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Induction on Seed Germination and Seeedling Performances against Sunflower (*Helainthus annuus* L.) and Castor bean (*Ricinus communis* L.) as Influenced by Different Water Stress Treatments

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Abstract: The objective of this study was to studied of the effects of water stress treatments on inhibition of seed germination and seedling growth in sunflower (*Helainthus annuus* L.) and castor bean (*Ricinus communis* L.). The experimental design was 3x5 Factorial in CRD (Completely randomized design) with four replications. Factor A as levels of seed qualities (sunflower and castor bean) divided into three treatments; 1) high quality seed 2) medium quality seed and 3) low quality seed as well as Factor B as the water stress treatments (WST) consisted of five treatments after watered at the first planting; T1 the watered treatment for every day (control treatment) T2 the watered interval for one day T3 the watered interval for two days T4 the watered interval for three days and T5 the watered interval for four days. Seed germination, speed of germination index, shoot length and seedling dry weight were tested. The results showed that the increase of water stress treatments resulted in the increase of inhibition of seed germination and seedling growth in two selected plants (sunflower and castor bean). The difference of seed quality showed the different inhibition of seed germination and seedling growth in two selected plants. The planting of high seed quality had the inhibition of seed germination and seedling growth which lesser than the planting of medium seed quality and low seed quality under water stress condition. The planting of sunflower with watered interval for four days exhibited that the maximum of inhibitory degree (68.04%) followed by the planting of sunflower with the watered interval for three days, the watered interval for two days and the watered interval for one day showed inhibitory degree for 55.37 37.97 and 27.01%, respectively. The planting of low seed quality of sunflower exhibited that the highest of inhibitory degree (56.70%), followed by the planting of medium seed quality of sunflower and the planting of high seed quality of sunflower showed the inhibitory degree for 46.81 and 37.79%, respectively. For castor bean testing, The planting of castor bean with watered interval for four days exhibited that the maximum of inhibitory degree (72.25%) followed by the planting of castor bean with the watered interval for three days, the watered interval for two days and the watered interval for one day showed inhibitory degree for 57.38 39.98 and 28.20%, respectively. The planting of low seed quality of castor bean exhibited that the highest of inhibitory degree (59.36%), followed by the planting of medium seed quality and the planting of high seed quality showed the inhibitory degree for 50.51 and 38.50%, respectively. The results showed that the planting of sunflower and castor bean must selection the high seed quality and selection of the planting of sunflower and castor bean whithout water stress condition. This result indicated that the comprehensive data of effects of water stress on seed germination and seedling growth against (sunflower and castor bean) as well as suggest select the optimum application of the high seed quality for the planting under water stress condition.

Keywords: Water Stress Treatments, Sunflower (*Helianthus annuus*), Castor Bean (*Ricinus communis*), Seed Germination, Seedling Growth Performance, Water Deficit

1. Introduction

Oil crops (sunflower and castor bean) are the economically important crops around the world. Sunflower is the important of oil crops, sunflower seeds rich a high amount of oil (50%) (Oraki et al., 2011). Sunflower seeds contain a high level of polyunsaturated fatty acid included oleic acid and linoleic acid (Kostik et al., 2014) as well as Pajak et al. (2014) exhibited that the seedling of sunflower (sprouts) had the high level of antioxidant activity, which the seeds and seeding from sunflower showed the useful to the health of human. For the benefit of castor bean for the oil industry, seeds of castor bean are the source of oil for 40% (Sonia et al., 2018). There are three products for the application of castor seeds in manufacturing included industrial paints,

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varnished products and lubricating oil (Papazoglou et al., 2020).

The production of two oil crops (sunflower and castor bean) have some the problematic issues, for example lack of high seed quality of the production, reduction of some factor of the production and the planting of crops under inappropriate environment. There are three conditions of the inappropriate environment in two oil crops (sunflower and castor bean) production namely the high temperature stress condition, water logging condition and water stress condition.

Water stress condition is a problematical importance on the some crops production as well as sunflower and castor bean production for two seasons namely the late rainy season and the summer season. The water stress conditions caused many of physiological processes included photosynthesis process and transpiration process resulted in reduction of growth and damage of yield component and seed yield (Pandey et al., 2014). Pandey and Shukla (2015) impressed that the water stress conditions lead to the damage of seedling characters include the decrease in fresh and dry weight of shoot and root of seedling and reduction of shoot length and root length of seedling as well as Nadeem et al. (2019) repeated that the water stress showed that the reduction of photosynthetic rate and respiration rate and repored that the injury of yield component and seed yield.

Besides, Fathi and Tari (2016) stated that the water stress conditions showed the reduction of seed germination and lead to poor stand establishment as well as the water stress lead to a damage of seedling growth and reduction in seed yield.

Many studies have been summarized the induction of water stress on seed germination, growth charateristics, yield components and yield against some crops. For instances, Saxena et al. (2010) exhibited that the water stress on seedling growth against coriander (*Coriandrum sativum*). Oraki et al. (2011) noted that the effect of water deficit stress on yield conponets and seed yield in sunflower (*H. annuus*), the intense water deficit stress showed the yield components interm of seed number per head, seed weight, head diameter and seed yield are lesser than other treatment (mild water deficit stress and normal irrigation).

Maralian et al. (2010) sayed that the water deficit stress for two treatment namely the water stress before tillering stage and the water stress after heading stage showed singnificantly affected grain yield and straw yield against wheat (*Triticum aetivum*), which lesser than the well-watered treatment (control condition). Suresh et al. (2010) definded that the the water stress for 24 days after planting on physiological changes (gas-exchange parameters, leaf water potential and quantum efficiency of photosystem II) against oil plam (*Elais giuneensis*) compared with the control treatment (normal irrigation), the water stress for 24 days after planting exhibited the physiological changes against oil palm is more injured than the control treatment. Maraghni et al. (2010) studied that the effects of water stress treatments (induced by (polyethelene glycaol (PEG-6000) at 0 (control treatment) 0.6 0.8 and 1.0 MPa) on seed germination and seedling growth in ziziphus (*Ziziphus lotus*), the water stress treatments at 1.0 MPa showed the lowest of seed germination, number of days to first emergence and mean time to emergence against the tested plant, while the control treatment (0 MPa) exhibited tha highest of seed germination, number of days to first emergence and mean time to emergence.

Sun et al. (2010) studied that the effects of the three kind of irrigation scheduling namely low irrigation, medium irrigation and high irrigation on seed yield of maize (*Zea mays*), as a results, the low irrigation treatment showed the seed yield is lesser than the other treatments (medium irrigation and high irrigation). Mut et al. (2010) noted that the effects of drought stress at different treatment (the drought stress induced by polyethelene glycaol (PEG-6000) for 0 (control treatment) -0.25 -0.50 and -0.75 MPa) on germination and seedling growth against oat (*Avena sativa*), the osmotic potential of -0.75 MPa showed the minimum of final germination, shoot length and root length of seedling against oat while, the osmotic potential of 0 MPa (control treatment) showed the maximum of final germination, shoot length and root length of seedling against oat.

Pejic et al. (2010) reported that the water stress treatment (evaporation rate in irrigation condition for 170-450 mm) showed the seed yield of soybean (*Glycine max*) for 3,739 ton/ha^{-1} is lesser than the control treatment (evaporation rate in irrigation condition for 432-501 mm) (the seed yield of soybean for 4,559 ton/ha^{-1}).

Besides, Chatzakis et al. (2011) discovered that the effects of water stress on growth and yield of castor bean (*R. communis*) , the water stress condition marked that the loss of growth and yield against castor bean is more injured than the control treatment (well-water treatment) as well as Papazoglou et al. (2020) studied the effects of the difference of water stress on growth and yield in castor bean (*R. communis*), the results showed that the two water stress (the moderately stress treatment ;the soil moisture content for 55%) and the highly stress treatment; the soil moisture content for 40%) had the damage of growth and yield against castor bean are more injured than the control treatment (the soil moisture content for 70%).

Furthernores, The water stress treatments showed the damage of the seed germination, seedling growth, yield component and seed yield, thses results that inconformity with the several resrechs who tested the crops under water stress treatments namely sugar cane (*Saccharum officinarum*) (Basnayake et al., 2012; Alemei et al., 2013), wheat (*Triticum durum*) (Khayaynezhad, 2012), corn (*Zea mays*) (Chang et al., 2013; Odiyi, 2013) and oil palm (*E. quineensis*) (Suresh et al., 2010; River-Mendes et al., 2016).

Anjun et al. (2011) iterated that the water stress condition exhibited the loss of the growth characters and reduction of yield component and seed yield.

An inadequate data of the water stress on inhibition of seed germination and seedling growth in two tested plants sunflower (*H. annuus* L.) and castor bean (*R. communis* L.).

The objective of this research was to study of the effects of water stress treatments on inhibition of seed germination and seedling growth in sunflower (*H. annuus* L.) and castor bean (*R. communis* L.). These data as comprehensive data conduce towards the optimum selection of different seed quality of two selected plants (sunflower and castor bean) for the planting under water stress condition.

2. Materials and Methods

2.1 Location

This experiment was carried out at Department of Applied Science, Faculty of Science and Technology, Phranakhon Si Ayutthaya Rajabhat University, Phranakhon Si Ayutthaya province (14° 21/N, 100°34/E), Thailand. The experiment was conducted in January 2019 to December 2019.

2.2 The seed tested and samples

The sunflower seeds were tested in this experiments as the hybrid variety (Hybrid 1 variety). Samples of sunflower seed qualities divided into three groups namely high quality seed had 95% germination, medium quality seed had 85-90% germination and low quality seed had 70-75% germination.

The castor seeds were tested in this experiments as the local variety (white leaf color variety). Samples of castor bean seed qualities divided into three groups namely high quality seed had 95% germination, medium quality seed had 85-92% germination and low quality seed had 65-75% germination.

The samples of two tested plants (sunflower and castor seeds) were planted on filter paper in petri dishs (20 cm) and the water for 100 ml was applied at the first planting.

2.3 The experimental design

The experimental design was 3x5 Factorial in CRD (Completely randomized design) with four replications. Factor A as levels of seed qualities (sunflower and castor bean) divided into three treatments; 1) high quality seed 2) medium quality seed and 3) low quality seed as well as Factor B as the water stress treatments (WST) consisted of five treatments after watered at the first planting; T1 the watered treatment for every day (control treatment) T2 the watered interval for one day T3 the watered interval for two days T4 the watered interval for three days and T5 the watered interval for four days.

2.4 The water stress treatments (WST)

The water stress treatments (WST) (the number of time (days) of the watered (100 ml) interval for seed germination and seedling growth test) consisted of five treatments after watered treatment at the first planting; T1 the watered treatment at every day (control treatment) (the number of time of the watered treatment for 14 days) T2 the watered interval for one day (the number of time of the watered treatment for 7 days) T3 the watered interval for two days (the number of time of the watered treatment for 5 days) T4 the watered interval for three days (the number of time of the watered treatment for 4 days) and T5 the watered interval for four days (the number of time of the watered treatment for 3 days). The water amount for 100 ml was applied for five treatments.

The timing of water stress treatments (five treatments) on seed germination and seedling growth test for 14 days after planting are shown in Table 1.

Table 1 The timing of the water stress treatments (WST) on seed germination and seedling growth tests for 14 days after planting.

Water stress treatments (WST)	Timing of the water stress treatments (WST) for 14 days after planting													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
T1 (14 days)	/	/	/	/	/	/	/	/	/	/	/	/	/	/
T2 (7 days)	/	-	/	-	/	-	/	-	/	-	/	-	/	-
T3 (5 days)	/	-	-	/	-	-	/	-	-	/	-	-	/	-
T4 (4 days)	/	-	-	-	/	-	-	-	/	-	-	-	/	-
T5 (3 days)	/	-	-	-	-	/	-	-	-	-	/	-	-	-

/ watered treatment and – no watered treatment

2.5 Seed germination bioassay
Seed germination and speed of germination index of seed samples were tested at 7-14 days after planting. The seed quality were tested followed by the rules for seed testing of ISTA (2002). The petri dishes were tested in the darkness at 20-30 °C. The seed germination and speed of germination index were measured at 10-14 days after incubation in darkness at 20-30 °C.

The water stress treatments (WST) consisted of five treatments after watered at the first planting; T1 the watered treatment for every day (control treatment) T2 the watered interval for one day T3 the watered interval for two days T4 the watered interval for three days and T5 the watered interval for four days.

The data of seed parameters (seed germination and speed of germination index) inhibition (M) with respect to the control treament was calculated from the formula (Sawatdikarn, 2020) as follows ;
M = [(A-B) / A] x 100

Where A is the seed parameters (seed germination and speed of germination index) of the control treament (the watered treatment for every day) and B is the seed parameters (seed germination and speed of germination index) of the water stress.

2.6 Seedling growth bioassay
eedling growth tests were conducted for two planted plants (sunflower and castor bean). The seedling quality were tested followed by the rules for seed testing of AOSA (2003).

The seeds for 25 seeds were surface sterilized with 5% (w/v) sodium hypochlorite solution for 10 min, rinsed two times with distilled water. 25 seeds of each plant species were put on two layer of filter paper in petri dishes (20 cm.) (Sawatdikarn, 2020).

The water stress treatments (WST) consisted of five treatments after watered treatment at the first planting; T1 the watered treatment for every day (control treatment) T2 the watered interval for one day T3 the watered interval for two days T4 the watered interval for three days and T5 the watered interval for four days.

The petri dishes were tested in the darkness at 25 °C. The seedling growth were measured at 10-14 days after incubation in darkness at 25 °C. (AOSA, 2002).

The seedling growth parameters (shoot length and seedling dry weight) was measured for 14 days after incubation in darkness at 25 °C. (AOSA, 2002). The control seeds were tested on the filter paper moistened with the watered at every day.

The growth parameters (shoot length and seedling dry weight) of seedling growth inhibition (M) with respect to the control treament was calculated from the formula (Sawatdikarn, 2020) as follows ;
M = [(A-B) / A] x 100

Where A is the seedling parameters (shoot length and seedling dry weight) of the control treament (the watered treatment for every day) and B is the seedling parameters (shoot length and seedling dry weight) of the water stress.

2.7 Statistical analysis
All experiments were tested for four replications. Data of seed germination and seedling growth for four characteristics (inhibition of seed germination, inhibition of speed of germination index, inhibition of shoot length and inhibition of seedling dry weight) of two tested plants (sunflower and castor seeds) at different seed qualities (high quality seed, medium quality seed and low quality seed) were subjected to analysis using Duncan 's Multiple Range Tests (DMRT).

4. Results and discussion
4.1 The effects of water stress treatments on seed germination and seedling growth against sunflower
The watered interval for four days showed the highest of the inhibition of seed germination and seedling growth performance in sunflower (Table 2-3).

The increase of water stress treatment resulted in the increase of the inhibition of four characteristics (seed germination, speed of germination index, shoot length and seedling dry weight) in sunflower.

The watered interval for four days showed the highest of the inhibition of seed germination and speed of germination ranged from 53.94% to 76.94% inhibition against sunflower, while the watered interval for one day exhibited that the least of inhibition of seed germination and speed of germination by 12.74-35.79% inhibition (Table 2).

The rising of the water stress treatments resulted in the accumulative of inhibition of seed germination and speed of germination against sunflower. This data is inconformity with the finding works of Fatemi et al. (2014) who presented that the impaction of water stress treatments on germination percentage and germination rate against sunflower. Besides, Sheshaiah et al. (2017) revealed that the water stress treatment (water stress induced by polyethelene glycol (PEG 6000) for 20 and 25% concentrations) inhibited the seed germination and germination time index against sunflower, which more injured than the control treatment (no water stress treatment)

The loss of seed germination and speed of germination resulted from water stress treatment, Pandey and Shukla (2015) noted that the water stress condition acts the reduction of cell elongation and inhibition of cell expansion as well as water stress lead to poor root development and reduction of leaf growth.

The reduction of seed quality of sunflower resulted in the increase of inhibition of seed germination and speed of germination. The high seed quality showed the minimum of inhibition of seed germination and speed of germination ranged from 12.74% to 53.94% and 15.96 % to 58.75% inhibition, respectively followed by the medium of seed quality exhibited the inhibition of seed germination and speed of germination for 21.04-60.84% inhibition and 24.68-68.79% inhibition as well as the low of seed quality of sunflower noted the maximum of inhibition of seed germination and speed of germination ranged from 32.76% to 71.82% and 35.79% to 76.94% inhibition, respectively (Table 2).

The data from the research showed that the increase of inhibition of seed germination and speed of germination resulted in the decrease of the seed quality of sunflower, as a results that inconformity with the finding works of Elsheikh et al. (2015) as well as Buriro et al. (2015) who showed the induction of the water stress on seed germination seedling growth and yield of sunflower.

Not only the water stress caused the damage of seed germination and speed of germination in sunflower planting but also the water stress lead to reduction of seedling growth in term of shoot length and seedling dry weight (Table 3).

The watered interval for four days displayed that the highest of the inhibitory degee of shoot length and seedling dry weight between 55.96-72.95% inhibition and 69.84-85.26% inhibition, respectively. meanwhile, the watered interval for one day presented that the lowest of shoot length and seedling dry weight by 17.82-42.69% inhibition and 20.21-40.84 % inhibition, respectively (Table 3). The water stress acted the loss of shoot length and seedling dry weight against sunflower. This results is agreement with the data of Alahdadi et al. (2011) and Patane et al. (2017) who showed the effects of water stress on seedling growth and yield components against sunflower.

The water stress showed the injury of the seedling growth incase of shoot length and seedling dry weight, this data is incorformity with the data of Anjum et al. (2011) who reported that the water stress acts the reduction of cell division and marks the reduction of cell elongation and cell enlargement. In addition, the loss of the leaf and stem growth interm of the number of leaf per plant, leaf size, plant height and stem diameter resulted from the planting of the crops under water stress conitions (Fathi and Tari, 2016).

The different seed quality in sunflower (high medium and low seed quality) demonstrated that the difference of the inhibition of seedling growth interm of shoot length and seedling dry weight (Table 3).

The low seed quality of sunflower marked that the highest of the inhibition of shoot length and seedling dry weight by 42.69-72.95% inhibition and 40.84-85.26% inhibition, respectively. On the other hand, the high seed quality of sunflower revealed that the least of the inhibition of shoot length and seedling dry weight by 17.82-55.96% inhibition and 20.21-69.84% inhibition, respectively.

The decrease of seedling growth against sunflower resulted in the rising of the damage of seedling growth. This data presented that the inconformity with the data of the experiment of Sheshaiah et al. (2017) who displayed that the high seed quality of sunflower had the seed germination and seeling growth under water stress is lesser than the low seed quality.

The increase of severity of water stress resulted in the loss of seed germination and seedling growth against sunflower (Table 4). The watered interval for four days marked that the farthest of inhibitory degree of seed germination and seedling growth for 68.04% inhibition followed by the watered interval for three days and the watered interval for two days showed the inhibitory degree for 55.37 and 39.79% inhibition, respectively while, the watered interval for one day displayed that the lowest of inhibitory degree of seed germination and seedling growth for 27.01% inhibition.

This data form the research corroborate with the researchs of Buriro et al. (2015) as well as Sheshaiah et al. (2017) who noted that the increase of water stress against sunflower resulted in the injury of seedling growth and component of yield.

The difference of seed quality in sunflower noted that the different inhibition of seedling growth interm of shoot length and seedling dry weight (Table 4). The low seed qulity of sunflower marked the highest of inhibition of seed germination and seedling growth for 56.70 % inhibition, followed by the medium seed quality (46.81% inhibition, while the high seed qulity of sunflower noted the lowest of inhibition of seed germination and seedling growth for 37.79% inhibition.

This data showed that inconformity with the data of

Oraki et al. (2011) who revealed that the high seed quality of sunflower had the seedling growth interm of shoot length and seedling dry weight under water stress condition is better than the low seed quality.

Besides, Anjum et al. (2011) who acted that the different of seed quality gave the differenece of injury of seedling growth and yield components, the high seed quality showed the seedling growth is more preferable than the different seed quality (medium seed quality and low seed quality).

4.2 The effects of water stress treatments on seed germination and seedling growth against castor bean

The increase of the inhibition of castor bean incase of seed germination ane speed of germination (Table 5) as well as shoot length and seedling dry weight (Table 6) caused by the rising of the water stress treatment.

The watered interval for four days displayed the maximum of the inhibitory percentage of seed germination and speed of germination ranged from 58.94% to 81.01% against castor bean, while the watered interval for one day acted that the least of the inhibitory percentage of seed germination and speed of germination between 11.76-36.74% (Table 5).

For the evaluation of seedling growth in term of shoot length and seedling dry weight in castor bean under water stress condition, the watered interval for four days noted that the highest of the inhibitory percentage for 60.80-85.09%, followed by the watered interval for three days (43.94-71.74%) and the watered interval for one day showed that the lowest of the inhibitory percentage between 20.28-41.21% (Table 6).

The data of this research is agreement with the data of the researchs of Sowmya et al. (2016) and Nikneshan et al. (2019) who reported that the effect of water stress on seed germination seedling growth and yield components against castor bean.

The data from this experiment (Table 5 and Table 6) supported that these previous researchs of the evatuation of seed germination and speed of germination as well as shoot length and seedling dry weight under water stress condition against different crops planting namely rice (Pandey et al., 2011), corn (Benjamin et al., 2014), sunflower (Oraki et al., 2011; Elsheikh et al., 2015), oil plam (Mendez et al., 2012; Asemota and Conarie, 2010) as well as castor bean (Junior et al., 2011 ; Papazoglou et al., 2020).

The reduction of seed quality of castor seed resulted in the accumulative of inhibition degree of seed germination and seedling growth against castor bean. The low seed quality demonstrated that the highest of inhibitory degree interm of seed germination and speed of germination ranged from 32.26% to 78.96% and 41.21% to 85.09%, respectively. On the other hand, The high seed quality presented that the lowest of inhibitory degree interm of seed germination and speed of germination ranged from 11.76 % to 58.94 % and 18.94% to 61.25%, respectively (Table 5).

Besides, the difference of seed quality of castor bean resulted in the inhibition of seedling growth incase of shoot length and seedling dry weight under water stress treatment. The low seed quality exhibited that the maximum of inhibitory degree in case of shoot length and seedling dry weight ranged from 41.26% to 82.02% and 41.21% to 85.09%, respectively. meanwhile, the high seed quality exhibited that the minimum of inhibitory degree in case of shoot length and seedling dry weight ranged from 20.28% to 60.80% and 22.96% to 65.84%, respectively (Table 6).

This data showed that inconformity with the data of Vallegos et al. (2011) who repoted that the high seed quality of castor bean, which noted that the seed germination and seedling growth under water stress condition is better than the low seed quality of castor bean. Besides, Tadayon et al. (2015) who exhibited that the high seed quality of castor bean showed the seed germination and seedling growth of the high seed quality under water stress condition is more preferable than the low seed quality of castor bean.

This data (Table 5 and Table 6) of different seed quality of castor bean showed the difference of seed germination and seedling growth under water stress condition, which supported of the previous researches of the effect of seed quality on seed germination seedling growth and yield components in water stress of castor bean (Junior et al., 2011; Chatzakis et al., 2011 ; Shi et al., 2014; Nikneshan et al., 2019 ; Papazoglou et al., 2020) as well as several crops planting namely rice (Nassir and Adewusi, 2011), wheat (Yani and Rashidi, 2012; Saeedipoor, 2012), maize (Luna-Flores et al., 2014; Simic et al., 2017), oil plam (Joseph-Adekunle et al., 2017), sugarcane (Begum and Islam, 2012), soybean (Aminifar et al., 2012; Maleki et al., 2013) and sunflower (Patane et al., 2017).

The increase of periodic duration of water stress resulted in the injury of seed germination and seedling growth against castor bean (Table 7). The watered interval for four days marked that the maximum of inhibition of seed germination and seedling growth for 72.25 % inhibition followed by the watered interval for three days and the watered interval for two days by 57.38 % and 39.98 % inhibition, respectively while, the watered interval for one day showed that the lowest of inhibition of seed germination and seedling growth for 28.20% inhibition.

This data is corroborate with the researchs of Radhamani et al. (2012) as well as Sonia et al. (2018) who repoted that the increase of water stress against cator bean resulted in the damage of seed germination seedling growth and component of yield in caster bean planting.

The difference of seed quality (high medium and low seed quality) in cator bean marked that the difference of t inhibitory percentage of seed germination and seedling growth (Table 7). The low seed qulity of castor bean showed the highest of inhibition of seed germination and seedling growth for 59.36 % inhibition, followed by the medium seed quality (50.51 % inhibition, while the high seed qulity of castor bean presented that the lowest of inhibition of seed germination and seedling growth for 38.50% inhibition (Table 7).

This data showed that inconformity with the research of Silva et al. (2015) who reported that the high seed quality of castor benn showed the seed germination and seedling growth under water stress condition is better than the low seed quality.

In addition, Sowmya et al. (2016) who reported that the different of seed quality showed the differenence of the loss of seedling growth and yield components against castor bean, which the high seed quality of castor bean showed the seedling growth is more superior than the low seed quality of castor bean.

The water stress condition marked that the inhibition of seed germination and seedling growth against sunflower (Table 2, Table 3 and Table 4) as well as castor bean (Table 5, Table 6 and Table 7). These data noted that the agreement of the data of Pandey et al. (2014) who reported that the effect of water stress on seed germination and seedling growth, which showed the loss of seed germination and the reduction of seedling growth. Besides, Nadeem et al. (2014) who showed the impaction of water stress on germination, growth and development charaters against legume crops including reduction of seed germination, decrease of shoot and root development, the loss of photosynthesis and injury of vegetative stage and reproductive stage.

Table 2. Inhibition of seed germination and speed of germination index of different seed qualities (high, medium and low) against sunflower at different water stress treatments compared with the watered treatment for every day (control treatment).

Water stress treatments (WST)	Inhibition of seed germination (%)			Inhibition of speed of germination index (%)		
	High quality	Medium quality	Low quality	High quality	Medium quality	Low quality
One day	12.74d	21.04d	32.76d	15.96d	24.68d	35.79d
Two days	22.74c	33.69c	42.84c	25.86c	36.94c	47.82c
Three days	39.82b	45.67b	53.94b	49.74b	59.26b	65.84b
Four days	53.94a	50.84a	71.82a	58.75a	68.79a	76.94a
C.V. (%)	6.74	8.69	7.64	8.82	7.65	4.86

Values with different letter showed significant difference (p<0.05) as determined by Duncan 's Muntiple Range Test (DMRT).

Table 3. Inhibition of shoot length and seedling dry weight of different seed qualities (high, medium and low) against sunflower at different water stress treatments compared with the watered treatment for every day (control treatment).

Water stress treatments (WST)	Inhibition of shoot length (%)			Inhibition of seedling dry weight (%)		
	High quality	Medium quality	Low quality	High quality	Medium quality	Low quality
One day	17.82d	26.89d	42.69d	20.21d	32.79d	40.84d
Two days	28.94c	38.69c	51.26c	32.16c	42.86c	52.86c
Three days	42.89b	52.82b	60.84b	51.26b	62.63b	72.84b
Four days	55.96a	65.76a	72.95a	69.84a	75.69a	85.26a
C.V. (%)	5.69	7.68	4.60	4.96	8.26	5.14

Values with different letter showed significant difference (p<0.05) as determined by Duncan 's Muntiple Range Test (DMRT).

Table 4. Mean of inhibition of seed germination and seedling growth of three seed qualities in sunflower as affected by different water stress treatments.

Water stress treatments (WST)	Seed qualities of sunflower			Mean
	High quality	Medium quality	Low quality	
One day	16.68d	26.35d	30.02d	27.01d
Two days	27.20c	38.04c	48.69c	39.97c
Three days	47.67b	55.09b	63.36b	55.37b
Four days	59.62a	67.77a	76.74a	68.04a
Mean	37.79C	46.81B	56.70A	47.09

Values with different letter showed significant difference ($p<0.05$) as determined by Duncan 's Muntiple Range Test (DMRT).

Table 5. Inhibition of seed germination and speed of germination index of different seed qualities (high, medium and low) against castor bean at different water stress treatments compared with the watered treatment for every day (control treatment).

Water stress treatments (WST)	Inhibition of seed germination (%)			Inhibition of speed of germination index (%)		
	High quality	Medium quality	Low quality	High quality	Medium quality	Low quality
One day	11.76d	20.86d	31.26d	18.94d	25.96d	36.74d
Two days	26.79c	32.86c	46.25c	29.74c	35.96c	48.74c
Three days	36.68b	51.84b	67.95b	42.84b	52.84b	62.83b
Four days	58.94a	69.86a	78.96a	61.25a	72.59a	80.01a
C.V. (%)	7.64	5.16	9.62	10.21	7.69	8.46

Values with different letter showed significant difference ($p<0.05$) as determined by Duncan 's Muntiple Range Test (DMRT).

Table 6. Inhibition of shoot length and seedling dry weight of different seed qualities (high, medium and low) against castor bean at different water stress treatments compared with the watered treatment for every day (control treatment).

Water stress treatments (WST)	Inhibition of shoot length (%)			Inhibition of seedling dry weight (%)		
	High quality	Medium quality	Low quality	High quality	Medium quality	Low quality
One day	20.28d	33.20	41.26d	22.96d	33.09d	41.21d
Two days	31.06c	42.08	51.84c	35.29c	41.49c	58.28c
Three days	42.94b	53.89	63.93b	45.98b	61.20b	71.74b
Four days	60.80a	71.21	80.02a	65.84a	79.52a	85.09a
C.V. (%)	9.24	7.62	9.82	6.95	7.82	8.96

Values with different letter showed significant difference ($p<0.05$) as determined by Duncan 's Muntiple Range Test (DMRT).

Table 7. Mean of inhibition of seed germination and seedling growth of three seed qualities in castor bean as affected by different water stress treatments.

Water stress treatments (WST)	Seed qualities of castor bean			Mean
	High quality	Medium quality	Low quality	
One day	18.48d	28.27d	37.86d	28.20d
Two days	30.71c	38.04c	51.21c	39.98c
Three days	43.11b	62.44b	66.61b	57.38b
Four days	61.70a	73.29a	81.71a	72.25a
Mean	38.50C	50.51B	59.36A	49.45

Values with different letter showed significant difference ($p<0.05$) as determined by Duncan 's Muntiple Range Test (DMRT).

This data showed that the sunflower and castor bean production under water stress condition should select the high quality seed reached the high seed germination and seedling growth, which higher than the medium quality seed and low quality seed and should select the water stress for two conditions included the watered interval for one day and the watered interval for days in two selected plants (sunflower and castor bean). The watered interval for four days exhibited the highest of inhibitory percentage of seed germination and seedling growth.

This finding demonstrated that the comprehensive data of effects of water stress on seed germination and seedling growth against (sunflower and castor bean) as well as suggest select the optimum application of the high seed quality for the planting under water stress condition, which the planting of high seed quality of two selected plans (sunflower and castor bean) showed the inhibitoty degree of seed germination and seedling growth (speed of germination index shoot length and seedling dry weight) lesser than the planting of medium seed quality and the plant of low seed quality.

5. Conclusion

This research presented the increase of water stress treatments resulted in the increase of inhibition of seed germination and seedling growth in two selected plants (sunflower and castor bean). The difference of seed quality showed the difference of inhibition of seed germination and seedling growth in two selected plants. The planting of high seed quality had the inhibition of seed germination and seedling growth which lesser than the planting of the medium seed quality and the low seed quality. The planting of sunflower with watered interval for four days exhibited that the maximum of inhibitory degree (68.04%) followed by the planting of sunflower with the watered interval for three days, the watered interval for two days and the watered interval for one day showed the inhibitory degree for 55.37 37.97 and 27.01%, respectively.

The planting of low seed quality of sunflower exhibited that the highest of inhibition degree (56.70%), followed by the planting of medium seed quality of sunflower and the planting of high seed quality of sunflower showed the inhibitory degree for 46.81 and 37.79%, respectively. For castor bean testing, The planting of castor bean with watered interval for four days exhibited that the maximum of inhibitory degree (72.25%) followed by the planting of castor bean with the watered interval for three days, the watered interval for two days and the watered interval for one day showed the inhibitory degree for 57.38 39.98 and 28.20%, respectively. The planting of low seed quality of castor bean exhibited that the highest of inhibitory degree (59.36%), followed by the planting of medium seed quality and the planting of high seed quality showed the inhibitory degree for 50.51 and 38.50%, respectively.

The sunflower and castor bean planting under water stress condition should be the high quality seed reached the highest of seed germination and vigor, which higher than the medium and low quality seed and should be the planting with the watered interval for one day and the watered interval for two days in two selected palnts. The watered interval for four days showed the highest of inhibition of seed germination and seedling growth.

This finding displayed that the precious informations of the effects of water stress on seed germination and seedling growth against two selected plants (sunflower and castor bean). Thses data is the newest application as the optimum selection of high seed quality for sunflower and castor bean cultivation under water stress condition as well as the avoidance of the low seed quality application for sunflower and castor bean cultivation under water stress condition.

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