The use of organic material for coating of caloetropis procera L. seeds

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Abstract: Calotropis procera L. is a perennial adapted plant distributed in areas of deserts of south Asia. Stage of Calotropis procera L. seeds germination is sensitive to drought stress. Seed coating with water absorbent material is a method for to increase the germination rate. The objective of this study was identifying Using of organic water absorbent material for increase the germination rate of calotropis procera L. seeds in drought stress. Factorial experiment in completely randomized design was with five levels of organic material (wheat residue, canola residue, sunflower residue, vermin compost and peat mass) and extract with four levels (0, 25, 50, 100 % by volume) the result showed that canola residue, wheat residue and wheat residue had Absorbed the most of the water in saturation mode respectively, but vermicompost and peat mass hold water longer than others. vermicompost and peat mass and canolaresidue showed the least of allelopathy effect. All seedling characteristics (germination percentage, germination rate, root length, shoot length, Lateral roots number and seedling weight) decreased with an increase in extract concentrations. Characters decline with an increase vermicompost and peat mass in extract with less steep than others. So canola residue, vermicompost and peat mass were the best organic material for calotropis procera L. seeds coating. Keywords: Calotropis procera L., coating, seed germination, organic material.
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1. Introduction

The term allelopathy from the Greek-derived compounds *allelo-* and *-pathy* (meaning "mutual harm" or "suffering"), was first used in 1937 by the Austrian professor Hans Molisch in the book *Der Einfluss einer Pflanze auf die andere - Allelopathie* (The Effect of Plants on Each Other) published in German.[3]Allelopathy is a biological phenomenon by which an organism produces one or more biochemicals that influence the growth, survival, and reproduction of other organisms. These biochemicals are known as allelochemicals and can have beneficial (positive allelopathy) or detrimental (negative allelopathy) effects on the target organisms. Allelochemicals are a subset of secondary metabolites,[1] which are not required for metabolism (i.e. growth, development and reproduction) of the allelopathic organism. Allelochemicals with negative allelopathic effects are an important part of plant defense against herbivory.

In 1971, Whittaker and Feeny published a study in the journal *Science*, which defined allelochemicals as all chemical interactions among organisms.[3] In 1984, Elroy Leon Rice in his monograph on allelopathy enlarged the definition to include all direct positive or negative effects of a plant on another plant or on micro-organisms by the liberation of biochemicals into the natural environment.[5] Over the next ten years, the term was used by other researchers to describe broader chemical interactions between organisms, and by 1996 the International Homeopathy Society defined allelopathy as "Any process involving secondary metabolites produced by plants, algae, bacteria and fungi that influences the growth and development of agriculture and biological systems."[6] In more recent times, plant researchers have begun to switch back to the original definition of substances that are produced by one plant that inhibit another plant.[3] Confusing the issue more, zoologists have borrowed the term to describe chemical interactions between invertebrates like corals and sponges.[3]

Calotropis procera L. (Asclepiadaceae) is a perennial shrub found in many areas of the Asian deserts (Gutterman1995). In these areas the average annual rainfall is between 30 and 200 mm, or less (Fu 1989). *Calotropis* sp. is distributed in Asia from the Mediterranean to the Africa coast. In Iran it is mainly distributed in the Fars province (Lamerd) and can be found in the Zahedan province as well. Iran is a country in the mid-latitude belt of arid and semi-arid regions of the Earth. Approximately 60% of Iran is classified as arid and semi-arid (Milton 1995). The main role of this species is in restoration of degraded lands and sustenance of these areas. *Calotropis* sp.

regenerate by seed. *Calotropis* sp. produces lots of small seeds that dispread by wind. Establishment of the species in a new site depends on seed dispersal, germination, and establishment of seedlings. Seed germination is extremely sensitive stage of plant life. *Calotropis* sp. is an important economic plant used for drug and other purposes. Scientists wanted to understand its biological and ecological ermination characteristics. *Calotropis* sp. regenerate by seeds and produce many seeds, but its density is very low.

Seed Coat biostimulant product is a dry seed treatment, designed to enhance Wildlife Food Plot performance. Treat Seed When You Plant. Seed Coat contains a proprietary chemistry from DeltAg Wildlife, that has been proven for many years to enhance seed germination, emergence, grow off, and survival. Seed Coat is designed to help establish a healthier stand in your food plots, regardless of weather conditions. Seed Coat contains a proprietary organic complexer, and specific amino acid, vitamin and enzyme chemistry to aid in seedling vigor and grow off.

Langan and christie (1985) was reported moisture absorbent compound was very suitable for increasing germination in semi arid zones. Scott (1998) was found that seed coat had positive effect on germination. Mehrabie et al (2010) research seed coat with hydrojele, mineral and organic is very effective but organic seed coat was the best of all in semi arid zones. Tomati et al (1988) found that vermi compost increasing water capacity, feed element and plant hormone and had positive effect on growth plant.

In compatibility of species and interactive among them was allelopathy of each other.

For seed coat of *Calotropis procera* L. should examine allelopathy potential quantity to organic mater. Xuan et al (2005) showed in experiment allelopathy extract of two species of wheat decreased germination and wool flower seedling growth. Calado et al (2010) were reported mulch of wheat vestiges stopped growth of weed *Amaranthus spinosus* L. and in uncover land was more effective than weed poison. Semidy (1992) showed in field investigation that growth of some weed species degrease around the sunshade because of excretory of this plant. Abbasie et al (2009) showed in experiment that all of germination characteristic of wild avena specially Radical length decrease in all of concentration of water extract of Kolza. Bachman and Davis (2000) observed that applied 10 percentages of vermi compost increased Magnolia Virginian dry weight significantly because of allelopathy unaffected.

This study was conducted to investigate the use of organic material for coating of *calotropis procera* L. seeds.

2. Material and Methods

Wheat residue, canola residue, sunflower residue were collected from agriculture college of shiraz university and drought in room temperature and become powder. vermin compost and peat mass were bought from Kimia company. For preparing extract 10 gram of powder was putted in erlenmire and addition 200cc distilled water and then was putted in incubator for 48 hours with 35°C and provides extract with 25, 50 and 100 concentration.

Mature seeds of *Calotropis procera* L. were collected from the shrubs of natural populations in the desert area in Sistan blochestan province (Sarbaz, 31° N and 57° E altitude) in 2010. Seeds were hand separated from the pods and stored in a refrigerator at a temperature of 5°C. Experiments were carried out with three replicates of 20 seeds each, on Whatman No. 1 filter paper, in 90 mm diameter Petri dishes at 30°C.

The experimental design was a factorial complete randomized design with three replicates. The factors were organic mater in five level (wheat residue, canola residue, sunflower residue, vermin compost and peat mass) and extract in four level (0, 25, 50 and 100 volum percentage).

The seeds were considered to have been germinated when the lengths of the emerging radicals were over 2 mm (International Seed Testing Association 1999). Germinated seedlings were counted every day, for 7 days.

The germination rate was calculated by inverse of MTG (Tobe et al. 2000) as follows:

$MTG = \Sigma (ni.ti)/\Sigma n$

$GR = 1/MTG$

MTG: Mean time to full germination

GR: germination rate

n: number of seeds newly germinating at time ‘t’

ti: number of day from sowing.

The seedling physical condition index was calculated as follows:

$\%G \times SL = VI$

%G: germination percentage

SL: seedling lenght

VI: Vigor index

Seedling dry weights were measured after drying for 24 h in an oven at 70°C (International Seed Testing Association 1999).

For measured moisture capacity and drawing moisture curve 10 gram from organic mater (wheat residue, canola residue, sunflower residue, vermin compost and peat mass) and mineral mater (vermiculite and clay) drying for 10 day in an incubator at 30°C.

Data were analyzed using ‘SAS’ statistical software. Means were separated by Duncan test in cases in which the *F*-value of the treatments was significant at the $P < 0.05$ or $P < 0.01$ Probability levels.

3. Results

The interaction of organic maters and time in moisture capacity was very significant on p<1% (Table 1). The most moisture capacity was in canola residue. Canola residue, wheat residue, maize residue at first time had the most moisture capacity but vermin compost and peat mass at after the first time lose it's moisture lately.

The result showed that mineral mater (vermiculite and clay) absorbed moisture very soon at first time but lose its moisture very soon, too (Table 2).

Tabel 1-Variation analysis of effect of organic mater and different time in moisture capacity

Source different	Degrees Of freedom	Moisture capacity
Organic mater (A)	7	3521.78**
Time (B)	5	7672.07**
A × B	35	571.39**
Error	96	0.05
CV (%)	0.95	

* significant on p< 5%
** significant on p<1%

Tabel 2- comparison of characteristics mean in the interaction of organic maters and time in moisture capacity

Organic mater / Time (h)	moisture capacity							
	Vermicompost	wheat	canola	sunflower	vermiculite	clay	maize	peat mass
(SP)0	27.52k	87.33b	117.75a	60.12e	40.26h	18.58o	61.03d	32.17j
(ASP)48	11.54t	61.15d	86.06g	41.12g	21.31n	10.06vw	34.57i	15.72q
(ASP)96	10.11vw	32.15j	53.38m	22.48m	9.75w	9.78vw	21.12n	12.83s
(ASP)144	10.12vw	21.17n	26.53r	14.68r	9.88vw	9.74w	12.54s	11.27t
(ASP)192	9.95vw	15.43q	16.25w	9.71w	9.86vw	9.88vw	7.01y	10.13vw
(ASP)240	9.9vw	10.75u	10.22x	8.8x	9.86vw	9.86vw	6.23z	10.03vw

The means The means that has the same letter in column in 1% Douncan test isn't significant different.
S SP: pri SP: primary saturation time ASP: The times after primary saturation time

Tabel 3- Variation analysis of effect of organic mater and extract concentration on growth of *Calotropis procera* L seedling

Source different	Degrees Of freedom	Germination %	Germination Rate (g/day)	Shoot Length (cm)	Root Length (cm)	Dry weight Root (gr)	Dry weight Shoot (gr)	Dry weight seedling (gr)	Vigor index
Organic mater (A)	4	425.625*	0.005*	3.681**	5.147**	1.318**	0.00000175**	0.00000447**	50973.003**
Extract concentration (B)	3	1501.528**	0.008**	4.171**	5.6**	6.172**	0.00000152**	0.00000143**	137151.052**
A × B	12	205.347 ^{ns}	0.001 ^{ns}	1.349**	1.082*	2.567**	0.00000328**	0.00000467**	22635.744**
Error	40	135.833	0.001	0.017	0.534	6.746	0.00000005	0.00000006	5142.483
CV (%)		15.251	13.77	2.045	22.871	8.168	5.441	5.025	14.328

Germination percentage

Organic mater had significant effect on germination percentage (p< 5%) (Table 3). Comparison meaning square showed that germination percentage was different in Organic mater kind. The vermin compost, canola residue and peat mass had the most germination percentage and sunflower residue and wheat residue had the least germination percentage. Germination percentage in vermin compost was 82.91 and in wheat residue and sunflower residue was 70.41 (Table 4).

Germination percentage was significantly decrease with increase organic mater concentration from 0 to 100 level (p< 5%) (Table 3). Germination percentage was 86.66 in control and decrease to 62.66 in 100 organic mater concentrations (Table 4).

The most germination percentage was at vermin compost, canola residue and peat mass in 25 and 50 volume percentages.

Tabel 4-The effect of organic mater and concentration on *Calotropis procera* L seedling characters

	Organic mater				
characters	sunflower	canola	wheat	Vermicompost	peat mass
Germination %	70.4b	81.66a	70.41b	82.91a	76.66b
Germination Rate (g/day)	0.29b	0.34a	0.34a	0.31b	0.31b
Shoot Length (cm)	6.09d	5.9e	6.33c	7.32a	6.58b
Root Length (cm)	3.06b	2.9b	2.9b	4.35a	2.76b
Dry weight Root (gr)	0.0007d	0.0008c	0.0006e	0.0015a	0.0011b
Dry weight Shoot (gr)	0.0033c	0.0043a	0.004b	0.0043a	0.0038b
Dry weight seedling (gr)	0.004176d	0.005119b	0.0047c	0.0058a	0.005b
Vigor index	444.58b	493.01b	451.44b	607.11a	506.33b
	Extract concentration (Volume percentage)				
characters	0	25	50	100	
Germination %	86.66a	78.33a	78a	62.66b	
Germination Rate (g/day)	0.35a	0.32b	0.31b	0.29b	
Shoot Length (cm)	6.94a	6.58b	6.57b	5.7c	
Root Length (cm)	2.84b	3.83a	3.58a	2.52b	
Dry weight Root (gr)	0.00096c	0.00094c	0.001b	0.001a	
Dry weight Shoot (gr)	0.0036c	0.0043a	0.0039b	0.0039b	
Dry weight seedling (gr)	0.004591c	0.005343a	0.005b	0.005b	
Vigor index	601.7a	515.79b	513.54b	370.94c	

The same letter in row in 1% and 5% isn't significant different

Germination rate

The kind of organic mater had significant effect on germination rate (p<5%) (Table 3). Comparison meaning square showed that germination rate was high at canola residue and wheat residue and was low at sunflower residue (Table 4). The concentration of organic mater had significant effect on germination rate (p<1%) (Table 3). Comparison meaning square showed that germination rate was 0.35 in controls and decrease to 0.29 in 100 volume percentages (Table 4). The factors interaction was not significant and the most germination rat was related on canola residue and wheat residue in 25 and 50 volume percentages.

Shoot length

The interaction of organic maters and extract concentration on shoot length was very significant on p<1% (Table 3). The most shoot length was in vermin compost and peat mass in 100 volume percentages concentration and the least shoot length was in canola residue, sunflower residue and wheat residue in 100 volume percentages concentration. With decreased concentration of canola residue, sunflower residue and wheat residue increased shoot length. But with increased concentration of vermin compost and peat mass increased shoot length (Table 5).

Tabel 5- comparison of characteristics mean in the interaction of organic maters and concentration on shoot length (cm), Root length (cm) and the number of *Calotropis procera* L duplicate root.

	Extract concentration			
	0	25	50	100
	Shoot Length (cm)			
Sunflower	6.65d	6.61d	6.35e	4.45g
Canola	6.94c	6.31e	6.22e	4.15h
Wheat	6.61d	6.43e	6.32e	5.63f
Vermicompost	7.21b	7.26b	7.48ab	7.62a
peat mass	6.94c	6.27e	6.46de	6.65d
Sunflower	4.8b	4.01bc	3.49b-e	1.89f
Canola	2.84c-f	2.96c-f	3.89b-d	1.92f
Wheat	4.18bc	3.79b-d	2.83c-f	2.12ef
Vermicompost	4.83ab	5.57a	4.8ab	4.18bc
peat mass	3.89b-d	2.81c-f	2.8c-f	2.51d-f

The same letter in row in 1% and 5% isn't significant different

Root length

The interaction of organic maters and extract concentration on root length was very significant on p<1% (Table 3). The most root length was in vermin compost in 25 volume percentages and the least root length was in sunflower residue, canola residue and wheat residue in 100 volume percentages. With decreased concentration of canola residue, sunflower residue and wheat residue increased root length (Table 5).

Root dry weight

The interaction of organic maters and extract concentration on root dry weight was very significant on p<1% (Table 3). The most root dry weight was in vermin compost and peat mass in 100 volume percentages concentration and the least root dry weight was in sunflower residue and wheat residue in 100 volume percentages concentration. With decreased concentration of sunflower residue and wheat residue increased root dry weight. But with increased concentration of vermin compost and peat mass increased root dry weight (Table 6).

Shoot dry weight

The interaction of organic maters and extract concentration on shoot dry weight was very significant on p<1% (Table 3). The most shoot dry weight was in wheat residue in 25 concentration and in vermin compost and canola residue in 100 and 25 volume percentages and the least shoot dry weight was in sunflower residue and wheat residue in 100 volume percentages concentration. With decreased concentration of sunflower residue and wheat residue increased shoot dry weight But with increased concentration of vermin compost and peat mass increased shoot dry weight (Table 6).

Seedling dry weight

The interaction of organic maters and extract concentration on seedling dry weight was very significant on p<1% (Table 3). The most seedling dry weight was in vermin compost in 100 volume percentages concentration and the least seedling dry weight was in sunflower residue and wheat residue in 100 volume percentages concentration. With decreased concentration of sunflower residue and wheat residue increased seedling dry weight. But with increased concentration of vermin compost and peat mass increased seedling dry weight (Table 6).

Vigor index

The interaction of organic maters and extract concentration on vigor index was very significant on p<1% (Table 3). The most vigor index was in vermin compost in 100 volume percentages concentration and the least vigor index was in sunflower residue in 100 volume percentages concentration. With decreased concentration of sunflower residue increased vigor index. But with increased concentration of vermin compost and peat mass increased vigor index (Table 6).

Tabel 6- comparison of characteristics mean in the interaction of organic maters and concentration root dry weight (gr), shoot dry weight (gr), seedling dry weight (gr) and vigor index *Calotropis procera* L seedling

Extract concentration / Organic mater	0	25	50	100
		Dry weight Root (gr)		
Sunflower	0.0008f-h	0.0007hi	0.0007hi	0.0006ji
Canola	0.0009e-g	0.0008f-h	0.0008f-h	0.0007hi
Wheat	0.001e	0.0008hi	0.0005jk	0.0004k
Vermicompost	0.0009e-g	0.0013d	0.0018b	0.0019a
peat mass	0.0007hi	0.0009ef	0.001e	0.0015c
		Dry weight Shoot (gr)		
Sunflower	0.0037e	0.0037e	0.0037e	0.0024g
Canola	0.0036e	0.0048c	0.0044d	0.0043d
Wheat	0.0029f	0.0065a	0.0029f	0.0028f
Vermicompost	0.0036e	0.0037e	0.0045dc	0.0053b
peat mass	0.0036e	0.003f	0.0042d	0.0046dc
		Dry weight seedling (gr)		
Sunflower	0.004590ef	0.0045369f	0.0044816f	0.0030957i
Canola	0.0063511b	0.0057209c	0.0053128cd	0.0051635d
Wheat	0.0045811ef	0.0073917a	0.0035490h	0.0032984hi
Vermicompost	0.0046354ef	0.0050144de	0.0063469b	0.0073587a
peat mass	0.0045111ef	0.0040529g	0.0053542cd	0.00617b
		Vigor index		
Sunflower	601.70ab	506.46a-c	477.31bc	192.81d
Canola	599.99ab	557.10a-c	549.70a-c	263.55d
Wheat	549.8a-c	440.30c	475.05b-c	288.70d
Vermicompost	601.83ab	593.45ab	610.75ab	622.55a
peat mass	603.70ab	481.65a-c	486.86a-c	487.10a-c

The same letter in row in 1% and 5% isn't significant different

4. Discussions

The result showed that organic mater absorbed moisture very much and lost its moisture very hard. This organic mater (wheat residue, canola residue, sunflower residue, vermin compost and peat mass) was very great. In arid and semi arid region ecosystem, in the beginning growth season we see rainfall after rains temperature become high. In high temperature water on top of the soil was not available but with using organic mater moisture was kept on top soil for along time and help to the seed establishment. After determining the allelopathy potential of above organic mater using some one for seed coating that has low rate allelopathy and high degree of moisture capacity (Table 2 and 3). Result showed vermin compost, peat mass and canola residue were in the best quality about all of above. Mehraby and et al. (2009) agreement with these results. Two organic mater, vermin compost and peat mass increasing growth characteristic. Tomity and et al. (2008) showed that vermin compost increased moisture capacity, supplied feed element and produced plant hormones. Bachman and Metzeger (1998) showed that vermin compost increased plant growth.

Result showed that the effect of organic mater on seedling characteristic was very significant on $p<1\%$ (Table 3). The different reply *Calotropis procera* L. seed growth index to five organic mater remind different degree tolerance to allelopathy effect. This characteristic was from object species (12, 17,19). Bergstorm and Tollsen (1988) had reported the same result. Radical as compared with plumule was very sensitive and had effective allelopathy negative influence whether allelochemical actives electively (17).

Wheat residue decreased seedling growth significantly on $p<1\%$ (Table 3). Chema and et al showed the same result. Takikawaand et al. (2003) reported that with using plant residue could controlled weed population. Xuan (2005) in the other research showed the same result about allelopathy effect of wheat residue on germination and seedling growth of amaranthus. Wu and et al. (2005) Calado and et al. (2010) reported that with using wheat residue could controlled weed population.

Sunflower residue decreased seedling growth significantly on $p<1\%$ (Table 3). Semidi (1992), Mominovic (1991) and chavez (1996)) reported that with using sunflower residue could controlled weed population. Canola residue decreased seedling growth significantly on p<1% (Table 3). Result showed that canola residue had allelopathy effect on *Calotropis procera* L. seedling. Abbasie and et al. (2008) reported that all of germination characters of wild avena especially radical length decreased in all of different concentration of canola extract.

Result showed that with increased extract concentration, germination percentage, germination rate, shoot length, root length, numbers of rootlet root dry weight, shoot dry weight, seedling dry weight, vigor index degreased significantly on p<1% (Table 3). This effete because of increasing allelochemical and the toxicity effect (21,20,18,12). Samedany and Baghestany showed the same result. Although osmotic potential aggravated allelochemical effectiveness.

The high level of moisture capacity in the beginning saturation time saw in canola residue but vermin compost and peat mass absorbed low humidity at the beginning saturation time but missed humidity after the beginning saturation time hardly.

Wheat residue, canola residue, sunflower residue, vermin compost and peat mass had allelopathy effects and decreased seed and seedling growth characteristics of *Calotropis procera* L.

With increasing extract concentration of all of above materials decreased more intensity growth characteristics.

Vermin compost, peat mass and canola residue had the lowest allelopathy effects.

Vermin compost, peat mass and canola residue were the best material for seed coating *Calotropis procera* L. seeds.

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