 | 35 |
| | female | 28 | 1 | 17 | 6 | 52 |
| | total | 49 | 2 | 24 | 12 | 87 |

adults(35 males and 52 females) who lived the metropolitan area and urban areas. The questionnaires were handed out to the subjects and collected after they had responded. A total of 102 questionnaires was handed out and 87 questionnaires were returned. Subjects were simultaneously presented with two similar colors as in the previous survey and asked to select the number of the 16 items(1. nature, 2. art, 3. plants, 4. plastics, 5. graphics, 6. pigment, 7. dye, 8. clothes, 9. food, 10. building, 11. cosmetics, 12. spring, 13. summer, 14. autumn, 15. winter, 16. others), and select the color name that corresponded to the color. A demographic questionnaire was developed to obtain information from the subjects on factors such as sex, age group, location of childhood residence, and current location of residence(Table 3).

A test of Independence was used to decide whether a mean difference between the demographic characteristics of subjects was statistically significant.

## III. Results

### 1. Relationship between Abstract Images of Color and Color Name

1) The abstract images of the color

Many subjects felt that Sample B(LP) was brighter, more relaxed, easier, more pleasant, closer, calmer, and more comfortable than Sample A(DP), but many subjects did not feel opposite images between these samples(Table 4).

Many subjects felt that Sample C(DG) was dark, familiar, natural and rural, but Sample D(LG) was bright, unfamiliar,

Table 4. Abstract images of sample A(Dark Pink) and sample B(Light Pink)

| | 1 | 2 | 3 | 4 | 5 | | |
|---|---|---|---|---|---|---|---|
| bright | 11.7 / 36.5 | 43.1 / 48.2 | 19.0 / 10.9 | 26.3 / 3.6 | 0.0 / 0.7 | dark | ** |
| unfamiliar | 7.3 / 6.6 | 25.5 / 37.2 | 40.1 / 32.8 | 23.4 / 18.2 | 3.6 / 5.1 | familiar | NS |
| relaxed | 5.1 / 13.1 | 23.4 / 40.1 | 44.5 / 38.7 | 22.6 / 7.3 | 4.4 / 0.7 | tense | ** |
| artificial | 10.9 / 1.5 | 33.6 / 29.2 | 30.7 / 38.0 | 21.2 / 24.8 | 3.6 / 6.6 | natural | * |
| vigorous | 10.9 / 9.5 | 29.9 / 38.0 | 46.0 / 46.7 | 11.7 / 5.8 | 1.5 / 0.0 | tired | NS |
| cool | 1.5 / 0.0 | 8.0 / 5.8 | 23.4 / 30.7 | 38.0 / 38.7 | 29.2 / 24.8 | warm | NS |
| easy | 10.9 / 14.6 | 34.3 / 43.1 | 38.7 / 32.8 | 14.6 / 9.5 | 1.5 / 0.0 | uneasy | * |
| unpleasant | 4.4 / 2.9 | 13.1 / 5.1 | 34.3 / 35.0 | 29.9 / 37.2 | 18.2 / 19.7 | pleasant | * |
| close | 9.5 / 9.5 | 20.4 / 28.4 | 43.8 / 48.2 | 23.4 / 13.1 | 2.9 / 0.7 | distant | * |
| exciting | 1.5 / 0.0 | 19.0 / 7.3 | 51.1 / 51.8 | 24.1 / 28.5 | 4.4 / 12.4 | calm | ** |
| beautiful | 18.2 / 13.9 | 43.1 / 43.1 | 27.7 / 36.5 | 10.2 / 5.1 | 0.7 / 1.5 | ugly | NS |
| uncomfortable | 0.7 / 0.0 | 8.8 / 5.3 | 48.2 / 39.4 | 31.4 / 43.3 | 10.9 / 10.9 | comfortable | * |
| rural | 2.2 / 4.4 | 24.1 / 22.6 | 29.9 / 34.3 | 35.0 / 31.4 | 8.8 / 7.3 | urban | NS |

Means are based on a scale of 1-5, with 1 most associated with the left term in the pair and 5 most associated with the right term in the pair
upper line : Percentage of subjects of survey on sample A, lower line : Percentage of subjects of survey on sample B
Wilcoxon signed rank test,  *p<.05 **.p<.01 NS:not significance

Table 5. Abstract images of sample C(Dark Green) and sample D(Light Green)

| | 1 | 2 | 3 | 4 | 5 | | |
|---|---|---|---|---|---|---|---|
| bright | 2.9 / 27.7 | 9.5 / 64.2 | 14.6 / 3.6 | 69.3 / 4.4 | 3.6 / 0.0 | dark | ** |
| unfamiliar | 2.2 / 8.0 | 4.4 / 44.5 | 44.5 / 32.1 | 43.8 / 9.5 | 5.1 / 5.8 | familiar | ** |
| relaxed | 13.9 / 15.3 | 40.9 / 40.9 | 35.8 / 31.4 | 8.0 / 12.4 | 1.5 / 0.0 | tense | NS |
| artificial | 2.2 / 5.1 | 13.1 / 34.3 | 21.9 / 27.7 | 40.9 / 21.9 | 21.9 / 10.9 | natural | ** |
| vigorous | 9.5 / 13.9 | 24.1 / 44.5 | 56.2 / 38.0 | 9.5 / 3.6 | 0.7 / 0.0 | tired | ** |
| cool | 0.7 / 0.0 | 17.5 / 16.1 | 44.5 / 43.8 | 30.7 / 35.0 | 6.6 / 5.1 | warm | NS |
| easy | 16.1 / 12.4 | 35.8 / 40.9 | 33.6 / 36.5 | 13.1 / 9.5 | 1.5 / 0.7 | uneasy | NS |
| unpleasant | 1.5 / 0.0 | 5.8 / 5.1 | 35.0 / 29.9 | 35.8 / 45.3 | 21.9 / 19.7 | pleasant | NS |
| close | 17.5 / 11.7 | 36.5 / 32.8 | 34.3 / 41.6 | 10.9 / 13.9 | 0.7 / 0.0 | distant | NS |
| exciting | 0.0 / 0.0 | 2.2 / 5.8 | 40.1 / 49.6 | 33.6 / 32.1 | 24.1 / 12.4 | calm | ** |
| beautiful | 13.9 / 19.7 | 31.4 / 44.5 | 41.6 / 31.4 | 11.7 / 4.4 | 1.5 / 0.0 | ugly | ** |
| uncomfortable | 0.0 / 0.7 | 2.9 / 0.7 | 39.4 / 37.2 | 42.3 / 45.3 | 15.3 / 16.1 | comfortable | NS |
| rural | 16.1 / 6.6 | 48.9 / 19.0 | 23.4 / 25.5 | 9.5 / 40.9 | 2.2 / 8.0 | urban | ** |

Means are based on a scale of 1-5, with 1 most associated with the left term in the pair and 5 most associated with the right term in the pair
upper line : Percentage of subjects of survey on sample C, lower line : Percentage of subjects of survey on sample D
Wilcoxon signed rank test,  *p<.05 **.p<.01 NS:not significance

artificial and urban, so it was suggested that the images of Sample C differed from Sample D(Table 5).

Many subjects felt that Sample E(LY) was unfamiliar, tense, artificial, distant, exciting and urban, but Sample F(DY) was familiar, relaxed, natural, close, calm and rural, so it was suggested that the images of SampleE differed from Sample F.
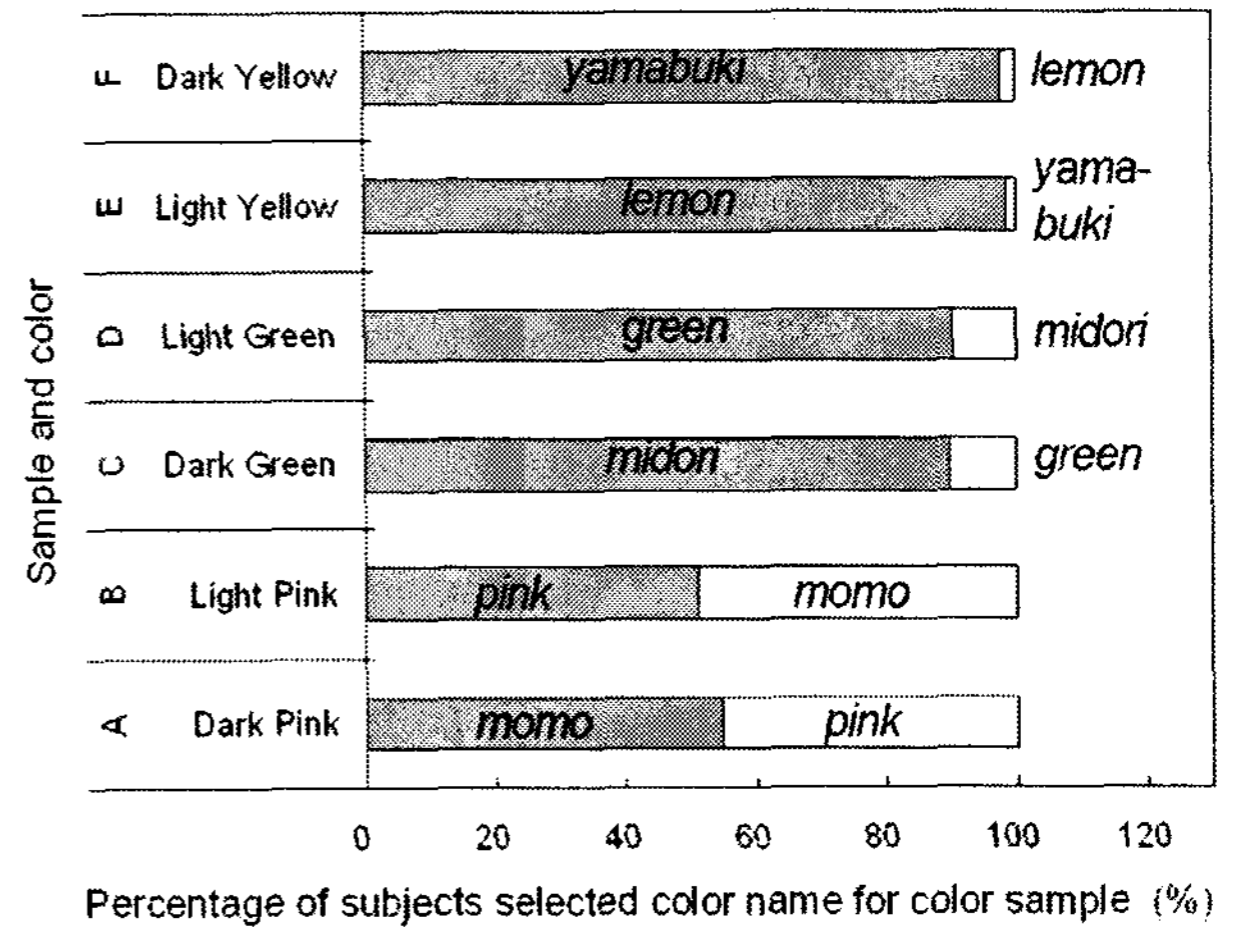


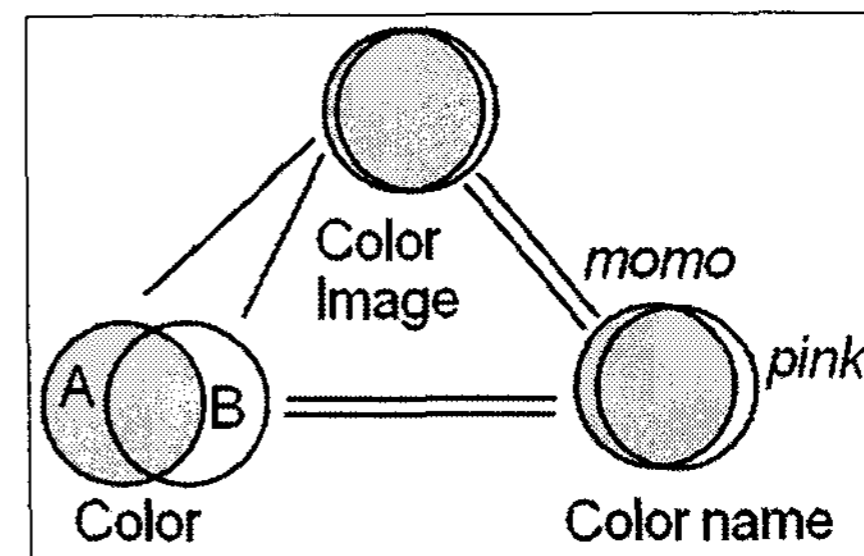Figure 2. Selection rate of color name corresponding to color sample



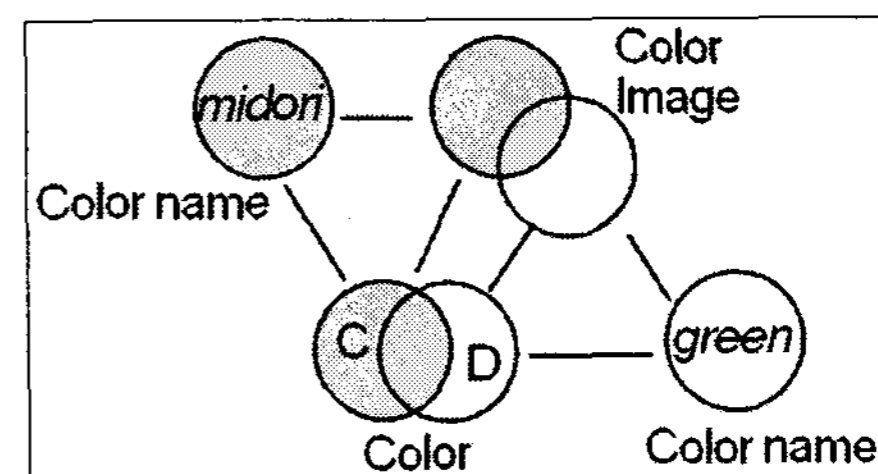Figure 3. Relationship between color, color image and color name of sample A and sample B



Figure 4. Relationship between color, color image and color name of sampleC and sample D

2) Selection rate of color name corresponding to the color

The percentage of subjects who selected the same color name was about a half for Sample A(momo: 54.7%) and Sample B(pink: 51.1%)(Figure 2). This result indicated that many subjects confused color names corresponding to the two similar colors(Figure 3).

On the other hand, most of the subjects selected midori for Sample C(89.8%), green for Sample D(90.5%), lemon for Sample E(98.5%) and yamabuki(97.8%) for Sample F (Figure 2). This result indicated that two similar colors were distinguished by color names respectively(Figure 4). Demo-

graphics influenced the images of color. There were "exciting – calm" and "rural – urban" that showed significant differences between urban residents and rural residents in childhood and subjects who lived in an urban area in childhood tended to felt that Sample D was urban, but not calm.

## 2. Relationship between Concrete Images of Color and Color Name

1) Relationship between the concrete images of color and color name

Many subjects felt same images such as clothes and cosmetics for Sample A and B, and there were a few items that showed significant differences between these samples (Table 6), the percentage of subjects who selected the same color name was about a half for Sample A(*pink*: 57.5%) and for Sample B(*momo*: 60.9%). This result indicated that many subjects confused color names corresponding to the two similar colors.

Many subjects felt that Sample C was nature, plants and summer, but Sample D was art, plastics, graphics and spring (Table 6). Also in this survey, most of the subjects selected *midori* corresponding to Sample C(89.7%), and on the other hand, *green* corresponding to Sample D(86.2%). The previous study(Masuda and Iwasaki, 2006) examined images of color names derived from plants reported that there were

many people who connected *midori* with nature and plants, but *green* with art. These results suggest that images of a color name(Figure 1, line B) correspond with images of the color(Figure 1, line A) and two similar colors were distinguished by color names such as *midori* and *green*.

Many subjects felt different images between Sample E and F such as Sample C and D. Most of the subjects selected *lemon* corresponding to Sample E(95.4%) and *yamabuki* corresponding to Sample F(95.4%). These results suggest that two similar colors were also distinguished by color names such as *lemon* and *yamabuki*. There were significant differences between subjects of the younger generation and those of the older generation, so the younger tended to feel that Sample C was plants and Sample D was art.

## IV. Conclusion

This study discussed the relationship between images of colors derived from plants and color names. The results are as follows.

1. With the pink colors, many subjects felt the same images and color names such as *momo* and *pink* are confused.
2. With the green colors and the yellow colors, many subjects felt different images between similar colors and these colors are distinguished by color names such as

Table 6. Concrete images of color sample

| Sample Color group | A Dark Pink | B Light Pink | | C Dark Green | D Light Green | | E Light Yellow | F Dark Yellow | |
|---|---|---|---|---|---|---|---|---|---|
| nature | 4.6 | 16.1 | * | 63.2 | 27.6 | ** | 19.5 | 35.6 | * |
| art | 31.0 | 16.1 | * | 4.6 | 42.5 | ** | 32.2 | 14.9 | ** |
| plants | 6.9 | 13.8 | NS | 77.0 | 49.4 | ** | 17.2 | 37.9 | ** |
| plastics | 9.2 | 9.2 | NS | 1.1 | 16.1 | ** | 25.3 | 4.6 | ** |
| graphics | 17.2 | 9.2 | NS | 5.7 | 18.4 | * | 12.6 | 9.2 | NS |
| pigment | 32.2 | 28.7 | NS | 8.0 | 6.9 | NS | 4.6 | 4.6 | NS |
| dye | 44.8 | 29.9 | * | 19.5 | 20.7 | NS | 17.2 | 34.5 | ** |
| clothes | 39.1 | 33.3 | NS | 9.2 | 17.2 | NS | 29.9 | 20.7 | NS |
| food | 5.7 | 6.9 | NS | 25.3 | 9.2 | ** | 42.5 | 23.0 | ** |
| building | 3.4 | 6.9 | NS | 2.3 | 3.4 | NS | 6.9 | 8.0 | NS |
| cosmetics | 37.9 | 43.7 | NS | 0.0 | 0.0 | - | 1.1 | 3.4 | NS |
| spring | 27.6 | 51.7 | ** | 8.0 | 28.7 | ** | 11.5 | 6.9 | NS |
| summer | 11.5 | 3.4 | * | 51.7 | 32.2 | ** | 25.3 | 9.2 | ** |
| autumn | 9.2 | 9.2 | NS | 5.7 | 2.3 | NS | 12.6 | 57.5 | ** |
| winter | 5.7 | 3.4 | NS | 3.4 | 0.0 | NS | 4.6 | 5.7 | NS |
| others | 4.6 | 6.9 | - | 6.9 | 8.0 | - | 6.9 | 5.7 | - |

Percentage of answers obtained from 87 subjects
Test of Independence. *p<.05 **p<.01 NS:not significance

'*midori-green*' and '*yamabuki-lemon*'.

In the pattern of Figure 3, images of colors derived from plants are connected with artificial things such as clothes and cosmetics, and the color names are confused. If the subjects were familiar with plants and there were opportunities to recognize colors in relation to plants, the relationship among colors, color images, and color names were strongly correlated, so the color names were not confused. In the pattern of Figure 4, similar colors of which images are different such as "nature - art" were distinguished by color names. This result suggests that natural colors are limited among many people. For example, there is a report that the green colors of trees is generally about six degrees of chroma, but it goes up to about seven degrees of chroma in spring(Nagata, 1986), so colors of plants vary with the variety and the growth stage of plants in addition to the season. Moreover, compared with older subjects, younger subjects tend to obviously distinguish images of colors derived from plants, and there are images of color influenced by the environment as a child. These results suggest that it is necessary to recognize colors derived from plants in relation to plants and to educate regarding the nature of plants, therefore landscape architecture focused on colors of plants is required.

## Acknowledgement

## References

1. Fukuda, K.(2001) Color name encyclopedia, Shufuno Tomo, Tokyo, p. 439.
2. Ito, K.(2004) Affective effects of two-color combinations within the same hue, Color Science Association of Japan 28(1), pp. 3-15.
3. Japan Standards Association Committee of JIS Note of Color Name(2002) JIS Z 8102 Textbook JIS Note of Color Name the second edition, Japan Standards Association, Tokyo, p. 63.
4. Kanazawa, R.(2003) The investigation of color image in words, Color Science Association of Japan 27(SUPPLEMENT), pp. 118-119.
5. Kaneko, T.(1990) Psychology of color, Iwanami Shoten, Tokyo, p. 234.
6. Lin, H., M. R. Luo, L. W. MacDonald, A. W. S. Tarrant(2001a) A cross-cultural colour-naming study. Part 1: Using an unconstrained method, Color Research and Application 26(1), pp. 40-60.
7. Lin, H., M. R. Luo, L. W. MacDonald, A. W. S. Tarrant(2001b) A cross-cultural colour-naming study. Part 2: Using a constrained method, Color Research and Application 26(3), pp. 193-208.
8. Lohr, V. I., C. H. Pearson-Mims(2000) Physical discomfort may be reduced in the presence of interior plants, HortTech 10(1), pp. 53-58.
9. Masuda, K., Y. Iwasaki(2006) A study on the relationship between Japanese and plants by analysis of the images of the colors and the color names derived from plants, Environmental Information Science 20, pp. 183-188.
10. Matsumura, A.(1988) Daijirin, Sanseido, Tokyo, p. 771.
11. Mizushima, K., T. Uesugi(1983) Basic psychology of image, Seishin Publishers, Tokyo, p. 325.
12. Nagata, Y., S. Yoshida, Y. Sakai, H. Miyazawa(1986) Color guide for architecture Hyogo, Color Science Association of Japan 10(1), pp. 40-41.
13. Nakamoto, Y., H. Nishina, Y. Hashimoto(2001) Analysis of amenity effect of ornamental foliage plants, imitation plants and photograph on human psychology, Environment Control in Biology 39(3), pp. 167-173.
14. Takei, K.(1995) An Introduction: Art and Color, Bijutsu Shuppan-Sha, Tokyo, p. 206.
15. Yasuda, H.(1986) Mystery of flower's color, Tokai University Press, Tokyo, pp. 12-16.