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RESEARCH PAPER

Foliar application Effect of Salicylic Acid and Drought Stress on Growth and Yield of Mung bean (*Vigna radiata*)

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A B S T R A C T:

This study was conducted to investigate the mitigation of drought stress by foliar application of salicylic acid in Mung bean **(*Vigna radita*)**. Treatments comprised of three drought stress which are control treatment without drought stress, drought stress at %50 flowering stage and drought stress at %50 pod formation stages and foliar application of salicylic acid (SA) in three concentrations which are 50 ppm, 100ppm, 150 ppm at two times, first spray was 30 days and spray was after 40 days spray after 40 days of sowing. The results showed that irrigation missing at flowering stage, affected reduction of growth and yield as compared to irrigation missing at both flowering and pod formation stage. Most of treatments were affected significantly on yield and yield components, the data represented highest values of control treatments were number of pod, weight 100 seeds, biological yield (19.88 pod. plant^{-1}, 5.21 g, 9, 28 ton.ha^{-1}) respectively, and the value of the same traits reduced in drought at %50 flowering stage to (18.71 pod. plant^{-1}, 4.58 g, 8.43ton.ha^{-1}) respectively. Also, the results indicated that the higher concentrations (150 ppm) of salicylic acid caused significant increase in value of seed yield, weight 100 seeds, and harvest index (0.93 ton.ha^{-1}, 5.09 g, 9.9%)Although water deficit stress has hampered the yield and yield components of mung bean .Foliar application of salicylic acid mitigate the adverse effects of drought stress significantly.

KEY WORDS: Vigna radiate; Growth; Drought; Salicylic acid.
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1.INTRODUCTION :

Mung beans [*Vigna radiata (L.)Wilczek*] (2n = 2x = 22) belong to the family fabaceae. It is one of the most important legume crops globally as a feed ingredient for staple foods in the tropics and subtropics (Uddin et al., 2013a).
Mung bean or (green bean) in early-maturing high-yielding legume crops, which is widely spread and is grown on an area of more than 6 million hectares in the warmer regions of the world. It is a short-term (65-90 days) grain legume with wide adaptability and low input (Nair et al., 2012). Cultivation extends over a wide latitude regime (40 N or S) in areas with daily growing season temperatures > 20 ^{o}C (Lawn and R.J, 1985). and moderate rainfall between 60 and 80 cm. Mung beans are believed to thrive in drought conditions (Dutta and Bera, 2008; Ahmad et al., 2015). Drought stress also affects protein changes in plants, Antioxidant production, osmotic regulation, hormone formation, root depth and extension, stomata opening and closing, epidermal thickening, photosynthesis inhibition, reduced chlorophyll content, reduced transpiration, and growth inhibition (Szegletes et al., 2000). Salicylic acid is a natural phenolic plant hormone that has a variety of effects on resistance to abiotic stresses (Khan et al., 2010). Application of SA (salicylic acid)induced tolerance in plants to many biotic and abiotic stresses including fungi, bacteria, viruses, cooling, drought and heat (Salehi et al., 2011). Involved in plant stomatal closure, ion absorption and transport, inhibition and transport of ethylene biosynthesis inhibition of

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ethylene biosynthesis regulation of photosynthesis and growth and other physiological processes, the effect of SA(salicylic acid) on the physiological processes of a plant depends on its concentration, plant type, plant development stage, and environmental conditions. Therefore, it can have beneficial or inhibitory effects on the physiological processes of the plant (Ashraf et al., 2010).

The exogenous application of SA can participate in the regulation of physiological processes in plants, such as Closure of the stomata, ion uptake and transport,(Barkoskyet al., 1993).

The use of salicylic acid at a concentration of 50 ppm led to increased growth and development of plant mung bean (Azooz and Youssef, 2010), As well as it enhances resistance to abiotic stress and protects plants from oxidative damage in many plants (Moosavi, 2012). It was found that salicylic acid at a concentration of 1 mM regulates physiological adaptation and protects the plant from oxidative damage by increasing the activity of antioxidant enzymes and reducing the level of ROS and lipid peroxidation (Orabi et al., 2010).

Drought is a leading abiotic factor that not only limits the growth and development of plants, but also limits crop yields (Hayat *et al*., 2010). The phenomenon of drought stress can temporarily or permanently affect various morphological, physiological and biochemical processes of crop plants. Better knowledge of how dehydration affects physiological activities, Plant biochemical processes and genetic regulation are important for increasing agricultural productivity and breeding efforts (Chaves et al., 2003).

Water stress affects a variety of physiological processes related to crop growth, development, and economic yields (Allahmoradi et al., 2011). Insufficient water can disrupt normal expansion pressure, and loss plasticity cells from expanding, resulting in reduced plant growth. Water stress increases the rate of root shoots, cell wall thickness, and the amount of cutting and wood formation (Srivalli et al., 2003).

Physiological mechanisms of crop responses to water scarcity stress under drought conditions are characterized by reducing transpiration processes by closing stomata. This in turn affects the movement of carbon dioxide into plants. Drought stress is also associated with reduced leaf area to maintain high tissue water potential and to protect metabolic functions from the adverse effects of stress (Chaves et al., 2009: Flexas et al., 2009). The aims of the current study were to determine the effect of drought stress and salicylic acid on phenological characters on mung bean.

2. MATERIALS AND METHODS

2.1. Materials

Seed Source:- seeds of local Mung bean *(Vigna radiata*) were received from the farmers Akre/ Duhok.

2.2. Field Experiment:

Two field experiments were carried out at (Grda-rasha and Grdmala) fields in Erbil Governorate - Kurdistan Region-Iraq located at (Latitude 36. 10116 N and Longitude 44.00925 E), and elevation of 415 meters above sea level. The second is Grdmala, located at (latitude 36. 01061N, and longitude 44. 05854E), (L) abbreviation is referred to locations. The study was conducted during the summer growing season of (10 June and 20 October 2021). The field divided into plots of (2*1.5 m^2) with 6 rows, the space between them is 30 cm and the space between plant to plant will be 20 cm. three replication both location 72 plot distance between replication 1 m^2 distance between plot 50 cm2. Then, the field was subdivided into three blocks' each block consists of 12 experimental units. The first factor was two drought stress which are control (D0), Drought stress at%50 flowering stage (D1) , Drought stress at %50 pod formation stage(D2) and The second factor was foliar application of salicylic acid(SA) was three different concentration water spray(control) (C0), 50ppm (C1), 100ppm(C2) and 150 ppm (C3).

2.3. Studied Parameters

2.3.1. Yield and yield components (t. ha^{-1})

2.3.1.1. Plant Height (cm):

The plant height was measured (from the soil surface to the top of the plant)

2.3.1.2. Number of nodule per plant:

Visible nodule had been counted on the roots

2.3.1.3. Yield and yield components (t. ha^{-1})

2.3.1.4. Number of Pods per plant:

The total number of pods per plant was calculated in ten randomly selected plants and their average were used for statistical analysis.

2.3.1.5. Seed Yield (ton. ha^{-1}):

After cleaning the seeds, the yield of each plot was weighed separately in kg per plot and converted in terms of seed yield in ton per hectare.

2.3.1.6. Weights of 100-grains (g):

Hundred seeds were selected randomly from each treatment, then weighted and expressed in grams.

2.3.1.7. The Leaf Area (LA) (cm2):

The plant leaf area measured from random 50 cm2 area at 50%of both flowering and pod stage the surface of the area and calculated by image J software (Rasul and Ali, 2020)

2.3.1.8. Biological yield (t.ha^{-1}):

Was calculated by weighing the total selected threshed twenty plants per plot in kg.m^{-1} divided by the ten tagged plants and converting to ton.ha^{-1}, determined according to following equation by (Jahan et al., 2019)

Biological yield =pod's weight +seed's weight +shoot's dry weight----- (1)

2.3.1.9. Harvest index (HI) (%):

It was calculated by using the following formula mentioned by (Hunt, 1987):

$$HI\% = \frac{Seed\ yield}{Biological\ yield}\ X\ 100$$

2.4. Determination of some mung bean plants infected with pests and insects

Mung bean as other plants can be contaminated by pests, insects and diseases some cases of mung bean plants infected by pests and insects in this current study at different stages of plant growth. For prevent these situations plants were sprayed with insecticides (radiant) 2cc in 18 liter water Apply fungi (zoxis) (10gm in 10 liter water) and(iron 12.5cc in 10 liter water).

2.5. Statistical analysis:

The data were statistically analysed according to the technique of analysis of variance (ANOVA) for randomized complete block factorial design (RCBD) using SAS. 2002. User's Guide, Version 9.0 SAS Institute Inc. Cary. NY. The mean comparison was fulfilled according to Duncans multiple range test at the level of significant 0.05.

3.RESULTS

3.1. Effect of drought stress on growth and yield components of mung bean:

Table (1) indicated the significantly effect of drought stress on all parameters except plant height and number of nodules / plants. As shown in table 1 the highest number of pods per plant (19.88pods.$plant^{-1}$) recorded in control, the lowest (18.71 pods.$plant^{-1}$) recorded with D1drought stress at %50 flowering stage. The highest seeds yield was (0.74 ton/ha) at drought stress at%50 pod formation stage, in the lowest (0.39 ton/ha) under drought stress at %50 flowering stage. The maximum weight of 100 seeds recorded (5.21g) from control treatment, the minimum (4.58g) recorded with drought stress at %50 flowering stage. Leaf area in drought stress at %50 flowering stage recorded highest number (34.43 cm^2) in drought stress at %50 flowering stage, the lowest number of leaf area (31.92 cm^2) recorded at control treatment while leaf area in the drought stress at%50 pod formation stage the highest leaf area was (32.56 cm^2) recorded in drought stress at %50 flowering stage while the lowest leaf area (30.05cm^2) recorded at drought stress at%50 pod formation stage. The highest biological yield (9.28 ton/ha) recorded in control, when the lowest (8.43 ton/ha) under drought stress %50 flowering stage. And the highest number of harvest index (8.42%) was at drought stress at %50 pod formation stage while the lowest was (4.44%) under drought stress at %50 flowering stage.

3.2. Effect of difference concentrations of salicylic acid on growth and yield components of mung bean:

Table 2 displays that there are significant differences between all studied data, except plant height and number of nodules / plants. The highest number of pods per plant was (21.17 pods.$plant^{-1}$) recorded by foliar application of SA (150ppm), treatment comparing to lowest number (17.22 pods.$plant^{-1}$) by foliar application of SA (100ppm) treatment. Effect was observed on number of seeds yield (ton/ha), the maximum data was (0.93) by foliar application of SA (150ppm) the minimum (0.43) recorded with spraying only water. The maximum weight of 100 seeds recorded (5.09 g) from foliar application of SA (150ppm) treatment, the minimum (4.59 g) spraying only water. Leaf area (cm^2) in the drought stress at%50 flowering stage recorded the highest value (35.68) by foliar application of SA (100ppm) whereas the lowest values of leaf area (32.03) was recorded at foliar application of SA (50ppm). Leaf area in the drought stress at%50 pod formation stage recorded highest number

(33.09) recorded with spraying only water. Biological yield and harvest index (9.59 ton/ha , 9.90. %) respectively recorded higher data by foliar application of SA (150ppm) while the lowest data were observed with foliar application of SA (100ppm) and spraying only water (8.40 ton/ha, 5.09. %) respectively.

3.3. Effect of drought and salicylic acid concentrations of salicylic acid on growth and yield components of mung bean:

The interaction between different drought stress and different levels of SA application showed significant variations (P≤0.05) on all studied parameters except plant height (Table 3). The highest number of pod (25pod.plant^{-1}) was obtained in control treatments and applied SA (100ppm) compared to drought at flowering stage and spray water which was (16.00 pod.palnt-1). The highest number of nodule per plant was (15.93 nodule.plant-1) recorded by drought at %50 pod formation with SA (150ppm) applied comparing to lowest number(13 pod.plant $^{-1}$) from control treatment with SA (50ppm). Significant effect was observed on seed yield the maximum data was (1.37 ton.ha^{-1}) recorded mung bean plots that treated drought at %50 pod formation with SA(150ppm) compared with lowest value (0.24 ton.ha $^{-1}$) treated with drought stress at %50 flowering stage . The greatest data was obtained weight 100 seeds control with SA (100ppm) (5.49 gm) comparing with lowest value (4.30gm) recorded by drought stress at %50 pod formation with spray water , The greatest value of leaf area at first time (39.60 cm^2) produced by drought stress at %50 pod formation with SA (100ppm). Also, leaf area second time (36.21cm^2) obtained by drought stress at %50 flowering stage with spray water. While the lowest value of leaf area two times (26.90 cm^2) recorded by drought stress at %50 flowering stage with SA(50ppm) , second time (26.99 cm^2) recorded by drought stress at %50 flowering stage with SA(100ppm). The maximum value of biological yield (10.76 ton/ha) recorded by drought stress at %50 flowering stage with SA (150ppm) the minimum value (7.23) obtained by %50 flowering stage with SA (50ppm) and harvest index recorded highest value (14.36) in drought stress at %50 pod formation with SA(150ppm) comparing with lowest value (3.27) in drought stress %50 flowering stage with SA(100ppm).

3.4. Effect of two locations on growth and yield component of mung bean.

Figure (1) explain that locations has significant impact on all studied parameters except plant height, number of pod and number nodule weight 100 seeds were non significant. The highest values observed for the following parameters: seed yield at Grdarasha L1 (0.77 ton/hec), leaf area first time Location Grdmala L2(34.70cm^2), leaf area second time L 2 (43.92cm^2) biological yield L1(9.27ton/hec) and harvest index L1(8.24). Minimum results were registered for the same parameters seed yield L2 (0.43), leaf area first time L1 (32.44), leaf area second time L1(27.17)(biological yield L2(8.16) ,L2(5.19).

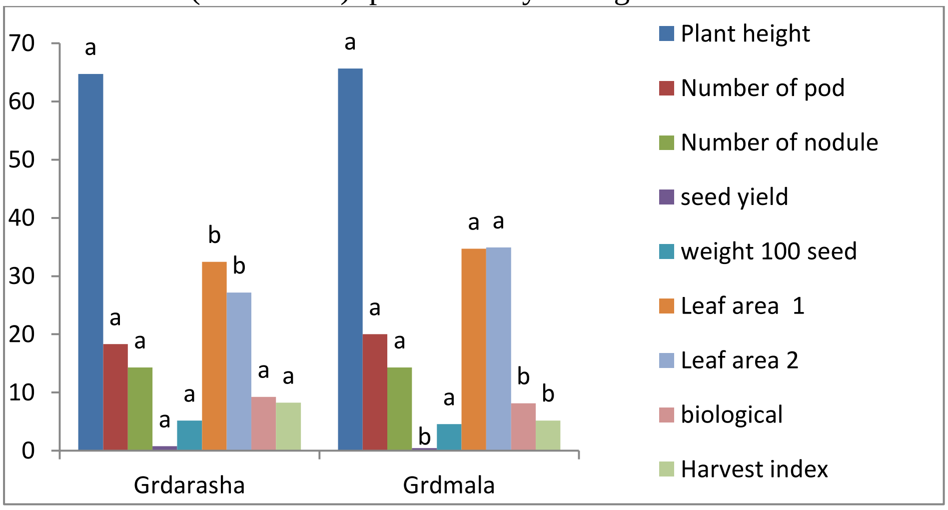

Figure 1: Effect of locations on growth and yield components of mung bean:

3.5. Effect of drought stress on two locations of growth and yield components:

The figure (2) clarified that the significant difference (P≤0.05) between interaction effect of two location and different drought stress on all parameters except the number of nodule was non-significant. The highest values was recorded for plant height (L2D0(67.60), number of pod (L2D2 (20.67), seed yield L1D2(1.08) , weight 100 seeds L1D2(5.34), leaf area first time L2D0(35.15), leaf area second time L2C0(36.65), (biological yield L1D0(9.80), harvest index L1D2 (12.18) while the lowest values were observed with plant height (L1D0(62.12),number of pod L1D2(17.17) ,seed yield L2D1(0.24) ,weight 100 seeds L2D2(4.28) leaf area first time L1D0(28.70),leaf area second time (L1D0(24.61), biological yield L2D2 (7.82), and harvest index L2D1(3.15).

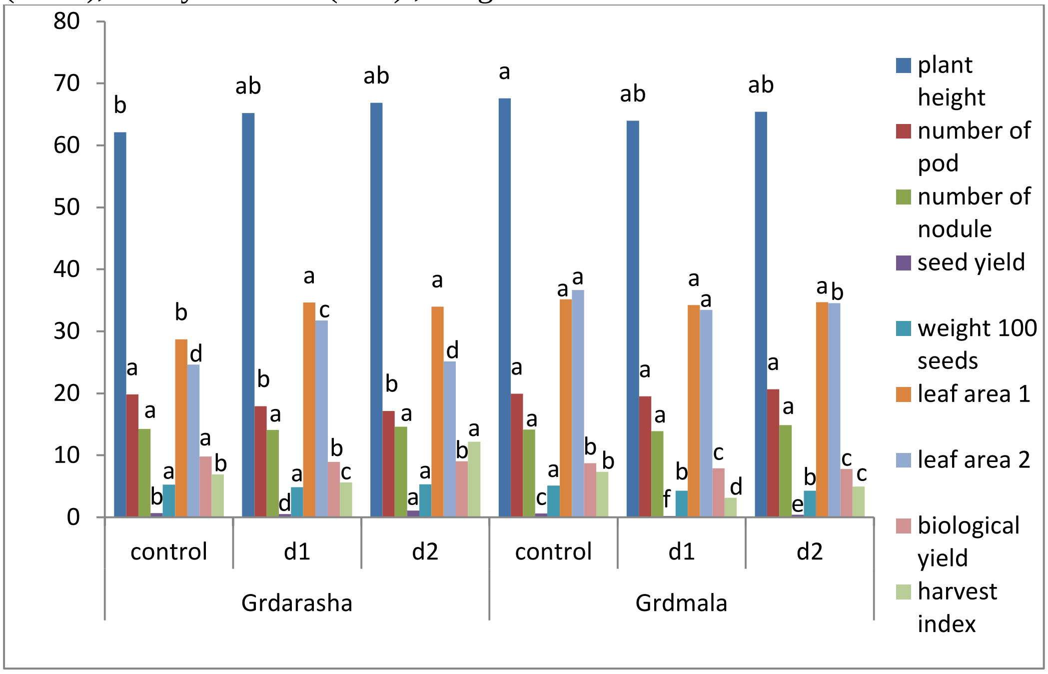

Figure 2: Effect of drought stress and locations on mung bean on growth and yield components:

3.6. Effect of difference concentrations on two locations of growth and yield components:

Table (4) that the growth indices parameters significantly affected by interaction effect of two locations and different foliar application of SA except plant height and number nodule were nan-significant. The highest values were recorded in ,number of pod L1C2(21.89), seed yield L1C3(1.36), weight 100 seedsL1C3(5.43), leaf area first time L2C2(36.90),leaf area second time L2C0(38.48),biological yield L1C4(11.03) and harvest index L1C3(13.34). But the lowest was recorded in number of pod L1C0 (13.89), seed yield L2C0 (0.35), weight 100 seeds L2C0 (4.27), leaf area first time L1C1 (28.91), leaf area second time L1C2 (23.55) (biological yield L2C1 (7.87) and harvest index L2C0 (4.03).

4. DISCUSSION

Water stress during flowering and early pod development is known to be the result of these low yields similar result was found by (Debaeke and Aboudrare, 2004,). The growth rate of the reduced burden caused by drought depends on plant height, leaf area and yield. The water pressure to cause more adverse effects in the vegetative stage than at the reproductive stage of the previous studies, this result is in agreement with those obtained by (Ratnasekera and Subhashi, 2015). The loss turgor agreed with these results by the leaf area which was reduced to drought (Farooq et al., 2010). Water stress during the vegetative phase reduces grain yields and limits plant size, leaf area and root growth, and the subsequent accumulation of dry matter in the pods and low yield index. It has been found that water deficiency during the flowering stage and after flowering has a greater adverse effect than in the vegetative stage same (table 1-3). These results are in conformity with the findings of (Rafiei and Asgharipu, 2009). In the course of the study, it was found that foliar application of SA per green gram increased the height of the plant. Results in both table 2,4 agreed with (Nagasubramaniam et al., 2007). In mung bean plant drying stress SA treatment with each passing day increases number of pods and seed /plants with 100 grain weight they indicated a positive correlation interaction drought stress and SA (table 4)(Ali and Mahmoud 2013). Many physiological processes in plants, such as photosynthesis, nitrogen metabolism, glycine betaine synthesis, and antioxidant production, are regulated by salicylic acid, ensuring plant resistance to abiotic stress management (SABA et al., 2013; Khan et al. 2014; Miura and Tada, 2014). The use of SA also resulted in a significant increase in morphological and physiological traits during drought, which may be related to its role in increasing nutrient uptake and increasing the rate of photosynthesis in drought-prone plants (Sadak et al., 2020). This increase in yield in SA-treated plants under stressful conditions may be due to the water-reserving actions of SA in plant cells, which leads to increased enzymatic actions under stressful conditions, which leads to improved metabolism and yield (Ezzo et al.,2018). It is reported that foliar spraying of salicylic acid strengthens the leaf area of the total leaf plant height and roots dry. Drought is a major environmental stress factors that can reduce crop productivity (Bideshki and Arvin, 2010). There is a reduction in the growth of plants, photosynthesis, and photosynthetic pigments induced (Lee et al., 2009). SA important has different effects on abiotic and biotic stress tolerance same (table 4) (Tayyab et al., 2020). SA increased plant productivity, because of the enhanced permeability and potential of chlorophyll content under drought conditions (Singh and Usha, 2003).

Mung beans suffering water stress by increase or decrease the number of pods of seed yield, 1000 seed weight, they were in accordance with what have been reported by (Mohi-Ud-Din et al.,2021) and similar results observed in this study of low yield yield element under drought pressure. The most obvious effect was observed when water stress occurred during the flowering or pod filling stage. In the reproductive phase, the water stress of the flowers and fruits will speed up the process of falling and decreased seed yield Similar results was reported by (Gan et al., 2004; MASOUD et al., 2007).

Mung bean is able to keep its harvest index above severe stress. Established on these results, the concepts of regulated deficit irrigation might be a good strategy for high yields, by less water. Dry stress is also accompanied by a decrease in leaf area to maintain a high water level to protect tissues from the effects of metabolic processes function stress (Flexas et al., 2006;Chaves et al., 2009). Under drought stress situation seed yield was affected and it was condensed as compared to non strain form that decrease, 1000 grain and pods per plant mass in first situation and shell duration, pod dry mass, and number pods per plant (Zare et al., 2013) . Plant height, pod length, pod fiber, contents, pod diameter, pod weight and other parameters that affected by drought stress, this relates to soil moisture due to the influence of stage nutrient deficiency in the low water absorption capacity, as well as grain yield and growth. Its growth force accumulates vigorously and dry weight can be before flowering (2016). It may be said that the drought avoidance mechanism can reduce the leaf area with less water due to transpiration. The reduction in leaf area may be due to the suppression of leaf expansion by reducing cell division due to the loss of cell turgor. Under the stress of drought, many plant species experienced a reduction in leaf area (Avramova et al., 2015; Larkunthod et al., 2018). Mung bean plants were reported to reach maturity earlier under water stress than under well-watered cultivation (Robertson et al., 2004). Drought-resistant of the reproductive stage is the most important economic gains. The development of the reproductive organs, which is controlled by the production and separation of photo assimilates by the original tissues, is the most critical at this stage, these results are similar with the findings of (Ranawake et al., 2011). Therefore, the development of a noticeable effect at this stage of the increase in drought yield, it has also been recorded in other soybean crop legumes; the yield is highly affected by drought and stress especially when drought overlaps in the early flowering pod setting. The early stages of pod development features are the active cell division in the young ovule and quickly pod expansion. The loss of yield due to drying stress associated with increased rates of flowers and pods abortion (Liu et al., 2003). The influence of dry stress cultivates remarkable physiological characteristics; however, the yield decline was less than the expected effect on physiological characteristics. This variation in morpho-physiological (physiological and phono-logical) traits might be due to the varying nature and duration of stress, as these traits are governed by a large number of genes (Thirunavukkarasu et al., 2017). Some previous studies similar to the morpho-physiological changes under variable ambient pressure conditions (Alderfasi et al., 2017), Drought is one of the principles of environmental factors limiting growth and yield of mung bean and its effect is more pronounced in the reproductive stage than in other stages of development and production is drastically reduced similar results indicated by (Sangakkara et al. 2001).

Table 1: Effect of drought stress on growth and yield components of mung bean
Common letter means there are no significant different at probability level (5%) by Duncans-test.

Drought	Plant height (cm)	Number of (pod. Plant^{-1})	Number of (nodule. Plant^{-1})	seed yield (ton.ha^{1})	weight 100 seed (gm)	Leaf area time 1 (cm$^{2)}$	Leaf area time 2 (cm^{2})	biological yield (ton.ha^{-1})	Harvest index(%)
Control	64.86 a	19.88 a	14.21 a	0.67 b	5.21 a	31.92 b	30.63 b	9.28 a	7.13 b
D1	64.59 a	18.71 b	14.00 a	0.39 c	4.58 b	34.43 a	32.56 a	8.43 b	4.44 c
D2	66.14 a	18.92 b	14.76 a	0.74 a	4.81 ab	34.36 a	30.05 b	8.43 b	8.42 a

Table 2: Effect of different concentrations of salicylic acid on growth and yield components of mung bean:

Con. (ppm)	Plant height (cm)	Number of (pod. Plant^{-1})	Number of (nodule. Plant^{-1})	seed yield (ton.ha^{1})	weight 100 seed (gm)	Leaf area time 1 (cm$^{2)}$	Leaf area time 2 (cm^{2})	biological yield (ton.ha^{-1})	Harvest index(%)
0	65.91 a	17.61 b	14.06 a	0.43 c	4.59 b	33.97 b	33.09 a	8.41 b	5.09 b
50	64.62 a	17.22 b	14.44 a	0.51 b	4.89 ab	32.03 c	30.49 b	8.45 b	5.83 b
100	63.70 a	21.17 a	14.26 a	0.53 b	4.90 ab	35.68 a	27.97 c	8.40 b	6.06 b
150	66.56 a	20.67 a	14.53 a	0.93 a	5.09 a	32.59 bc	32.64 a	9.59 a	9.90 a

Common letter means there are no significant different at probability level (5%) by Duncans-test.

Table 3: Effect of drought stress and concentrations of salicylic acid on growth and yield components of mung bean

Drought	Con. (ppm)	Plant height (cm)	Number of (pod. Plant^{-1})	Number of (nodule. Plant^{-1})	seed yield (ton.ha^{1})	weight 100 seed (gm)	Leaf area time 1 (cm$^{2)}$	Leaf area time 2 (cm^{2})	biological yield (ton.ha^{-1})	Harvest index(%)
Control	0	67.63 a	18.33 cd	14.33 bc	0.53 e	5.06 abc	32.43 bcd	33.52 ab	9.06 c	5.89 cde
	50	61.33 a	16.17 d	13.00 c	0.67 c	5.04 abc	30.12 de	28.86 cde	9.31 bc	7.21 bcd
	100	65.40 a	25.00 a	15.17 ab	0.65 cd	5.46 a	33.09 bc	29.00 cde	8.86 c	7.32 bcd
	150	65.07 a	20.00 cd	14.33 bc	0.83 b	5.29 ab	32.04 bcd	31.15 bc	9.88 b	8.10 b
D1	0	67.43 a	16.00 d	14.33 bc	0.38 fg	4.40 cd	38.42 a	36.21 a	8.20 d	4.23 ef
	50	62.63 a	18.50 cd	15.00 ab	0.34 g	4.68 bcd	26.90 f	31.77 bc	7.23 f	4.69 ef
	100	61.13 a	18.50 cd	13.33 c	0.24 h	4.52 cd	34.36 b	26.99 e	7.53 ef	3.27 f
	150	67.17 a	21.83 b	13.33 c	0.61 d	4.73 bcd	38.78 a	35.82 a	10.76 a	5.79 cde
D2	0	62.67 a	18.50 cd	13.50 c	0.40 f	4.30 d	31.07 cde	29.54 cde	7.98 de	5.15 e
	50	69.90 a	17.00 d	15.33 ab	0.52 e	4.96 abcd	39.07 a	30.84 bcd	8.83 c	5.58 de
	100	64.57 a	20.00 bc	14.27 bc	0.69 c	4.72 bcd	39.60 a	27.92 de	8.80 c	7.59 bc
	150	67.43 a	20.17 bc	15.93 a	1.37 a	5.26 ab	28.64 ef	31.63 bc	8.12 de	14.36 a

Common letter means there are no significant different at probability level (5%) by Duncans-test.

Table 4: Effect of different concentrations of salicylic acid and locations on growth and yield components on mung bean:

Location	Con. (ppm)	Plant height (cm)	Number of (pod. Plant^{-1})	Number of (nodule. Plant^{-1})	seed yield (ton.ha^{1})	weight 100 seed (gm)	Leaf area time 1 (cm$^{2)}$	Leaf area time 2 (cm^{2})	biological yield (ton.ha^{-1})	Harvest index(%)
Grdarasha	0	66.29 a	13.89 d	14.11 a	0.52 d	4.91 ab	32.79 cd	27.70 e	8.57 c	6.15 bcd
	50	63.64 a	16.33 c	14.33 a	0.56 c	5.10 ab	28.91 e	27.43 e	9.04 b	6.10 bcd
	100	61.98 a	21.89 a	14.29 a	0.65 b	5.43 a	34.47 bc	23.55 f	8.42 c	7.39 b
	150	67.02 a	21.11 a	14.56 a	1.36 a	5.23 ab	33.58 bcd	30.00 d	11.03 a	13.34 a
Grdmala	0	65.53 a	21.33 a	14.00 a	0.35 g	4.27 c	35.15 ab	38.48 a	8.25 cd	4.03 e
	50	65.60 a	18.11 bc	14.56 a	0.45 e	4.69 bc	35.14 ab	33.54 bc	7.87 d	5.56 cd
	100	65.42 a	20.44 a	14.22 a	0.40 f	4.37 c	36.90 a	32.39 c	8.37 c	4.73 ed
	150	66.09 a	20.22 ab	14.51 a	0.51 d	4.95 ab	31.60 d	35.27 b	8.14 cd	6.45 bc

Common letter means there are no significant different at probability level (5%) by Duncan-test.

5.CONCLUSIONS

Overall it is concluded that irrigation missing both at flowering and pod formation stage affect the growth and yield, yield components of mung bean and spray application of SA mitigated effects of drought stress. In water shortage situation, foliar application of (100,150 ppm) of SA and drought stress was useful to mitigate the negative effects of water stress in mun gbean. Although water deficit stress has hampered the yield and yield components of mung bean.

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Conflict of Interest

The authors declare no conflict of interest.

Refearence

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