# Comparisons of yield potential in spring and autumn sowing cultivation of rapeseed (*Brassica napus* L.)

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**Abstract**

The purpose of this trial was conducted to test yield potential in spring and autumn sowing cultivation. Field tests were conducted with $F_1$ hybrids of two cultivars of 'Sunmang' and 'Chungram' and pedigree lines of two cultivars of 'Hallayuchae', and 'Tamlayuchae' during two years at Muan county(the north latitude 34°58′, the east longitude 126°27′) of southwestern peninsula. The yield potential of autumn sowing cultivation was higher than those of spring sowing cultivation. Because culturing periods of spring season was shorter than those of autumn season. In spring and autumn sowing cultivation, all the investigated morphological characters are shown to a higher extent in the composite $F_1$ hybrids compared to the pedigree line. $F_1$ hybrids had a greater yield potential because the yield components such as number of productive plants per $m^2$, siliqua per plant, and seeds per siliquae were higher than those of pedigree lines.

**Key words**: rapeseed, *Brassica napus*, cultivation, spring and winter

## Introduction

Rapeseed which is grown for its edible oil and biodiesel fuel, is one of the most important oil crops in the Republic of Korea, providing good quality oil, meal, honey and beautiful scenery. The commercial production of rapeseed in Korea started in the 1960's and by 1975 rapeseed was planted more than 26,000 hectares were covered by rapeseed crop. The rapeseed plant is successfully grown from October to June in the southern areas of Korean peninsula, and its yellow flowera also provide honey and beautiful scene to tourists, particularly in Jeju island. Today, rapeseed that is zero in erucic acid content has grown only 1,500 hectares for edible oil or sightseeing.

The growth of rapeseed is most vigorous in temperatures between 10° and 30°C with the optimum around 20°C. Rapeseed is very sensitive to high temperatures at the blooming time even when ample moisture is available. Long periods of over 30°C can result in severe sterility and high yield losses. During the pod-filling period rapeseed is somewhat more tolerant to high temperatures. The seed oil content, however, is highest when the seeds mature under low temperatures (10° to 15°C). Extended periods of high temperature during the seed-fill period invariably result in low oil contents and poor seed quality.

The rapeseed plant's ability to tolerate low temperatures depends essentially on its development and the degree of hardening it has achieved. Unhardened plants can survive -4°C, while fully-hardened spring type rapeseed can survive -10deg. to -12°C. Hardened winter rapeseed can survive short periods of exposure to temperatures between -15° and -20°C. Dehydration during sunny and/or windy days while the soil is frozen can cause extensive winter kill in much higher temperatures even when the plants are optimally developed and fully hardened.

Seeing the present condition of supply and demand of energy in the world, we are confronted by a crisis due to kenosis of fossil fuel such as petroleum, coal, natural gas, and uranium. The Republic of Korea has been discussing the introduction of the obligatory blending of 5% or 20% biodiesel into fossil diesel. This example can be used to illustrate how the proposed measure would incur high costs yet yield almost no positive effects for the environment and for security of supply. The actual environmental friendliness of biodiesel depends not only on the efficiency with which they are processed and used, but on how ecological and socially compatible the agricultural raw materials for them are produced.

First of all, it is essential to improve the potentials for raw materials of biodiesel production. A plan of problem solution is increased the rate of arable land utilization, through the introduction of double cropping system or vegetable oil crops cultivation of fallow land. Rapeseed culture could be concentrated in the southern Korea where rice-rapeseed double cropping system would be profitable for farmers. Double dropping increases the utilization of paddy fields.

Stage of seed development at harvest influences both rapeseed yield and seed quality. Harvesting too early may result in low yield and poor seed quality, whereas harvesting too late may result in shattering and reduced seed yield (Oplinger et al., 1989). Harvesting at full maturity (when seed moisture content is near 100g $kg^{-1}$) is preferred for better threshing and storability because of the suitable moisture content of both pods and seeds. However, it may be advisable to harvest the crop at physiological maturity than at harvest maturity if the crop is excessively weedy (Salunkhe and Desai, 1986; Fenwick, 1988) or to avoid excessive bird damage or unfavorable weather conditions during late maturation and harvest (possible frost damage or excessive rain). Therefore, it is important to determine when physiological maturity is reached in rapeseed. Because quick field estimation of physiological maturity from physiological measurements such as seed dry weight or moisture content is somewhat difficult, methods for determining physiological maturity in rapeseed based on morphological indicators are needed. Identification of harvest maturity is important because the proper period for harvesting rapeseed is short.

The objectives of this study were to establish cultural practice for yield potential of spring and autumn cultivation and to evaluate the agronomic characteristics of rapeseed in southern areas of Korea.

## Materials and Methods

The experiment was performed in the field of Mokpo Experiment Station during two years of 2004-2006.

We were used winter types of $F_1$ hybrids of two cultivars of 'Sunmang' and 'Chungram' and pedigree lines of two cultivars of 'Hallayuchae', and 'Tamlayuchae'. The sowing time of spring culture was March 15$^{th}$ and the sowing time of autumn culture was October 15$^{th}$. Their sowing amount was 1.0kg/10a. Plots, 6.5m$^2$ in size, were arranged in a randomized complete block design with three replications. The mode of sowing was drill seeding as the ridge width of 40cm, and the seeding of 5cm. The investigation of agronomic characteristics was during growing season. Their item included the following pre-harvest characters: flowering times, maturing times, plant height at maturity, No. of plants per m$^2$, degree of lodging, and degree of sclerotial disease. Yield components included No. of branches, No. of siliqua on the main raceme, No. of setted seeds per siliquae, and weight of 1,000 grains. The measurement of oil content was used the method of ether extraction with soxhlet equipment.

## Results

The aim of the experiment was to estimate yield potentials to the expression of rapeseed productivity and to compare yield between $F_1$ hybrids and pedigree lines in spring and autumn culture.

In spring culture, Yield of $F_1$ hybrids were higher than that of pedigree lines because of high expression of yield components. But the yield of $F_1$ hybrids and pedigree lines was lower than original yield. Because the growing period of spring culture was shorter than that of autumn culture. In two cultivars of $F_1$ hybrids, 'Sunmang' was expressed more favorable growth condition than that of ' Cheongram'. Flowering times and maturing times of 'Sunmang' was very early among tested cultivars (Table 1, 2).

**Table 1. Comparison of agronomic characteristics of $F_1$ hybrids and pedigree lines in spring culture.**

| Cultivars | Flowering times | Maturing times | No. of plants per m$^2$ | Plant height | Degree of lodging | Degree of sclerotial disease |
|---|---|---|---|---|---|---|
| Sunmang ($F_1$ hybrid) | June 16th | July 25th | 74 | 137 | 0 | 0 |
| Cheongram ($F_1$ hybrid) | June 17th | July 27th | 72 | 139 | 0 | 0 |
| Hallayuchae (pedigree line) | June 17th | July 27th | 69 | 114 | 0 | 0 |
| Tamlayuchae(pedigree line) | June 19th | July 29th | 72 | 128 | 0 | 0 |

**Table 2. Comparison of yield, yield components and oil content of $F_1$ hybrids and pedigree lines in spring culture.**

| Cultivars | No. of branches | No. of siliqua on the main raceme | No. of setted seeds per siliquae | Weight of 1,000 grains | Yield (kg/ha) | Oil Content (%) |
|---|---|---|---|---|---|---|
| Sunmang ($F_1$ hybrid) | 5 | 21 | 13 | 3.4 | 1,830 | 41.5 |
| Cheongram ($F_1$ hybrid) | 5 | 20 | 13 | 3.5 | 1,815 | 41.2 |
| Hallayuchae (pedigree line) | 3 | 18 | 11 | 3.3 | 1,320 | 42.0 |
| Tamlayuchae(pedigree line) | 3 | 18 | 11 | 3.5 | 1,350 | 42.0 |

The yield potentials of autumn culture were contrasted with spring culture. The growth period of autumn culture was longer than that of spring culture. All of $F_1$ hybrids and pedigree lines were shown a good growth ability and their yield components of autumn culture were higher than that of spring culture.

In autumn culture, the plant height of $F_1$ hybrids showed a increase as compared with that of spring culture. The increased plant height makes it possible for the $F_1$ hybrids to produce more yield potentials. This can be seen from increased number of branches and siliqua. Particularly, Increasing of the number of siliqua on the main raceme of $F_1$ hybrids was produced grain yield more than 4,200kg per hectare. The oil content of $F_1$ hybrids and pedigree lines at autumn culture were more increased than that of spring culture because the growth period of autumn culture was longer than that of spring culture. And also the maturing times of 'Sunmang'($F_1$ hybrid) was early a 5days as compared with that of pedigree lines (Table 3, 4).

This is advantage by means of security raw materials for the production of biodiesel through winter culturing of rapeseed in paddy fields and fallow land. Early maturity of rapeseed was considered desirable situation to reduce the competition between two crops in rice-rapeseed double cropping system.

**Table 3. Comparison of agronomic characteristics of $F_1$ hybrids and pedigree lines in autumn culture.**

| Cultivars | Flowering times | Maturing times | No. of plants per m$^2$ | Plant height | Degree of lodging | Degree of Sclerotial disease |
|---|---|---|---|---|---|---|
| Sunmang ($F_1$ hybrid) | April 11th | June 5th | 113 | 142 | 0.3 | 0 |
| Cheongram ($F_1$ hybrid) | April 20th | June 16th | 115 | 148 | 0 | 0 |
| Hallayuchae (pedigree line) | April 17th | June 11th | 110 | 126 | 0 | 0 |
| Tamlayuchae(pedigree line) | April 21th | June 17th | 109 | 129 | 0 | 0 |

**Table 4. Comparison of yield, yield components and oil content of $F_1$ hybrids and pedigree lines in auyumn culture.**

| Cultivars | No. of branches | No. of siliqua on the main raceme | No. of setted seeds per siliquae | Weight of 1,000 grains | Yield (kg/ha) | Oil Content (%) |
|---|---|---|---|---|---|---|
| Sunmang ($F_1$ hybrid) | 7 | 53 | 24 | 4.2 | 4,480 | 45.5 |
| Cheongram ($F_1$ hybrid) | 7 | 52 | 23 | 4.2 | 4,240 | 44.5 |
| Hallayuchae (pedigree line) | 4 | 35 | 20 | 4.2 | 2,840 | 44.3 |
| Tamlayuchae(pedigree line) | 4 | 35 | 20 | 4.3 | 2,860 | 44.6 |

## Conclusion

The results from this experiment show that it will be possible immediately to promote the spread of $F_1$ hybrids which are more vigor and higher yield than that of pedigree lines. Especially, early maturity of rapeseed is emphasized because of the competition in rice-rapeseed double cropping system. Identification of harvest maturity is important because the proper period for harvesting rapeseed is short.

So we should be achieved in order to develop of $F_1$ hybrids which have high yield potentials and early maturity. In addition, the trials of combing ability and yield in order to select best $F_1$ hybrids have to conduct several area which are different climates and soil conditions because of unlike in the expression of the agronomic characteristics.

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