Integrating Physiological Conditioning and Mutagen Seed Treatments to Reduce Redrying Damage in Legumes

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With most alkylating agents in the chemical experimental mutagenesis, increased damage, which is not completely preventable by post treatment washing, occurs on redrying and storage of seeds (3). In this work seeds were conditioned and primed before the mutagen treatment.

Materials and Methods:

The legume species tested were: Phaseolus vulgaris L., (white navy bean, cv. Hyden), Pisum sativum L., (cv. Alaska 81), Vigna angularis L. (adzuki bean, cv. Erimo), and Lens culinaris L. (cv. Palouse).

The seeds were primed by matriconditioning in Micro-Cel E carrier[2] as recommended by Khan et al. (1,2) for snap beans. All the cv's were primed three days at 15°C except for the adzuki bean that was primed at 20°C. The seeds were mutagenized after matriconditioning with 0.025% EMS for 2h followed by 0.001M sodium azide (for 1.5h) in aerated phosphate buffer at pH 3.5. Two variants with concentrations 0.1M and 0.01M of phosphate buffer were included. The mutagenized seeds were dried with forced air in a fume hood for 12 h and stored at room temperature. The effect of the matriconditioning and integrating with the mutagen treatments on the germination and initial growth of the seeds was tested in Petri dishes at 15°C and in flats with a commercial soil mixture in the greenhouse after two days and 2 weeks of storage.

Results and Discussion:

The effects of matriconditioning and of the integrated treatment after two days and two weeks storage are shown in Tables 1 and 2. In all cases seeds with matriconditioning showed a better performance for the tests both at 15°C and in the greenhouse compared with the controls after 2 days and 2 weeks of redrying. Mutagenized seeds showed the poorest performance compared with controls and matriconditioned variants. Except for adzuki, the integrated treatments produced higher seed viability and growth than the controls and mutagenized seed for both storage periods. The lower values of gemination for Azuki bean may be related to the mutagen concentrations used in relation to the previous matriconditioning. For both storage periods the use of 0.01M phosphate buffer increased the germination percentage.

Conclusions:

The results indicate that preplant matriconditioning of large legume seeds with a solid carrier such as Micro-Cel E can possibly be an effective method to improve the emergence of seeds in field planting. Integration of chemical mutagen treatments with seeds conditioning offers a new technique for chemical mutagenesis with grain legume crops such as bean, pea and lentil. These procedures may markedly reduce variability in responses from mutagen treated legume seeds which can be redried for convenience of planting and shipping.

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[2] Gifts of carrier used "Micro-Cel E", using of the laboratory means for matriconditioning and the advises from prof. J. D. Maguire, E. Maring, and M. Steen are greatly appreciated.

Table 1. Effect of integrating matriconditioning and mutagen seed treatment after two days redrying.

Crop Variety / Treatment	Test at 15°C in petri dishes for 3 days (1 day for lentil, 20°C for Adzuki)			Test in greenhouse		
	Water content %	Germ. %	Max. length of radical (mm)	Days for emergence	Emerg. %	Height of plants 10 days after planting (cm.)
1. WNB - "Hyden" - control	45.3	22.8	14	4	62.0	6.5
matriconditioned	144.1	100.0	20	3	98.0	11.5
dormant seed mutagenized	61.3	17.1	7	4	59.0	6.5
matriconditioned mutagenized 0.1% buffer	138.2	97.1	18	3	98.0	10.5
matriconditioned mutagenized 0.01% buffer	132.9	100.0	22	3	94.0	10.5
2. Adzuki - "Erimo" - control	105.4	71.4	20	6	80.0	2.5
matriconditioned	139.5	91.4	47	5	93.0	3.7
dormant seed mutagenized	126.3	71.4	32	6	69.0	2.3
matriconditioned mutagenized 0.1% buffer	146.2	57.1	30	5	93.0	3.7
matriconditioned mutagenized 0.01% buffer	146.5	48.6	30	5	94.0	3.5
3. Pea - "Alaska 81" - control	92.2	40.0	13	4	94.0	3.5
matriconditioned	120.0	100.0	30	3	98.0	5.3
dormant seed mutagenized	104.6	51.4	23	3	78.0	4.0
matriconditioned mutagenized 0.1% buffer	100.0	85.7	30	3	99.0	5.5
matriconditioned mutagenized 0.01% buffer	100.7	88.6	23	3	100.0	5.5
4. Lentil - "Palouse" - control	100.0	40.0	2	3	96.0	5.0
matriconditioned	123.8	100.0	5	3	100.0	7.5
dormant seed mutagenized	90.5	5.7	1	3	30.0	5.0
matriconditioned mutagenized 0.1% buffer	114.3	71.4	3	3	92.0	6.0
matriconditioned mutagenized 0.01% buffer	118.2	88.6	5	3	96.0	6.5

Table 2. Effect of integrating matriconditioning and mutagen seed treatment after two weeks redrying.

Crop Variety / Treatment	Test at 15°C in petri dishes for 3 days (1 day for lentil, 20°C for Adzuki)			Test in greenhouse		
	Water content %	Germ. %	Max. length of radical (mm.)	Days for emergence	Emerg. %	Height of plants 10 days after planting (cm.)
1. WNB - "Hyden" - control	62.1	25.7	13.0	4	65.0	6.3
matriconditioned	138.2	100.0	27.0	3	100.0	11.0
dormant seed mutagenized	21.7	20.0	16.0	5	48.0	5.0
matriconditioned mutagenized 0.1% buffer	138.3	97.1	25.0	3	92.0	9.0
matriconditioned mutagenized 0.01% buffer	143.1	100.0	30.0	3	97.0	9.7
2. Adzuki - "Erimo" - control	117.6	80.0	45.0	6	96.0	3.0
matriconditioned	126.8	85.7	47.0	5	83.0	4.0
dormant seed mutagenized	121.9	57.1	45.0	7	76.0	2.3
matriconditioned mutagenized 0.1% buffer	136.3	48.6	43.0	5	47.0	3.5
matriconditioned mutagenized 0.01% buffer	140.9	48.6	40.0	5	42.0	3.0
3. Pea - "Alaska 81" - control	104.6	77.1	22.0	4	95.0	3.9
matriconditioned	105.6	94.3	40.0	3	100.0	5.5
dormant seed mutagenized	100.0	54.3	13.0	5	78.0	3.5
matriconditioned mutagenized 0.1% buffer	100.0	71.4	22.0	3	61.0	3.9
matriconditioned mutagenized 0.01% buffer	100.0	97.1	31.0	3	88.0	4.5
4. Lentil - "Palouse" - control	110.0	74.3	2.0	3	98.0	6.8
matriconditioned	131.8	100.0	7.0	3	100.0	7.0
dormant seed mutagenized	95.0	8.6	1.0	5	34.0	4.3
matriconditioned mutagenized 0.1% buffer	122.2	82.8	4.0	3	92.0	5.8
matriconditioned mutagenized 0.01% buffer	131.8	88.6	5.0	3	98.0	6.2