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Effects of PEG Priming Treatment on Germination and Seedling Growth of Onion Seed(*Allium cepa* L.)*

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ABSTRACT

These experiments were conducted to evaluate the variability of seed germination and seedling growth with different levels of polyethylene glycol(PEG 6,000) solution in onion seed. Average germination percentage of seed primed in PEG solution with 1.00 and 0.75 MPa was higher than control, and that of seed primed in 1.50MPa was lower than unprimed control. Germination percentage(GP) of seed primed for 5 days was highest, and as the primed days become long, the GP was decreased. The GP of airation seed during the primed was higher than that of unairation seed, about 5%, respectively. The GP of washed seed after primed was higher than that of unwashed seed, but that of redried seed after primed was lower than that of the others. The highest GP cultivar was Chunjoogoohyung and the lowest GP cultivar was Seouldego in unredried seed after primed, but Chunjoojoonggo was highest and Jungpoonwhang was the lowest cultivar in redried seed after primed. As the PEG concentration increased, the seedling length(SL) was shortened, and seed primed for 15 days was longer than other treatments. The SL of primed seed was similar to GP. The SL of washed seed after primed was longer than that of others, but that of redried seed after primed was shortest among the others. The SL of Chunjoojoonggo and Nongwoodego was longest and Seouldego was shortest among the cultivars in unredried seed after primed, but that of Chunjoogoohyung and Chunjoojoonggo was longest and Seouldego was the shortest cultivars in redried seed after primed.

Key Words : Onion seed germination, seedling growth, seed primed, washed seed, unwashed seed, redried seed.

INTRODUCTION

Onion(*Allium cepa* L.) contains abundant Ca, P and mineral, and was utilized for spice, health food. Onion cultivation area in Korea is 15,817 ha(1995) and Chonnam district accounts for 46% of total cultivated area. Direct seeding cultivation is a pressing question in onion, because the traditional cultivation was transplanting it after raising seedling and the cost of raising seedling and transplanting accounts for 34% of total labour cost for onion cultivation. The most difficult problem in direct seeding cultivation is the unsettled emergence and seedling establishment in field, poor progress early seedling growth. Stability of emergence and establishment percentage will be raised

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with complex farming system such as decreasing period from seeding to emergence by the control of combined environmental factors, such as preventive control damping-off and promotion of early seedling growth.

One method of improving seed germination performance in the field has been the use of presowing treatment such as priming(Heydecker et al 1973), which involves the controlled hydration of seed sufficient to permit pregerminative metabolic events to take place but insufficient to allow radicle emergence. The germination of such primed seed is more rapid and uniform than that of unprimed seeds(Brocklehurst and Dearman,1983) with additional benefits occurring from seed priming treatments via a shorter growing period and reduced energy input requirements for seedling raised plants for transplantation(Brocklehurst et al 1984)

The purposes of this investigation were 1)to study and develop model that describes the effects of direct sowing cultivation; 2)to select different combination of PEG solution concentration and levels on onion seed germination and seedling growth.

MATERIALS AND METHOD

Osmic priming

Seeds of all eight speicies were primed on solution of 223, 273 and 342g PEG '6000' KG-1 water giving nominal osmic potentials of -0.75, -1.00 and -1.50MPa respectively(Michel & Kaufmann, 1973). All treatments were placed at 5 ℃ for three durations(5, 10 and 15 days). The seeds were divided two, and one was half airation treatment during primed in PEG solution, and the other was unairation. The primed seeds were rinsed with the running water for 15 minute, and one half of each sample had surface dried without other treatment and the other half surface dried for 24 hours and in the condition of airflow at 5℃ for 120 hours. Following treatment seeds were placed in germination tests at 20 ℃ after sowing 50 seed per paper towel(pH. 7.0, 60× 30cm, Anchor Co.) Treatments were compared with a three replicated untreated control. The germinated seeds(radicle emergence) and emerged seedlings were counted daily until no more seeds germinated or seedling emerged. The mean germination/emergence times were calculated as described by International Seed Testing Association(ISTA) and Association of Official Seed Analysts(AOSA). The first and last evaluation were 6 and 10 days after sowing, respectively.

RESULT AND DISCUSSION

1. Germination percentage(GP)

Fig.1 shows germination percentage of primed onion seed in different PEG solution levels. The GP at -0.75 and -1.00 MPa was higher than that of control, and the controls, averaging 85.3%, and analysis of this graph revealed no significant treatment effects. This is in agreement with Brocklehurst and Dearman' s(1983) findings for celery primed using a same technique but at an osmotic potential of -1.00MPa. The germination percentage in 5 days primed duration was highest among all the treatment, and increasing the primed

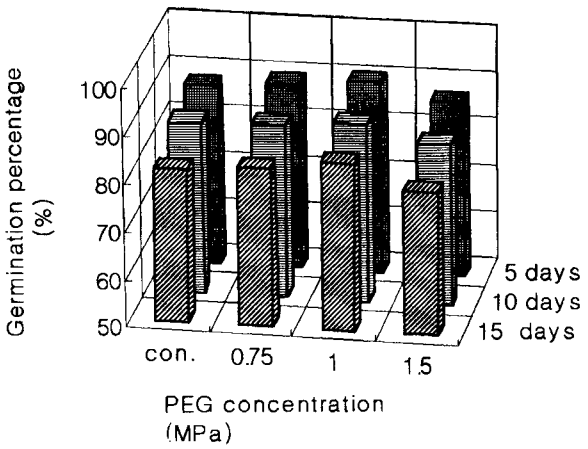

Fig. 1. Germination percentage of soaked onion seed in different soultion

Table 1. Germination percentage of different seed condition in onion

Seed condition		0.75MPa				1.00MPa				1.50MPa			
		5†	10	15	M‡	5	10	15	M	5	10	15	M
Airation	A	97	94	92	94.3	97	95	94	95.3	94	90	89	91.0
	B	99	97	95	97.0	99	97	95	97.0	95	94	91	93.3
	C	79	73	56	69.3	76	65	58	66.3	87	72	75	78.0
	M	91.7	88.0	81.0		90.7	85.7	82.3		92.0	85.3	85.0	
Non-air	A	92	89	87	89.3	92	91	88	90.3	88	86	84	86.0
	B	94	90	90	91.3	94	93	90	92.3	91	89	85	88.3
	C	73	67	51	63.7	72	60	57	63.0	83	69	68	73.3
	M	86.3	82.0	76.0		86.0	82.0	78.3		87.3	81.3	79.0	

† Evaluated days after seeding in paper towel ‡ Mean

A; Priming in PEG B ; Washed after primed C ; Redried after primed

Table 2. Varietal difference of germination percentage of seed primed in PEG solution in onion

Varieties	0.75MPa				1.00MPa				1.50MPa			
	5†	10	15	M‡	5	10	15	M	5	10	15	M
Yoeeuijoo	99	95	93	95.7	99	99	94	97.3	95	90	91	92.0
Seouldego	95	96	86	92.3	92	89	89	90.0	85	83	81	81.0
Chunjoowhang	99	94	94	96.0	95	91	93	93.0	85	82	81	82.6
Chunjoodego	97	91	76	87.3	97	92	87	92.0	90	86	86	87.3
Chunjoogoohyung	96	99	99	98.0	99	99	97	99.7	99	98	95	97.3
Chunjoojoonggo	98	90	92	93.3	88	85	88	87.0	99	88	85	90.7
Bonganwhang	99	99	97	98.3	99	99	99	99.0	99	99	99	99.0
Nongwoodego	99	99	98	98.7	99	99	99	99.0	99	99	96	98.0
Jungpoongwhang	86	88	82	85.3	95	96	95	95.3	91	84	81	85.3
L. S. D(0.05)	7.4	7.9	12.5		8.2	9.5	8.0		10.3	10.9	10.5	

† Evaluated days after seeding in paper towel ‡ Mean

duration was decreasing. The GP of seed with different seed treatment condition as onion(Table 1). The average GP of washed seed with running water for 15 minute after primed and unwashed seed after primed, and dried seed after washed with tapping water for 15 minute, were high in order. The GP of washed seed after primed was higher than unwashed seed, 2% in all treatment. The GP of unwashed seeds after primed in -1.00MPa, -0.75MPa and -1.50MPa were 90.2, 89.2 and 85.9 %, respectively. The GP of 5 days primed seed was also higher than any other primed duration seed. The GP of primed afte dried seed was lower than other treated seeds. This is due to complete loss of priming benefits(Nienow A.W. et al)

Table 2 gives data on varietal difference of GP of seed primed in PEG solution. On primed seeds in -0.75MPa, high GP cultivars as Chunjoojoonggo, Chunjoogoogyung and Bonanhwang were 95.0, 94.0 and 93.5%, and Jungpoonhwang and Chunjoodego were low GP, 84.6, 87.3 %, respectively. On primed seed in -1,00MPa, Bonanhwang, Nongwoodego, Chunjoogoo-hyung and Chunjoojoonggo were high GP, while Seouldego was low. On primed seed in -1.50MPa, Chunjoojooonggo, Yoeeuijoo and Chunjoojoohyung were high cultivars, Seouldego and Cunjoodego were low.

Table 3. Varietal difference of germination percentage of washed seed after primed PEG solution seed in onion

Varieties	0.75MPa				1.00MPa				1.50MPa			
	5†	10	15	M‡	5	10	15	M	5	10	15	M
Yoeeuijoo	99	96	95	96.7	99	99	93	97.0	99	99	93	97.0
Seouldego	97	95	88	93.3	92	89	90	90.3	91	84	85	86.7
Chunjoowhang	99	98	95	97.3	99	94	90	94.3	93	94	98	95.0
Chunjoodego	98	91	88	92.3	99	87	87	91.0	90	86	85	87.0
Chunjoogoohyung	99	97	99	98.3	99	99	99	99.0	90	98	99	95.7
Chunjoojoonggo	99	98	99	98.7	99	99	94	97.3	99	99	96	98.0
Bonganwhang	99	97	97	97.7	99	99	99	99.0	95	95	93	94.3
Nongwoodego	98	96	98	97.3	99	99	99	99.0	99	98	85	94.0
Jungpoongwhang	93	89	87	89.7	97	96	95	96.0	90	89	85	88.0
L. S. D(0.05)	4.7	4.9	8.4		5.1	8.8	8.6		8.5	8.7	9.7	

† Evaluated days after seeding in paper towel ‡ Mean

Table 4. Varietal difference of germination percentage of redried seed after primed in PEG solution in onion

Varieties	0.75MPa				1.00MPa				1.50MPa			
	5†	10	15	M‡	5	10	15	M	5	10	15	M
Yoeeuijoo	81	80	50	70.3	81	68	56	68.3	89	77	80	82.0
Seouldego	60	58	51	56.3	71	61	43	58.3	87	64	63	71.3
Chunjoowhang	81	70	64	71.7	81	64	58	67.7	95	79	72	82.0
Chunjoodego	74	73	42	63,0	65	55	56	58.7	85	67	67	73.0
Chunjoogoohyung	83	80	65	76.0	85	75	56	72.0	93	69	83	81.7
Chunjoojoonggo	96	90	86	90.7	99	82	79	86.7	99	84	92	91.7
Bonganwhang	78	64	37	59.7	76	62	54	64.0	85	59	87	77.0
Nongwoodego	81	75	69	75.0	75	60	73	69.3	78	69	70	72.3
Jungpoongwhang	72	61	36	56.3	47	44	46	45.7	67	64	50	60.3
L. S. D(0.05)	16.1	16.3	19.0		18.7	17.0	17.3		16.2	12.5	18.4	

† Evaluated days after seeding in paper towel ‡ Mean

Table 3 showed varietal difference of GP of washed seed after primed in PEG solution. The high GP cultivars primed in -0.75MPa PEG solution were Chunjoojoonggo, Chunjoogoohyung and Bonganhwang, 95.0, 94.0 and 93.5, respectively, and low germination cultivars were Jungpoongwhang and Chunjoodego, and this tendency was different in -1.00 and -1.50 MPa respectively.

Varietal difference of GP of redried seed after primed in PEG solution(Table 4). GP of Chunjoojoonggo cultivar as 85.6%, was significantly higher than other cultivars, and Jungpoongwhang and Seouldego as 51.3, 51.3% respectively, were low cultivars, and this tend was in accord with other concentration PEG solution. There is wide difference with varietal GP of redried seed after primed in PEG solution, and the highest GP was in Chunjoojoonggo, while the lowest GP was in Jungpoongwhang.

In order to decrease labour to onion cultivation and increase the international competitive power in onion, the direct sowing cultivation was necessary, and in spite of reduced primed advantage in redried seed after primed, Chunjoojoonggo had the highest GP among the cultivars, suggested that was good benefit characteristics for direct sowing cultivation in onion.

Table 5 showed the relationship between GP and

Table 5. Relationship between germination percentage and primed days in PEG solution in onion seed

Concentration (MPa)	Regression	
	Equation	R^2
Con.	Y = 95.9 - 2.39X	- 0.464**†
0.75	Y = 97.0 - 2.39X	- 0.369**
1.00	Y = 92.1 - 1.89X	- 0.264**
1.50	Y = 92.0 - 3.06X	- 0.340**

† : Significant at 1% level.

primed days in PEG solution. Negative relationship was between the GP and primed duration in all treatment, and that of the highest relationship was control, as -0.464** ,while the lowest relationship was -1.00 MPa, as -0.264.

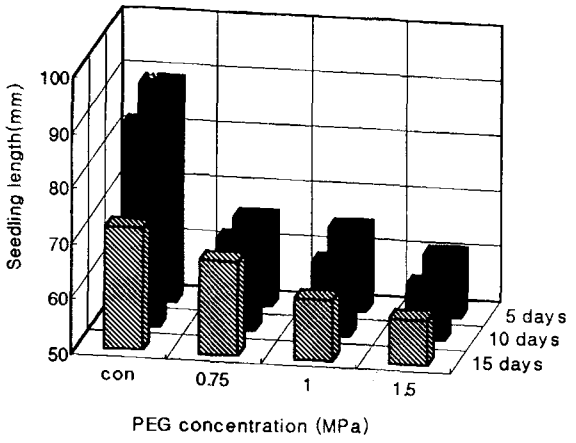

Fig. 2. Seedling length of soaked onion seed in different PEG solution.

2. Growth of seedling

The SL of primed seed in different PEG solution (Fig.2). Average SL was longest at control, and as the increased PEG concentration, SL was shortening. The SL in 15 days primed duration were longest among the all PEG solution, and as the decreased the primed duration, SL was shortening, but those were adverse in control.

Table 6 gives data on varietal difference of 10 days SL after sowing paper towel with primed seed in PEG solution. On primed seed in -0.75MPa, the long SL cultivars as Nongwoodego, Chunjoojoonggo, and Chunjoojoohyung were 81.0, 78.6 and 75.6mm, respectively, and the short SL cultivars as Seouldego, Jungpoongwhang and Bonganwhang were 36.6, 62.3 and 63.0mm, respectively. These tendency were as same as primed seed in -1.00 and -1.50MPa.

Table 7 showed varietal difference of SL of washed seed after primed in PEG solution. The result of Table 7 were similar as Table 6. These tendency were as same as redried seed(Table 8).

The characteristics of seedling growth was different with PEG solution concentration, primed duration,

Table 6. Varietal difference of seedling length of primed seed in PEG solution in onion

Varieties	0.75MPa				1.00MPa				1.50MPa			
	5†	10	15	M‡	5	10	15	M	5	10	15	M
Yoeeuijoo	65	68	85	72.7	68	70	83	73.7	69	78	76	74.3
Seouldego	44	43	39	42.0	47	44	43	44.7	51	42	42	45.0
Chunjoowhang	68	67	78	71.0	58	61	76	65.0	63	60	60	61.0
Chunjoodego	70	76	80	75.3	58	64	75	65.7	69	71	71	70.3
Chunjoogoohyung	72	84	86	80.7	68	69	81	72.7	71	67	67	68.3
Chunjoojoonggo	75	79	97	83.7	77	79	83	79.7	81	79	77	79.0
Bonganwhang	60	63	81	68.0	67	77	77	73.7	59	63	70	64.0
Nongwoodego	76	84	98	86.0	77	82	91	83.3	72	75	72	73.0
Jungpoongwhang	64	67	71	67.3	68	65	64	65.6	62	63	61	62.0
L. S. D(0.05)	66.00	18.3	17.2		19.4	16.1	18.6		13.4	17.1	16.9	

† Evaluated days after seeding in paper towel ‡ Mean

Table 7. Varietal difference of seedling length of washed seed after primed in PEG solution in onion

Varieties	0.75MPa				1.00MPa				1.50MPa			
	5†	10	15	M‡	5	10	15	M	5	10	15	M
Yoeeuijoo	92	93	92	92.3	80	85	86	83.7	80	84	82	83.0
Seouldego	51	57	55	54.3	63	47	51	53.7	47	45	50	47.3
Chunjoowhang	93	89	87	89.7	79	82	86	82.3	71	77	85	77.7
Chunjoodego	88	81	77	82.0	80	81	76	79.0	84	75	75	78.0
Chunjoogoohyung	85	85	88	86.0	77	86	89	84.0	78	77	85	80.0
Chunjoojoonggo	85	95	99	93.0	85	90	92	89.0	78	93	90	87.0
Bonganwhang	83	90	92	88.3	70	81	89	73.3	45	78	87	70.0
Nongwoodego	98	99	99	98.7	83	99	89	90.3	73	99	84	85.3
Jungpoongwhang	83	82	91	85.3	73	75	87	78.3	43	68	85	65.3
L. S. D(0.05)	66.00	18.3	17.2		19.4	16.1	18.6		13.4	17.1	16.9	

† Evaluated days after seeding in paper towel ‡ Mean

Table 8. Varietal difference of seedling height of redried seed after primed in PEG solution in onion

Varieties	0.75MPa				1.00MPa				1.50MPa			
	5†	10	15	M‡	5	10	15	M	5	10	15	M
Yoeeuijoo	50	76	45	57.0	57	46	37	46.7	41	54	46	47.0
Seouldego	36	39	31	35.3	35	40	25	33.3	29	38	26	31.0
Chunjoowhang	52	54	49	51.7	51	50	51	50.7	33	51	46	43.3
Chunjoodego	47	56	47	50.0	56	53	44	51.0	44	52	47	47.7
Chunjoogoohyung	55	70	51	58.7	55	63	52	56.7	55	61	52	56.0
Chunjoojoonggo	60	72	59	63.7	41	82	53	58.0	41	55	57	54.3
Bonganwhang	47	54	43	48.3	46	50	54	50.0	46	49	43	46.0
Nongwoodego	63	65	59	62.3	51	52	47	50.0	50	48	42	46.7
Jungpoongwhang	46	44	37	42.3	45	49	39	44.3	45	44	42	43.7
L. S. D(0.05)	12.3	18.2	16.4		11.5	15.2	16.1		12.3	12.4	12.9	

† Evaluated days after seeding in paper towel ‡ Mean

cultivars, and long SL cultivars were always long, while short SL cultivars were short regardless environmental condition. The SL of Chunjoojoonggo was the longest, while Seouldego was the shortest among the cultivars and all treatment.

In order to induce the early seedling growth by the seed treatment, it suggest that evaluated excellent seedling growth characteristics before sowing practice field.

Relationship between SL and primed duration in PEG solution was shown in Table 9. There were highly significant correlation among the all treatment, and the highest significant correlation as r= 0.387** in -0.75MPa PEG solution, and increasing the PEG concentration, decreasing the correlation.

Table 9. Relationship between plant length and primed days in PEG solution in onion seed

Concentration (MPa)	Regression	
	Equation	R^2
Con.	Y = 56.0 + 6.89X	0.368**†
0.75	Y = 53.4 + 6.72X	0.387**
1.00	Y = 55.1 + 4.67X	0.321**
1.50	Y = 68.9 + 3.06X	0.219*

† : Significant at 1% level.

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