

Using Urea Formaldehyde and Polyethyleneglycol as Seed Coating to Improve Maize Seed Qualities

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ABSTRACT

The objective of this experiment was to determine the effectiveness of various ratio of nitrogen slow release fertilizer urea formaldehyde and polyethyleneglycol (PEG 6000) concentration for coating maize seeds. The seeds were coated with urea formaldehyde at the concentration 0.2, 0.6, 0.8, 1.0, 1.2 gN in combination with 3% (w/v) of PEG 6000. The qualities of coated seed were assayed by germination percentage, germination index, seedling vigor classification, shoot and root growth rate and accelerated aging test. The results showed that coated seeds with urea formaldehyde at 0.4 gN and 3% (w/v) of PEG 6000 provided promising results in germination percentage, germination index, seedling vigor classification and accelerated aging test comparing to uncoated seeds.

Key words: Maize seed, Urea formaldehyde, Polyethyleneglycol

INTRODUCTION

Usually seed coating is a process that coating substances are covered on the surface of seed. The substances are nutrient materials, fungicides, herbicidal agents, systemic insecticides and other compound (Lloyd, 1979). The ideal of seed coatings polymer are that they should be water-based polymer, have a low viscosity range, contain a high concentration of solids, have a adjustable hydrophilic/hydrophobic balance and form hard film upon drying (Rushing, 1988). These traits should lead to excellent plantability, contain no “dust off” of additives, and provide for excellent germination under all environmental condition (Copeland and Miller, 1995). Urea formaldehyde (UF or ureaform) is used for enhancing the delivery of nitrogen needed for plant development and growth (Wertz et al., 2007). It was widely used as slow or controlled release nitrogen fertilizers which contained methylene urea polymers of varying chain length. The higher methylene urea polymer had limited solubility in soil solution and hence serve to prolong the release of nitrogen. The release process of nitrogen was normally thought to be by microbial decomposition. The literature relating to such products has emphasized the importance of the longer chain water insoluble polymers which had been considered safer and desirable for slow release (Goertz, 1983). Slow release fertilizers were designed to release nutrients to plants over an extended period of time, which was more efficient than multiple of water soluble fertilizers. Therefore, slow release fertilizers (also referred to as controlled release or extended release) minimize the frequency which plants must be fertilized, as well as reduce or minimize leaching (Wertz et al., 2005b). Polyethyleneglycol (PEG) are neutral polymers available in a range of molecular weights, highly soluble in water and with low toxicity to mammals. Because of these properties they have been used by several investiga-

tors to impose water stress on plants, by decreasing the water potential of the rooting medium and so the water potential of the plant (Lawlor, 1970). The advantages of all mentioned above were induced to the objection in this study which was to determine the effectiveness of various ratio of nitrogen slow release fertilizer urea formaldehyde and polyethyleneglycol (PEG 6000) concentration for coating maize seed.

MATERIALS AND METHODS

This experiment was conducted at the Seed Laboratory, Department of Plant Science and Natural Resources, Faculty of Agriculture, Chiang Mai University. The experimental design was a randomized complete block of 13 treatments with 3 replications. The treatments were uncoated and coated the seed with the concentration of 0.2, 0.3, 0.4, 0.6, 0.8, 1.0, and 1.2 gN urea formaldehyde plus 3% (w/w) PEG 6000 molecular weight per 1 kg of seeds. Temperatures used for preparing the mixture were 60°C. The coated seeds were stored at room temperature. After that, the seed samples were tested for seed germination percentage (ISTA, 2006), germination index, shoot and root growth rate, seedling vigor classification, (AOSA, 2009). Analysis of variance (ANOVA) was used for means comparison. The variation differences between treatments were assayed by the Least Significant Difference (LSD) with the confident of 95% ($P \leq 0.05$).

RESULTS AND DISCUSSION

The results of determining standard germination test, germination index and accelerated aging technique of UF coated seeds were shown on Table 1. The coated seeds lot with UF 0.2, 0.4, 0.6 gN and UF with 3% (w/v) of PEG 6000 at concentration 0.2, 0.4, 0.6, and 0.8 gN resulted no significant differences in germination percentage when compared to uncoated seed (Table 1). Seed lots coated with UF 0.2, 0.4 gN and UF with 3% (w/v) of PEG 6000 at 0.2 and 0.4 gN provided the best result in term of germination index (Table 1). The results of this experiment supported Hathcock et al. (1984) which reported that coating seed with nitrogen and phosphorus provided better seed vigor than uncoated seed. The seed coated with UF 0.2, 0.4 gN and UF with 3% (w/v) of PEG 6000 at concentration 0.4, 0.6 gN showed no differences after significantly in accelerated aging test. It might be due to seed received nutrient from the coating with fertilizer (Smid and Bates, 1971). The Shoot and root growth of uncoated seed showed the best results in term of growth rate (Table 2). However, uncoated seed in term of seedling vigor classification provided the number of high vigor seedling only 45%. Although, shoot and root growth of uncoated seed give the best result in term of growth rate but in term of number of high vigor seedling, coated seed with UF 0.2 and UF with 3% (w/v) of PEG 6000 at 0.2 gN, 0.4 gN showed significantly better number of 76, 71 and 71%, respectively (Table 3). This results supported Khankhamkat et al. (2009) which reported that coating seed with UF 2% (w/v) was significantly increase in seedling classification more than the uncoated seeds. However, Wertz et al. (2005a) reported that coated seeds with slowly released fertilizer had an effect on growth and development of plant.

Table 1. Standard germination test, germination index and accelerated aging test of maize seed after various coating treatments.

Treatments	Germination test (%) ¹	Germination index ¹	Accelerated aging test (%) ¹
Control	91 ab	15.31 bc	84 abc
UF 0.2 gN	93 ab	16.51 ab	86 ab
UF 0.4 gN	94 ab	16.74 ab	75 abc
UF 0.6 gN	88 abc	13.94 cd	69 bc
UF 0.8 gN	84 bc	12.65 d	34 d
UF 1.0 gN	57 d	8.31 e	5 e
UF 1.2 gN	30 e	4.10 f	2 e
UF 0.2 gN + 3% PEG 6000 (w/v)	94 a	17.71 a	66 c
UF 0.4 gN+ 3% PEG 6000 (w/v)	95 a	17.74 a	90 a
UF 0.6 gN+ 3% PEG 6000 (w/v)	92 ab	16.63 ab	77 abc
UF 0.8 gN+ 3% PEG 6000 (w/v)	92 ab	15.70 bc	32 d
UF 1.0 gN+ 3% PEG 6000 (w/v)	79 c	12.57 d	30 d
UF 1.2 gN+ 3% PEG 6000 (w/v)	56 d	8.40 e	2 e
F-test	**	**	**
LSD _{0.05}	5.07	0.87	9.67

¹Mean values within a column followed by the same letter do not differ significantly according to t-test at $P \leq 0.05$

Table 2. Effects of maize seed coating substances on direct vigor test from seedling performances of shoot and root growth rates.

Treatments	Shoot growth rate (cm/seedling/5 days) ¹	Root growth rate (cm/seedling/5 days) ¹
Control	5.09 a	14.56 a
UF 0.2 gN	4.30 b	10.91 b
UF 0.4 gN	3.04 d	9.89 b
UF 0.6 gN	1.83 e	6.33 c
UF 0.8 gN	1.35 ef	4.25 d
UF 1.0 gN	0.47 g	1.56 e
UF 1.2 gN	0.12 g	0.36 e
UF 0.2 gN + 3% PEG 6000 (w/v)	3.93 bc	11.67 b
UF 0.4 gN+ 3% PEG 6000 (w/v)	3.18 cd	10.10 b
UF 0.6 gN+ 3% PEG 6000 (w/v)	3.18 cd	7.67 c
UF 0.8 gN+ 3% PEG 6000 (w/v)	1.94 e	6.78 c
UF 1.0 gN+ 3% PEG 6000 (w/v)	0.69 fg	2.14 e
UF 1.2 gN+ 3% PEG 6000 (w/v)	0.49 g	1.33 e
F-test	**	**
LSD _{0.05}	0.37	0.92

¹Mean values within a column followed by the same letter do not differ significantly according to t-test at $P \leq 0.05$

Table 3. Maize seedling vigor classification results from various coating treatments.

Treatments	Seedling vigor classification		
	High vigor (%) ¹	Medium vigor (%) ¹	Low vigor (%) ¹
Control	45 b	41 bc	6 d
UF 0.2 gN	76 a	14 h	4 d
UF 0.4 gN	43 b	45 ab	4 d
UF 0.6 gN	46 b	27 ef	11 cd
UF 0.8 gN	1 d	42 bc	33 a
UF 1.0 gN	1 d	23 fg	27 ab
UF 1.2 gN	0 d	4 i	18 bc
UF 0.2 gN + 3% PEG 6000 (w/v)	71 a	18 gh	4 d
UF 0.4 gN+ 3% PEG 6000 (w/v)	71 a	20 fgh	5 d
UF 0.6 gN+ 3% PEG 6000 (w/v)	47 b	37 cd	10 cd
UF 0.8 gN+ 3% PEG 6000 (w/v)	25 c	50 a	11 cd
UF 1.0 gN+ 3% PEG 6000 (w/v)	15 c	40 bc	23 b
UF 1.2 gN+ 3% PEG 6000 (w/v)	0 d	32 de	23 b
F-test	**	**	**
LSD _{0.05}	6.29	3.99	4.36

¹Mean values within a column followed by the same letter do not differ significantly according to t-test at $P \leq 0.05$

CONCLUSION

The results showed that coated seeds with urea formaldehyde at 0.4 gN and 3% (w/w) of PEG 6000 provide promising results in germination percentage, germination index, seedling vigor classification and accelerated aging test comparing with uncoated seeds.

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