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EFFECTS OF ADENOSINE MONOPHOSPHATE SEED TREATMENT AND SEED VIGOR LEVEL ON SUNFLOWER AND SAFFLOWER SEEDLING EMERGENCE

Sami Süzer[1] and A.A. Schneiter[2]

[1] *Thrace Agricultural Research Institute, Edirne, TURKEY.*
[2] *NDSU, Crop & Weed Sciences Dept., Fargo, ND, USA.*

SUMMARY

This research was conducted to evaluate adenosine monophosphate seed treatment on seedling emergence and emergence index (EI) in sunflower (*Helianthus annuus* L.) and safflower (*Carthamus tinctorious* L.) seed lots of varying vigor levels. Treatments were evaluated in the field and in the laboratory.

Results indicated that percent PLS emergence of both crops in the field was influenced significantly ($P \leq 0.01$) by the adenosine monophosphate seed treatment. This suggests that seed treatment with adenosine monophosphate may improve seedling growth rate of low vigor seed lots under low temperature ($\leq 10°C$) stress.

Key words: Sunflower, safflower, seed vigor level, adenosine monophosphate.

INTRODUCTION

Seed germination is an energy requiring process. Adenosine triphosphate (ATP) is the main energy source for biological activities in the seed embryo (Perl, 1986). Amplify^{R*} is a commercially available chemical for seed treatment which contains 95.8% adenosine monophosphate (AMP), a precursor to ATP. McDaniel (1982) evaluated Amplify^{R} on "Deltapine 62" and "Pima S-5" cotton (*Gossypium hirsutum* L.) in field experiments. Seeds treated by dust and liquid formulations of Amplify^{R} were sown in areas where salt and cold stress occurred. He reported that Amplify^{R} helped to insure maximum seed germination, vigor, and stand establishement in the presence of *Thielaviopsis basicola*, a soil borne organism which causes damping off at low temperatures. Amplify^{R} increased available energy in the seed embryo, and had a fungistatic effect on soil pathogenic fungi. Usually Amplify^{R} had non-significant effects when seedbed and germination conditions were near optimal. Fetch (1984) reported that seedling weight of sunflower increased in greater proportion in low vigor seed lots than in high vigor seed lots after AMP treatment.

The objective of this research was to determine the influence of adenosine monophosphate seed treatment and seed vigor level on sunflower and safflower seedling emergence.

* ^{R}Conklin Company, INC. 4660 W. 77th St. Minneapolis, MN. 55435. Mention of this product does not constitute endorsement by the autor or by North Dakota State University.

MATERIAL AND METODS

This research was carried out at the NDSU, Crop & Weed Sciences Dept., Fargo, USA, in 1989 and 1990. Six levels of sunflower hybrid "Interstate 7101", and five levels of safflower "Girard" seed vigor were developed by accelerated aging (AA). In order to do this seeds were treated in a chamber at 41°C for either 2,3,4,5,6,7 days and then removed. Treatments were evaluated in the field and in a germinator. Amplify^R was applied directly as a powder to the seed coat (1g Amplify^R/100g seed) for a 26.8% adenosine monophosphate and sodium phosphate concentration. Treated seeds were germinated at 10°C using the standard germination test. Experimental design was a split plot arrangement in a RCBD with three replications of 50 seeds each. The number of germinated seedlings was determined and hypocotyl + radicle lengt measured.

Emergence index (EI) and pure live seed (PLS) emergence of both crops for the treatment were determined in dryland field studies conducted at Fargo. Field planting was made on 20 April, 1990. Experimental design was a RCBD with four replications. Emergence index was calculated using the formula EI=A(1/X)+...+(1/N), where A is the number of cotyledons that penetrated the soil surface each day, X is the number of days after initial emergence and N is the last emergence day counted (Anfinrud and Schneiter, 1984).

RESULTS AND DISCUSSION

1. Laboratory Experiment:

The effect of a dry powder formulation of Amlify^R on germination and seedling length of both crops was determined by the analyses of variance. Results indicate that Amplify^R seed treatment and seed vigor levels had significant ($P \leq 0.01$ and $P \leq 0.05$) effects on seedling length of both sunflower hybrid IS-7101 and Girard safflower.

The interaction between seed treatment and level of seed vigor was significant ($P \leq 0.01$) for seedling length of Girard safflower. This indicates that some seed vigor levels of Girard safflower responded differently to Amlify^R than others. Mean values for percent PLS emergence are presented for both crops in Table 1. Results suggest that for seedling length the high level of seed vigor responded to Amplify^R seed treatment more than the low level of seed vigor. Similar results have been reported on the effect of adenosine monophosphate on germination of Pima cotton (McDaniel, 1982), seedling lenght of sunflower (Fetch, 1984), and safflower (Luth, 1987).

2. Field Experiment:

Percent field PLS emergence and EI of both crops from treated seed (Amplify^R), sown in 1990 at Fargo, were determined. Results indicate that seed treatment and the seed vigor level both had a significant ($P \leq 0.01$ or $P \leq 0.05$) effect on percent PLS emergence of sunflower hybrid IS-7101 and Girard safflower.

Mean values for percent PLS emergence and EI are presented for both crops in Table 2. Results indicate that percent PLS emergence of both crops responded significantly ($P \leq 0.01$) to seed treatment. Percent PLS emergence and EI of the longer accelerated aging seed lots of IS-7101 sunflower and Girard safflower were significantly increased due to seed treatment.

Table 1: Mean values for percent laboratory germination and seedling length (SDL) of sunflower hybrid IS-7101 and Girard safflower treated with Aplify^{R}.

Days AA[1]	Sunflower IS-7101				Girard safflower			
	Cont.	Treat.	Cont.	Treat.	Cont.	Treat.	Cont.	Treat.
treatment	Germ%		SDL (cm)		Germ.%		SDL (cm)	
0	94.4	99.3	3.1	4.0	93.7	95.8	5.4	7.2
2	62.0	69.6	2.3	2.7	89.0	90.6	4.0	5.4
3	49.1	58.2	1.9	2.2	80.9	87.1	2.1	2.9
4	54.1	59.5	1.6	1.7	68.6	83.5	1.6	2.3
5	30.3	33.3	1.2	1.3	59.5	62.2	1.4	1.7
6	7.1	17.9	1.1	1.1	-	-	-	-
7	0.0	0.0	0.0	0.0	39.3	35.7	1.1	1.2
Mean	42.4	48.3	1.6	1.9*	71.8	75.8	2.6	3.5*
LSD (0.05)	7.5[2]	8.7[3]	0.3[2]	0.3[3]	11.0[2]	16.0[3]	0.4[2]	0.7[3]

*: significantly different at the P≤0.05 level compared with control treatment.

[1] Accelerated aging treatment.

[2] LSD for days AA effect.

[3] LSD for treatment effect.

Table 2: Mean values for pure live seed (PLS) field emergence and emergence index (EI) of sunflower hybrid IS-7101 and Girard safflower treated with Amplify^{R}.

Days AA[1]	Sunflower IS-7101				Girard safflower			
	Control		Amplify^{R}		Control		Amplify^{R}	
	%Emerg.	EI	%Emerg.	EI	%Emerg.	EI	%Emerg.	EI
0	93.1	27.5	87.8	29.2	82.7	11.6	86.1	14.6
2	51.8	7.2	66.8	10.4	83.9	8.7	84.2	10.0
3	47.5	5.9	74.3	9.3	59.7	5.8	58.4	6.3
4	53.7	7.3	69.9	10.7	49.3	3.9	55.2	5.1
5	43.2	5.9	52.3	7.6	51.7	4.1	57.8	3.6
6	37.5	4.3	42.9	6.0	-	-	-	-
7	0.0	0.0	0.0	0.0	41.5	3.1	44.2	3.3
Overall mean	46.6	8.3	56.3	10.5*	61.4	6.2	64.3	7.2
LSD (0.05)	18.1[3]	2.7[3]	3.5[4]	2.2[4]	10.2[3]	1.6[3]	15.0[4]	1.9[4]

*: Overall treatment means significantly different at the P≤0.05, and P≤0.01 level compared with control treatment.

[1] Accelerated aging treatment.

[2] Calculated using the formula EI: (1/X+...+A(1/N),where A is the number of seedlings emerged per day, X is the number of days after initial emergence, and N is the last day emergence was counted.

[2] LSD for days AA effect.

[4] LSD for treatment effect.

Table 3: Correlation coefficients between field and laboratory experiment results of Amplify^R for seed treatments of sunflower hybrid IS-7101 and Girard safflower.

Crop	reat.	Field variables	Laboratory variables			
			Amplify^R seed treatment			
			% PLS Emergen.		SDL leng. (cm)	
			Cont.	Treat.	Cont.	Treat.
sunflower	control	PLS Emerg.[1]	0.92**	0.93**	0.95**	0.95**
IS-7101	"	EI[2]	0.85*	0.83*	0.84*	0.88**
"	Amplify	PLS Emerg.	0.89**	0.92**	0.93**	0.89**
"	"	EI	0.90**	0.90**	0.90**	0.93**
Safflower	Control	PLS Emerg.	0.90*	0.77^{NS}	0.95**	0.95**
Girard	"	EI	0.86*	0.73^{NS}	0.99**	0.99**
"	Amplify	PLS Emerg.	0.89*	0.77^{NS}	0.96**	0.96**
"	"	EI	0.85*	0.74^{NS}	0.99**	0.96**

*, **: Significant at the $P \leq 0.05$, and $P \leq 0.01$ levels respectively.
[1]PLS Emerg.: Pure live seed emergence.
[2]EI: Emergence index.

Significant ($P \leq 0.05$ or $P \leq 0.01$) correlations between PLS emergence and EI with seed treatment in the field and the germinator for both crops were found (Table 4). The data indicate that seed treatment on low vigor seed lots either in the laboratory or in the field may help to insure an even stand establishment under cool seedbed conditions. Similar results have been reported on the effect of fungicide on emergence of several agronomic crops under low temperature conditions (AOSA, 1981, 1983).

CONCLUSIONS

Percent PLS emergence of both crops in the field was influenced significantly ($P \leq 0.01$) by the Amplify^R seed treatment. Results indicate that seed treatment with Amplify^R may improve seedling growth rate of low vigor seed lots under low temperature ($\leq 10°C$) stress. Consequently, seed treatments may improve low vigor seed lots in expressing their germination potential under unfavorable field conditions.

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EFECTOS DEL TRATAMIENTO CON ADENOSINA MONOFOSFATO Y NIVEL DE VIGOR DE LA SEMILLA SOBRE LA EMERGENCIA DE PLANTULAS DE GIRASOL Y CARTAMO

RESUMEN

Esta investigación fue conducida para evaluar el tratamiento de la semilla con adenosina monofosfato sobre la emergencia de plántulas y el índice de emergencia (IE) en lotes de semilla de giraspl (*Helianthus annuus* L.) y cártamo (*Carthamus tinctorius* L.) con distinto nivel de vigor. Los tratamientos fueron evaluados en el campo y en el laboratorio.

Los resultados indicaron que el porcentaje de emergencia en ambos cultivos en el campo estuvo influenciado significativamente (P x 0.01) por el tratamiento de la semilla con adenosina monofosfato. Esto sugiere que el tratimiento de la semilla con adenosina monofosfato puede mejorar el crecimiento de las plántulas procedentes de lotes de semillas de bajo vigor en condiciones de baja temperatura (x 10°C).

EFFETS D'UN TRAITEMENT À BASE D'ADÉNOSINE MONOPHOSPHATE ET EFFETS DU NIVEAU DE VIGUEUR DES SEMENCES SUR LA LEVÉE DE PLANTULES DE TOURNESOL ET DE CARTHAME

RÉSUMÉ:

Cette étude a été menée afin d'évaluer l'effet de traitements à base d'adénosine monophosphate sur la levée de plantules et sur l'indice de levée (El) de lots de semences de tournesol (*Helianthus annuus* L.) et de carthame (*Carthamus tinctorius* L.) présentant divers niveaux de vigueur. Les traitements ont été testés en champ et en laboratoire.

Les résultats montrent une influence significative (P x 0.01) de l'adénosine monophosphate sur le pourcentage de levée des deux cultures en champ. Cela suggère une amélioration du taux de croissance des plantules après ce type de traitement pour des lots de semences de faible vigueur et en présence d'un stress imputable á des températures faibles de l'ordre de 10°C.

THE F.A.O. EUROPEAN COOPERATIVE RESEARCH NETWORK ON SUNFLOWER

TECHNICAL METTING

Technical meeting of the F.A.O. European Cooperative Research Network on Sunflower was held in Montpellier, France, from 20 to 23 June, 1994. At the meeting progress reports were discussed and programs for future cooperation of three working groups:

1. Experimentation of sunflower hybrids (Leader: Dr Alex V. Vranceanu);
2. Evaluation of wild Helianthus species (Leader: Dr Gerald J.Seiler);
3. Identification , study and utilization in breeding programs of new CMS sources (Leader: Dr Herve Serieys).

Enclosed is the full report by the working group "Experimentation of sunflower hybrids" and the abridged versions of very extensive reports by the other two working groups.