

Effect of Transplanting Dates and Density on Dry Root Yield in *Alisma plantago* Cultivated after Early Maturing Rice Cropping

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ABSTRACT

The result of this experiment which are conducted, to improve the cultivation technology of *Alisma plantago*, to increase its quantity and to contribute for stable production with Yongjun local group by examining the optimal planting density and transplanting period of double cropping of *Alisma plantago* in the southern region. The characters of plant height, leaf width and length tend to be reduced as the seeding period is later by the order of the 10th, 20th and 30th of July. The period required for flowering is reduced as the transplanting period is later and dense planting is applied. Plant height, the number of leaves and yield of dry root have much quantity at the dense planting density of 20 x 15cm as they are transplanted later in the 30th of August or the 10th of September, but they are rather less in sparse planting density of 20 x 25cm or 20 x 35cm.

Key Words : *Alisma plantago*, transplanting date and density, dried root yield

INTRODUCTION

Alisma plantago is perennial herb grown in pond or water as medicinal crop used for diuresis, vomit and dizziness. Its rootstock is short, fibrous root grows dense and petiole is long and oval. In Korea *Alisma plantago* of 100ha is cultivated in Suncheon and it occupies 76% of the national cultivation area 130ha. *Alisma plantago* is double cropping after early cultivation of rice and when it is transplanted to the main rice field in the 30th of August, it blooms in the 20th of September and then farmhouse eliminates the

rachis, the nutrients required for seeding are delivered to root and the growth of root is fostered.

There were many researches of major characters and quantity of *Perilla frutescens* depending on the seeding period by Choi et al., (1991), growth and quantity of *Cassia tora* according to vinyl covering and the change of seeding period by Kwon et al., (1990), quantity of fiber and sexual presentation rate by planting density of cannabis by Kwon et al., (1996) and the influence of planting density of *Perilla frutescens* on its growth and quantity by Park et al., (1995), but there was no research on the change of quantity according to the difference of planting density and seeding period of

Table 1. Soil properties of the experimental plot at the beginning of experiment.

pH(H ₂ O)	EC	OM	T-N	Av. P ₂ O ₅	Ex. cation(cmolt/kg)			SiO ₂
					K	Ca	Mg	
1 : 5	(ds/m)	(g/kg)	(mg/kg)	(mg/kg)				
5.2	0.093	20.7	0.34	952	0.66	3.74	0.98	40

double cropping of *Alisma plantago*. Therefore, this experiment is to investigate the optimal seeding period and planting density with the double cropping of *Alisma plantago*.

MATERIALS AND METHODS

This experiment was conducted at farmhouse field, Haeryong-myeon, Suncheon-city, Chonnam from July to December 1999, Physicochemical composition of arable soil layer has 5.2 pH and rich contents of organic matters and phosphate, but its contents of K, Ca and Mg are low as shown in Table 1.

Test variety is Yongjun, the placement of experimental plot is made on the basis of seeding period (transplanting period) and seeding is carried out in July 10 (transplanted in Aug. 20), July 20 (transplanted in Aug. 30) and July 30 (transplanted in Sep. 10). Planting density has three plots and it is tested by three repetitions with divided plot placement planted by 20 x 15cm, 20 x 25cm and 20 x 35cm respectively. Seedbeds apply 25kg of complex fertilizer (21-17-17) and 200kg of compost at the area of 66m² and after making seedbed of 120cm wide, the mixture of 1 l of seed and 10 l of sand are sown equally on the whole surface of seedbed.

Water is provided only for furrow before it sprouts after seeding and the vinyl tunnel is installed for preventing the loss of seeds by showers. When it sprouts completely after 10 days of seeding, water is provided to top by night and it is provided only for furrow by day.

As seed grows, water is provided more and it is managed by the depth of 3cm. Amount of application to

the main rice field is 100kg of complex fertilizer (21-17-17) per 10a and 2,000kg of compost and 50kg of urea is applied as the first addition in 30 days of transplantation and 50kg of urea is applied as the second addition in 60 days of transplantation.

For the prevention of damages by blight and harmful insects, Chlorothalonil-Wp. 75% is applied for preventing Brown leaf blight, Imidacloprid-Wp. 10% for aphides and Tebufenozide-Wp. 8% for *Spodoptera exigua* by three times at intervals of 10 days after 10 days of transplantation.

Other controls conform to the cultivation of second cropping *Alisma plantago* of early cultivated rice at farmhouse, Haeryong-myeon, Suncheon-city and when flower stalk buds in the flowering time, the lower part of the root is cut before hardening. For the investigation of growth and characteristic, 20 samples showing uniform growth are selected and the examination method is based on the standard of medicinal crops of Rural Development Administration.

RESULTS AND DISCUSSION

1. Examination of nursery characters and flowering reaction

In the growth condition of nursery according to seeding period at seedbed, the plant height of nursery is 29cm at seeding groove in the 10th of July, 28cm at seeding groove in the 20th of July and 25cm at seeding groove in the 30th of July, and the leaf width of nursery is 3.9cm at seeding groove in the 10th of July, 3.8cm at seeding groove in the 20th of July and 3.7cm at seeding groove in the 30th of July, the leaf length of nursery is

9.4cm at seeding groove in the 10th of July, 8.2cm at seeding groove in the 20th of July and 7.1cm at seeding groove in the 30th of July, and as the seeding period is later, plant height and leaf length are shorter and the leaf width is narrower.

By transplantation periods, the days required for flowering are short and it flowers earlier because it is delayed at 10 days interval from the 20th of August and it is considered that while the mean temperature is 22.2 °C , maximum temperature 26.2 °C , minimum

Table 2. Effect of sowing dates and transplanting dates on the nursery characters of *Alisma plantago* cultivated after early maturing rice cropping.

Sowing date	Transplanting date	Plant height (cm)	Leaf width (cm)	Leaf length (cm)
July 10	Aug. 20	29	3.9	9.4
July 20	Aug. 30	8	3.8	8.2
July 30	Sep. 10	25	3.7	7.1
LSD(0.05)	-	1.4	0.2	0.3

To compare the days of flowering and flowering date by planting density and transplantation period, the groove transplanted in the 20th of August with the planting density of 20 x 15cm flowers in the 7th of September and requires 18 days for flowering, the groove transplanted with the planting density of 20 x 25cm and 20 x 35cm flowers in the 8th of September and requires 19 days for flowering. The groove transplanted in the 30th of August with the planting density of 20 x 15cm flowers in the 16th of Sept. and requires 17 days for flowering and the groove transplanted with the planting density of 20 x 25cm and 20 x 35cm flowers in the 17th of September and requires 18 days for flowering. The groove transplanted in the 10th of September with the planting density of 20 x 15cm flowers in the 27th of September and requires 16 days for flowering and the groove transplanted with the planting density of 20 x 25cm and 20 x 35cm flowers in the 28th of September and requires 17 days for flowering.

Therefore, in the dense planting groove of 20 x 15cm days required for flowering are shorter than sparse planting groove of 20 x 25cm or 20 x 35cm and it tends to flower early.

temperature 19.2 °C, rainfall 197.5mm and daylight hours 15.6 in late August which is 10 days with vigorous growth after the transplantation in the 20th of August, for early september which is 10 days with vigorous growth after the transplantation in the 30th of August, the mean temperature is 24.2 °C, maximum temperature 29.5 °C, minimum temperature 20.1 °C, rainfall 63.0mm and daylight hours 41.6, for the mid september which is 10 days with vigorous growth after the transplantation in the 10th of September, the mean temperature is 24.2 °C, maximum temperature 30.1 °C, minimum temperature 20.0 °C, rainfall 207.0mm and daylight hours 46.9 and then as the period of transplantation is later, the days required for flowering are reduced and flowering period is earlier due to the rise of temperature and daylight hours.

These results are identical with the report by Park et al (1995) that the days required for flowering are delayed as 97~112 days at the seeding in the 1st of April and it is earlier as 74~80 days at the seeding in the 10th of May.

2. Variation of growth and quantity in roots

Growth and quantity of *Alisma plantago* shown in the difference of seeding and transplanting period

Table 3. Variation of growth habit and yield of *Alisma plantago* under different planting density from cultivated after early maturing rice cropping.

Planting space (Row × Intra row)cm	Sowing date	Transplant -ing date	No. of plants /10a	Plant height (cm)	No. of leaves	Brown leaf blight (0~5)	Yield	
							Dry root (kg/10a)	Index
20 × 15	July 10	Aug. 20	33.333	62	12	2	232.3	100
	July 20	Aug.30	33.333	63	16	2	325.1	140
	July 30	Sep. 10	33.333	65	18	2	356.2	153
20 × 25	July 10	Aug. 20	20.000	67	15	2	326.6	139
	July 20	Aug. 30	20.000	62	14	2	306.7	132
	July 30	Sep. 10	20.000	60	13	2	274.2	118
20 × 35	July 10	Aug. 20	14.285	69	16	2	348.3	150
	July 20	Aug. 30	14.285	58	12	2	279.6	120
	July 30	Sep. 10	14.285	56	11	2	244.2	105
LSD(0.05)			-	15.0	3.0	-	120.1	-

according to planting density are shown in Table 3.

While the plant height is 62cm, the number of leaves is 12, Brown leaf blight is 2 and yield of dry root per 10a is 232.3kg in the *Alisma plantago* sown in the 10th of July and transplanted in the 20th of August at the dense planting groove of 20x15cm, plant height is 63cm, the number of leaves is 16, Brown leaf blight is 2 and yield of dry root is 325.1kg per 10a in the *Alisma plantago* sown in the 20th of July and transplanted in the 30th of August and plant height is 65cm, the number of leaves is 18, Brown leaf blight is 2 and yield of dry root is 356.2kg per 10a in the *Alisma plantago* sown in the 30th of July and transplanted in the 10th of September and as the seeding and transplanting period at the dense planting groove of 20x15cm is later, plant height is longer, the number of leaves is more and quantity is increased.

On the other hand, while the plant height is 67cm, the number of leaves is 15, Brown leaf blight is 2 and yield of dry root per 10a is 323.6kg in the *Alisma plantago* sown in the 10th of July and transplanted in the 20th of August at the sparse planting groove of 20x25cm, plant height is 62cm, the number of leaves is 14, Brown leaf blight is 2 and yield of dry root is

306.7kg per 10a in the *Alisma plantago* sown in the 20th of July and transplanted in the 30th of August and plant height is 60cm, the number of leaves is 13, Brown leaf blight is 2 and yield of dry root is 274.2kg per 10a in the *Alisma plantago* sown in the 30th of July and transplanted in the 10th of September and as the seeding and transplanting period is later, plant height is shorter, the number of leaves is reduced and quantity is low.

While the plant height is 69cm, the number of leaves is 16, Brown leaf blight is 2 and yield of dry root per 10a is 348.3kg in the *Alisma plantago* sown in the 10th of July and transplanted in the 20th of August at the sparse planting groove of 20x35cm, plant height is 58cm, the number of leaves is 12, Brown leaf blight is 2 and yield of dry root is 279.6kg per 10a in the *Alisma plantago* sown in the 20th of July and transplanted in the 30th of August and plant height is 56cm, the number of leaves is 11, Brown leaf blight is 2 and yield of dry root is 244.2kg per 10a in the *Alisma plantago* sown in the 30th of July and transplanted in the 10th of September and as the seeding and transplanting period is later, plant height is shorter, the number of leaves is reduced and quantity is low.

As shown in variance analysis, the dense planting

Table 4. Analysis of variance for yield and agronomic characters of *Alisma plantago* under different sowing date and density from cultivated after early maturing rice cropping.

Factor	d.f	Plant height(cm)	No. of leaves	Dry root yield (kg/10a)
Block	2	0.83	0.11	115.45
A	2	148.05	56.33**	384.31
Error(a)	4	1.48	0.78	215.12
Main plot	8			
B	2	16.05**	2.11	469.87*
AB	4	26.20**	26.20**	11177.30**
Error(b)	12	0.04	0.41	123.28
Sub plot	18	3.22		
Total	26			

groove of 20 x 15cm is increased in late transplantation of the 10th of September and spare planting groove of 20 x 25cm or 20 x 35cm shows the increase from rapid transplantation of the 20th of August.

Major three reasons that major production site of double cropping *Alisma plantago* is prepared at Haeryong-myeon, Suncheon, Chonnam are low maximum temperature and high minimum temperature compared to the inland area due to oceanic climate, which inhibits the obstacle of high temperature in summer and although there may be the damage of lodging in ocean region due to typhoon because its plant height is long, double cropping can reduce the damage of typhoon because of its short plant height. The third reason is that the highest selling price can be achieved by early cultivation of rice and the cultivation of *Alisma plantago* by double cropping can achieve the profit.

Therefore, when it is transplanted in the 20th of August at the southern region which cultivates *Alisma plantago* by double cropping, sparse planting density of 20 x 25cm or 20 x 30cm and the dense planting of 20 x 15 cm for transplantation in the 10th of September can increase the quantity.

REFERENCES

- Kwon B. S., J. I. Lee and H. J. Park 1988. Comparison of agronomic character and yield as affected by seeding dates of flax. *Korean J. Crop Sci.* 33(2) : 169-173
- Kim S. G., H. J. Park, D. H. Chung and B. S. Kwon 1995. Differences of internode brix degree on different seeding date in sweet sorghum. *Korean J. Crop Sci.* 40(4) : 451-459
- Kwon B. S., J. T. Lim, D. H. Chung and J. J. Hwang 1994. Relationships between meteorological factors and growth and yield of *Alisma plantago* L. in Seungju area. *Kor. J. Medicinal Crop Sci.* 2(1) : 7-13
- Park H. J., B. K. Jung, J. T. Lim and B. S. Kwon 1993. The current status of cultivation of *Alisma plantago* L. in Seungju area. *Kor. J. Medicinal Crop Sci.* 1(2) : 202-204
- Kwon, B. S., H. J. Park, J. Y. Lim and D. Y. Shin 1990. Growth and yield as affected by vinyl mulching and sowing time in Cassia Tora L. *Kor. J. Crop Sci* 35(4) : 315~319
- Kwon, B. S., H. J. Park, J. I. Lee, E. R. Son and J. K. Hwang 1989. Response of flax varieties to planting density. *Kor. J. Crop Sci* 34(3) : 225~228
- Kwon B. S., J. T. Lim and H. J. Lee 1989. Effect of

transplanting date and density on the variation of dry stem yield and agronomic traits in Wanggol cultivated before the rice crop. J. Agric Sci. Res. of Sunchon Natl. Uni. 3 : 29-34

Kwon, B. S., H. J. Park, J. I. Lee and D. H. Chung 1992 Influences of PE film mulching and planting density on growth and yield of Sickle Senna (Cassia tora L.) Kor. J. Crop Sci 37(1) : 54~60

Kwon B. S., D. H. Chung, Y. H. Mun and J. E. Chun 1996 Fiber yield and sex ratio of hemp in different

planting density. Kor. J. Crop Sci 41(2) : 230~235

Park, H. J., S. G. Kim, D. H. Chung and B. S. Kwon 1995 Influences of planting density on growth and yield of perilla frutescens BRITTON var. acuta KUDO. Kor. J. Medicinal Crop Sci 3(2) : 135~139 : 499~505

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