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SEED TREATMENTS TO IMPROVE EMERGENCE OF SUNFLOWER AND SAFFLOWER SEED LOTS OF VARYING VIGOR LEVELS FROM COLD SOILS

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SUMMARY

This research was conducted to evaluate a mixture of dry powder formulations of Apron and Captan on percent pure live seed (PLS) 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 a growth chamber using the cold soil test.

Results indicated that PLS emergence of the low vigor seed lots of both crops increased due to fungicide treatment to a higher degree than did high vigor seed lots. Percent PLS emergence in the field and the growth chamber for each crop was significantly ($P \leq 0.05$ or $P \leq 0.1$) correlated. This suggests that seed treatment is important in stand establishment for low vigor seed lots due to its protective effect against seed and soil borne microorganisms.

Key words: Sunflower, safflower, seed vigor level, seed treatment, pure live seed emergence.

INTRODUCTION

The cold soil test is one the oldest and most accepted seed vigor tests and it is used to measure germination and emergence of seed under high soil moisture, low temperature, and microbial activity (AOSA, 1983; and Burris and Navratil, 1978). This test can be used to adjust planting rates for seed sown when soil conditions are cold and wet. The cold soil test is commonly used to evaluate seed vigor in corn (*Zea mays* L.). Several studies have indicated that the cold soil test has the ability to forecast seed performance in other crops such as soybean (*Glycine max* L. Merr.) (Johnson and Wax, 1978; Tao, 1978; Gill and Singh, 1970), cotton (*Gossypium hirsutum* L.) (Bishnoi and Delouche, 1980), and sorghum (*Sorghum bicolar* L.) (Pinthus and Roseblum, 1961). Microorganisms play a significant role in the cold soil test. Seed that germinate quickly under such adverse conditions are less susceptible to infection by soil/seed borne pathogens. Anfinrud and Schneiter (1984) evaluated the cold soil test on several sunflower seed lots. All procedures involved a stress period of 10 days at 8°C followed by a 10 day grow out at 21°C. They reported that sunflower seed lots differed for vigor index.

The cold soil test can be used effectively to evaluate fungicide efficiency. For example, Bradford et al. (1988) reported that methalaxyl N-(2,6-dimetylphenyl)-N-(methoyacetyil) alanine methyl ester application to the seed at low temperatures improved emergence of early-season muskmelons (*Cucumis melo* L.), but the effects varied with cultivar, location, and planting method.

The cold soil test can also be used to evaluate physiological deterioration of seeds resulting from prolonged or adverse storage, freezing injury, immaturity, injury from drying, mechanical damage, and other causes. Selection of those seed lots which perform best in early spring planting provide a basis for adjusting the planting rate of individual seed lots.

The objectives of this research was to determine if seed treatment can increase pure live seed emergence in sunflower and safflower seed lots of varying vigor levels.

MATERIALS 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. Seed of various vigor levels were treated with dry formulations of Captan N(trichlorometyl) thio-4-cyclohexene-1, 2-dicarboximide and Apron [methalaxyl (N-2, 6-dimetylphenyl aniline methyl ester). Apron and Captan were applied directly as a powder to the seed coat (the mixture of 0.26 g Apron + 0.13 g Captan/100 g seed). Treatments were evaluated in the field and in a growth chamber using the cold soil test. For the cold soil test (AOSA, 1983) seeds were planted 5 cm deep in a mixture of loamy clay, sand, and peat compost (w:w:w) adjusted to 8°C. Water at 8°C was added to bring the mixture to 70% of water holding capacity. Plastic containers were placed in a darkened growth chamber at 8°C for 7 days followed by 7 days at 21°C. The number of emerged seedlings was determined. Experimental design was a split plot arrangement in a RCBD with five replications. The main plots were the treatments and the sub plots were the seed vigor levels.

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 the dry powder formulation of fungicide for seed treatment (a mixture of Apron and Captan) on percent PLS emergence of both crops was determined by the analyses of variance. Analyses of the data indicate that seed treatment and seed vigor level had a significant ($P \leq 0.01$ and $P \leq 0.05$) effect, respectively, on percent PLS emergence of both sunflower hybrid IS-7101 and Girard safflower.

Table 1: Mean values for pure live seed (PLS) emergence in the cold soil test of sunflower hybrid IS-7101 and Girard safflower treated with the mixture of Apron and Captan seed treatment.

Days AA[1] treament	Sunflower IS-7101		Girard safflower	
	Control	Treated	Control	Treated
	% PLS emerg.		%PLS emerg.	
0	87.3	89.0	79.4	95.5
2	62.6	71.1	67.1	79.4
3	48.0	58.9	42.8	71.0
4	42.2	64.9	37.7	68.6
5	36.4	43.6	48.7	61.6
6	25.7	38.6	-	-
7	0.0	0.0	25.7	34.3
Overall mean	43.2	52.3*	50.2	68.4**
LSD (0.05)	9.3[2]	7.8[3]	8.5[2]	5.0[3]

*, **: Overall means significantly different at the $P \leq 0.05$, and $P \leq 0.01$ level compared with control treatment.
[1] Accelerated aging treatment.
[2] LSD for days AA effect.
[3] LSD for treatment effect.

Mean values for percent PLS emergence are presented for both crops in Table 1. The data indicate that percent PLS emergence of both crops responded significantly ($P \leq 0.05$ and $P \leq 0.01$, respectively) to seed treatment. Generally, seed having a low level of vigor responded to seed treatment to a greater degree than did high vigor seed. Similar results have been reported on the effect of Apron seed treatment alone on emergence of muskmelons (Bradford et al., 1988).

2. Field Experiment:

Percent field PLS emergence and EI of both crops from treated seed (a mixture of Apron and Captan), 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.

Significant ($P \leq 0.05$ or $P \leq 0.01$) correlations were found between PLS emergence and EI with seed treatment in the field and the growth chamber for both crops (Table 4). The data indicate that seed treatment of 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).

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 the mixture of Apron and Captan.

Days AA[1]	Sunflower IS-7101				Girard safflower			
	Control		Apr.& Cap.		Control		Apr.& Cap.	
	% Emerg.	EI[2]	% Emerg.	EI	% Emerg.	EI	% Emerg.	EI
0	93.1	27.5	96.8	31.1	82.7	11.6	89.0	13.9
2	51.8	7.2	70.5	10.8	83.9	8.7	95.4	11.6
3	47.5	5.9	70.9	10.7	59.7	5.8	68.2	6.5
4	53.7	7.3	66.0	9.2	49.3	3.9	65.9	5.8
5	43.2	5.9	60.2	8.3	51.7	4.1	68.9	6.8
6	37.5	4.3	50.9	6.7	-	-	-	-
7	0.0	0.0	0.0	0.0	41.5	3.1	44.2	3.6
Overall mean	46.6	8.3	59.5*	10.9*	61.4	6.2	71.9[NS]	8.0[NS]
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 means significantly different at the $P \leq 0.05$, and $P \leq 0.01$ 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.

[3] LSD for days AA effect.

[4] LSD for treatment effect.

Table 3: Correlation coefficients between field and laboratory experiment results of the mixture of Apron and Captan for sunflower hybrid IS-7101 and Girard safflower.

Crop	Treat.	Field variables	Laboratory variables: Apron & Captan seed treat. % PLS Emergence	
			Control	Treatment
Sunflower	Control	PLS Emerg[1]	0.96**	0.96**
IS-7101	"	EI[2]	0.86*	0.77*
"	Apron &	PLS Emerg.	0.94**	0.97**
"	Captan	EI	0.91**	0.83*
Safflower	Control	PLS Emerg.	0.94**	0.86*
Girard	"	EI	0.95**	0.87*
"	Apron &	PLS Emerg.	0.93**	0.90*
"	Captan	EI	0.99**	0.89*

*, **: 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.

CONCLUSIONS

Generally, PLS emergence of the low vigor seed lots of both crops increased due to fungicide treatment to a higher degree than did high vigor seed lots. Percent PLS emergence in the field and the growth chamber for each crop was significantly ($P \leq 0.05$ or $P \leq 0.1$) correlated. This suggests that seed treatment is important for stand establishment of low vigor seed lots due to its protective effect against seed and soil borne microorganisms.

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TRATAMIENTOS DE SEMILLA PARA MEJORAR LA EFICIENCIA DE LOTES DE SEMILLA DE GIRASOL Y CARTAMO DE DIFERENTE VIGOR EN SUELOS FRIOS

RESUMEN:

Esta investigación fue llevada a cabo para evaluar una mezola de formulaciones de polvo seco de Apron y Captan sobre porcentaje de emergencia e índice de emergencia en lotes de semilla do girasol (*Helianthus annuus* L.) y cártamo (*Carthamus tinctorius* L.) con diferentes niveles de vigor. Los tratamientos fueron evaluados en el campo y en una cámara de crecimiento utilizando el test de suelo frio.

Los resultados indicaron que el porcentaje de emergencia de los lotes de semilla de bajo vigor de ambos cultivos se incrementó con el tratamiento de fungicida en un grado mas alto que con el nivel de vigor de los lotes de semilla. El porcentaje de emergencia en el campo y en la cámara de crecimiento para cada cultivo estuvieron significativamente correlacionados (P x 0.05 ó P x 0.01). Esto sugiere que el tratamiento de la semilla es importante en el establecimiento de lotes de semilla con bajo vigor debido a su efecto protector contra los microorganismos del suelo y las semillas.

APPLICATION DE TRAITEMENTS A DES LOTS DE SEMENCES DE TOURNESOL ET DE CARTHAME DE VIGUEUR DIFFERENTE, POUR AMELIORER LA LEVEE EN SOLS FROIDS

RÉSUMÉ

Cette étude a été conduite pour évaluer l'effet de formulations correspondant à des mélanges de poudre sèche d'Apron et de Captane sur le pourcentage de levée (PLS) et l'indice de levée (EI) de lots de graines présentant divers degrés de vigueur, chez le tournesol (*Helianthus annuus* L.) et le carthame (*Carthamus tinctorious* L.). L'effet des traitements a été évalué au champ et en chambre de culture en utilisant le test do sol à basse température.

Les résultats révèlent qu'en relation avec le traitement fongicide, le pourcentage de levée (PLS) des lots de semence à faible vigueur chez les deux espèces augmente davantage que celui des lots à vigueur plus élevée. Les pourcentages (PLS) de levée au champ et en chambre de culture pour chaque type de plante, apparaissent significativement corrélés ($P=0.05$ ou $P=0.01$). Ces observations suggèrent que le traitement des semences est important pour l'implantation des lots à faible vigueur à cause de son effet protecteur contre les micro-organismes du sol ou présents sur la graine.